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A COMPARISON OF MICROBLADE CORES FROM EAST ASIA AND NORTHWESTERN NORTH AMERICA: TRACING PREHISTORIC CULTURAL RELATIONSHIPS

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Abstract

Intercontinental similarities in microblade technology have long been used as evidence in support of the hypothesis that human populations migrated from East Asia to northwestern North America during the late Pleistocene. This study synthesizes the available data in an effort to provide a preliminary overview of this technological tradition. Comparative analysis reveals that wedge-shaped cores from Chinese Upper Paleolithic assemblages, the Dyuktai Culture of eastern Siberia, Japan, and the American Paleo-Arctic Tradition of Alaska share many similarities in the selection of raw materials, core morphology, platform preparation and rejuvenation, and edge angle variation. However, it also reveals that Alaskan wedge-shaped cores are more closely related to Dyuktai Culture cores than they are to Hokkaido cores. The study concludes that the distribution of microblade complexes is best explained by migration and/or diffusion from inland Asia to North America during the late Pleistocene.

PRÉCIS

Les similarités intercontinentales révélées par la technologie des micro-lames ont depuis longtemps été utilisées comme preuve au soutien de l'hypothèse que les populations humaines ont migré de l'Asie de l'Est au Nord-Ouest de l'Amérique du Nord durant la fin du Pléistocène. Dans cette étude, les données disponibles ont été analysées afin d'esquisser un survol préliminaire de cette tradition technologique. Une étude comparative révèle que les nucléus en biseau provenant d'assemblages du Paléolitique supérieur chinois, de la culture Dyuktai de la Sibérie de l'Est, du Japon et de la tradition paléo-artique américaine de l'Alaska partagent plusieurs similarités dans le choix des matières premières, de la morphologie des nucléus, de la préparation et du rafraîchissement du plan de frappe et de la variation de l'angle de bord. Cependant, cette étude indique aussi que les nucléus en biseau de l'Alaska ont plus en commun avec les nucléus de la culture Dyuktai qu'avec les nucléus du Hokkaido. Cette étude conclut que c'est la migration et/ou la diffusion de l'Asie intérieure à l'Amérique du Nord durant la fin du Pléistocène qui explique le mieux la distribution des complexes micro-lames.

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In addition, before I started to prepare my dissertation, I had fruitful discussions with Drs. Richard Morlan and Jacques Cinq-Mars of the Canadian Museum of Civilization. They allowed me to examine the microblade specimens from the Bluefish Caves and presented me with their publications. When I visited the University of Oregon in 1988 and attended The First World Summit Conference on the Peopling of the Americas at the University of Maine in 1989, Profs. Melvin Aikens, Douglas Anderson, and Yung-jo Lee of Chungbuk National University of Korea presented me with their valuable publications.

At the Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Science in Beijing, I reexamined and measured microblade cores from many sites in Inner Mongolia, Hebei, Shanxi, and Shandong Provinces which were made available to me by Prof. Jia Lanpo, Prof. Huang Weiwen, Mrs. Wei Qi, Dong Zhuan, and Yuan Xiaofeng. Profs. Wang Jian, Wang Xiangqian, and Chen Zheying of the Provincial Institute of Archaeology of Shanxi let me reexamine the microblade collections from the Xiachuan and the Xueguan sites and measure the microblade cores. I also measured the microblade cores found by Prof. Chen Zheying at Yaozitou and Gaoshanzhen in Shanxi Province. Prof. Gai Shanlin of the Inner Mongolia Museum allowed me to measure microblade cores from Inner Mongolia which he has collected over the last forty years. In the Provincial Institute of Culture Relics of Hebei, Mr. Xie Fei let me examine and measure a newly discovered microblade assemblage at Jiqitan, near Hutouliang, Hebei Province. In the Nanjing Museum, Mr. Zhang Zhufang allowed me to reexamine the microblade cores found in the Malingshan area, Jiangsu Province.

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Table of Contents

List of Figures

List of Tables

CHAPTER I. - INTRODUCTION

A. OBJECTIVES AND SIGNIFICANCE

One of the most frequently cited types of archaeological evidence used to trace the links between the Old and New World is the presence of microblade technology on both continents. Since the hypothesis of prehistoric cultural contact between these two regions was first examined by N.C. Nelson (1937) and P. Teilhard de Chardin (1939), numerous microblade assemblages have been documented in East Asia and North America, although comparative studies have been relatively limited in scope. Nevertheless, there developed a general consensus that microblade technology was among the clearest indicators of prehistoric cultural relationships between East Asia and North America. Some major questions still remain unresolved, however, including: (1) when and where was microblade technology first invented; (2) what are the major factors that led to the development and spread of microblade technology; (3) to what extent are microblade assemblages from the different regions in East Asia and North America historically related; and (4) what kind of temporal and spatial variations is present among these microblade assemblages? These questions persist largely because crucial microblade data from the hinterland of East Asia or North China have been inaccessible to foreign scholars due to language barriers and limited academic exchange.

The discovery of late-Pleistocene microblade assemblages in North China has shed new light on the questions of cultural relationships among microblade assemblages and the origin of microblade technology. Although the archaeological data available at present are still inadequate to answer all the questions mentioned above, the discoveries in North China, together with many others in adjacent regions of both East Asia and northwestern North America, make a preliminary comprehensive study possible.

The goal of this study is to outline the techno-typological development of microblade cores in East Asia and North America, in terms of their temporal and spatial distribution, in order to identify potential cultural relationships within and between these two regions, and then to propose that North China might have been the cradle of the microblade tradition. To accomplish this, the study will investigate such techno-typological variables as: raw material selection; frequencies of core types in assemblages, complexes, or traditions; core preform and platform preparation, and platform rejuvenation; platform edge angle variations; and core dimensions. Particular reasons for the selection of these variables will be discussed in more detail in Chapter Three. These variables, and the results of this analysis, will provide significant information on the distribution of distinctive core attributes in time and space, and will be used to support the hypothesis that the transmission of microblade technology from East Asia to North America is the result of migration and diffusion during the late Pleistocene.

There are two reasons to choose microblade cores for this study. First, microblade cores exhibit more diagnostic attributes than microblades. The technical and stylistic complexity of microblade cores is an important source of information on manufacture and use, and also helps identify cultural tradition and cultural affinities. Microblade core technology is thought to represent one of the oldest and most complex of prepared core traditions (Johnson 1987). These cores were formed and maintained by a variety of complex and distinctive manufacturing procedures in preform and platform preparation, and microblade removal. It is argued here that because technologies as complicated as microblade production must be socially transmitted, the occurrence of stylistically distinctive cores in different regions may strongly reflect cultural connection and information exchange.

Second, much attention has been given by many researchers in different countries, to the examination, analysis, and comparison of microblade cores, in their attempt to determine prehistoric cultural affinity through time and across space. This study draws on the works of these researchers. Their observations can be incorporated into my own framework for the comparative analysis. For some of the assemblages that were not examined personally, published measurements and descriptions were used. It is hoped that the apparent discrepancies in various archaeologists' interpretations can be resolved through the application of a uniform typological framework in this comparison.

In the incipient stage of microblade research, morphological or typological comparison was the only method employed. Greater attention was given in later years to the technology, particularly the processes of core preparation and reduction. Since a wedge-shaped core technology called the Yubetsu technique was first reconstructed and defined by M. Yoshizaki in 1961 (see Morlan 1967a:177), an increasing number of microblade techniques has been identified and reconstructed. Techno-typological analysis became a standard approach used in microblade research. Techno-typological approach was advanced by K. Hayashi in his study of the Fukui microblade technology. This approach obviously follows Yoshizaki's influential work to conduct typological classification based on core technology. Hayashi defined "techno-typology" to be the typology based on manufacturing patterns, in contrast to "morpho-typology" which is based on morphological attributes of the artifact (Hayashi 1968:129). Although the term "techno-typology" is not commonly used by Western archaeologists, a similar idea is expressed by many authors in their typological analyses. For example, Meltzer (1981:315) argued that archaeologists must recognize that tool morphology is determined by tool technology. Sackett (1989:51) also stated that typology, as it is currently practiced, investigates stone tool morphology in ever more comprehensive terms, and he emphasizes the need to understand the dynamics that underlie their patterning. Clearly, typologists now regard stone tool technology to be integrally linked to morphology, hence an important diagnostic consideration. In this study, therefore, technological analysis will be used to supplement morphological classification.

After more than one century of discovery, and nearly two centuries after Thomas Jefferson's speculation that American Indians might have come from Asia, archaeologists assessing the peopling of the New World still rely mainly on the distribution of microblades rather than the distribution and spread of fluted points (Dumond 1980, Morlan 1987). This study will contribute towards an increased understanding of the human occupations of northwestern North America and the peopling of the New World.

B. THE DEFINITION OF MICROBLADES

The term microblade refers to small blades or bladelets. Different authors have attempted to differentiate microblades from blades on the basis of absolute values of width. Taylor (1962) suggested a maximum width of 11 mm for microblades, although he also claimed that this is not the only or absolute distinguishing criterion (1962:426). Akazawa Takeru and others (1980:74) preferred a maximum width of 12 mm for microblades. Gai Pei proposed a maximum width of less than 10 mm for "typical microblades" (Gai 1985:227). Some authors have found no marked bimodality between blade and microblade widths in Arctic Small Tool Tradition assemblages (Wyatt 1970; Owen 1984). Bordes and Gaussen (1970) suggested a maximum width of 8 mm for microblades from a French Magdalenian assemblage, and 12 mm for an assemblage from the Epi-paleolithic of the Maghreb. Hahn (1977) used the average of these two, 10 mm, in his analysis of Upper Paleolithic material (see Owen 1988:2). For this reason, Owen (1988:2) stressed that there seems no universal criterion based on width to divide microblades and blades. The measurements may differ in individual assemblages or techno-complexes.

In this study, the term *microblade* refers to a techno-typological category in which small elongated flakes were removed from several distinctively designed cores. This category has a restricted geographic distribution in East Asia and northwestern North America. The term *small blade* used here is a relative concept. Although the vast majority of microblades from assemblages in East Asia and North America may statistically fall within a certain size range, perhaps typically less than 11 to 12 mm in maximum width, some specimens may exceed this range and should be included in the category so long as they were produced from microblade cores. Although size alone is not sufficient to define lithic technology or tradition, dimensional variation of artifacts is indeed a significant indicator. In other words, core dimensions are important cultural or technological attributes but only when seen in conjunction with morphological attributes. Therefore, the microblade, in the context of East Asian and North American archaeology, should be seen as a cultural or technological rather than merely a dimensional concept. For example, microblades are also found in the Santa Barbara Channel region of southern California, but their technology is entirely different from that of Asian-North American microblades (Arnold 1985, 1987). In some microblade assemblages, such as those from Inner Mongolia in China and Hokkaido in Japan, there are microblades which sometimes exceeding the maximum widths distinguishing blades from microblades. Although microblade discoveries have also been reported from other regions in the world, their manufacturing technologies and origins are significantly different. Therefore, for the purposes of this study, I would more narrowly define *microblade* as follows: a bladelet with a maximum width around 12 mm produced from one of several specifically designed cores, such as: wedge-shaped, boat-shaped, conical, cylindrical, semiconical, or funnel-shaped, which have a restricted geographic distribution in East Asia, the American Arctic, and northwestern North America.

It is worth mentioning here that in Chinese archaeology the concepts of *microlith* and *microblade* sometimes have caused terminological confusion. For a long time, the term microlith was used in China in its literal sense to refer to "small tools" such as end scrapers, small points, perforators, burins, and tiny arrowheads which occurred frequently in association with microblades and microcores. Some Chinese archaeologists argued that the term *microlith* should be used exclusively to refer to microblades, microcores and tools made of microblades (An 1978, 1986; Chen and Wang 1989). In this sense, the term *microlith* in Chinese archaeology is equivalent to "microblade remains" in western terminology. Unfortunately, this usage has not yet been universally accepted. In most Chinese literature, authors tend to use "typical microlith" when they refer to microblade remains, and "microlith" for all small tools including microblade remains.

C. SPATIAL AND TEMPORAL DISTRIBUTION OF MICROBLADES

Microblade remains have been reported from China, Outer Mongolia, eastern Siberia, Japan, and northwestern North America (Table 1). In China, the greatest concentration of microblade remains is reported in Inner Mongolia and the three provinces of Northeast China. Most of these materials, however, belong to more recent ages. We now know that microblade technology appeared in the Chinese Upper Paleolithic approximately 26,400 B.P. and persisted into the Mesolithic and the Neolithic. It possibly persisted into historic times as late as the Han dynasty (206 B.C.-A.D. 724) or even the Liao and Jin dynasties (A.D. 916-1234) in North China (Gai 1985; Jia 1978; Wang 1986).

In eastern Siberia, microblade technology appeared in the Upper Paleolithic, but its early chronological placement about 35,000 to 30,000 B.P. is still controversial. It persisted probably into the Bronze Age (Konstantinov *et al.* 1979; Mochanov 1980; Powers 1973; Yi and Clark 1985).

In Japan, microblade remains occur in late preceramic and early ceramic contexts. The first appearance of the technology in Hokkaido is around 17,000 B.P., on the basis of obsidian hydration dating, or younger than 13,000 B.P., on the basis of fission-track dating. It appeared around 14,000-13,000 B.P. in the south (Aikens and Higuchi 1982; Ichikawa and Nagatomo 1978; Ikawa-Smith 1976, 1978; Morlan 1967a; Tang 1985). The technology was not present after the Incipient Jomon period.

In Korea, several microblade industries have been reported in the south of the peninsula. Unfortunately, their cultural contexts and chronological placement are still poorly known. They have been tentatively dated to the Upper Paleolithic or the Mesolithic periods (Aso *et al.* 1972; Lee 1989).

In North America, microblade remains occur in the Arctic and northwest part of the continent from Alaska southward to the Columbia River valley and eastward to Greenland. The earliest occurrence probably dates to about 12,000-11,000 B.P. and the latest disappeared about 3,000 B.P. in Alaska, and about 2,800 B.P. in central Arctic Canada along with the Arctic Small Tool Tradition. In British Columbia and Washington, microblades were gradually abandoned by the people of the Nesikep Tradition around 1500 B.P. They might have lasted to the late Dorset period about 900 B.P. in the eastern Arctic. (Dumond 1978; Maxwell 1985; McGhee 1978).

Table 1. Chronometric dates of Microblade sites in North China, Japan, eastern Siberia, and North America.

Site	Date(B.P.)	Lab.No.	Inventory
NORTH CHINA			
Chaishi	26,400±800	ZK-635	microblade cores and other stone artifacts
(Institute of Archaeology 1983, Wang 1986)			
Xiachuan	from 23,900±800 to 13,900±300	ZK-413 ZK-762	abundant microblade cores, end scrapers, burins, side scrapers, arrowheads, perforators, backed knives, choppers, hammers, etc.
(Institute of Archaeology 1983)			
Xueguan	13,550±150	?	many boat-shaped and wedge-shaped cores, end scrapers, points, burins, and backed knives
(Wang *et al.* 1983)			
Hutouliang	11,000±210	PV-156	more than 200 wedge-shaped cores, bifacial points, end scrapers, etc.
(Gai 1985)			
Ang-ang-xi	11,800±150	PV-369	one conical core, scrapers, end scrapers, burins, choppers, etc.
(Huang *et al.* 1984)			
Layihai	6,745±85	?	wedge-shaped cores, flake cores, scrapers,

Table 1. Chronometric Dates of Microblade Sites in North China, Japan, eastern Siberia, and North America, continued

Site	Date(B.P.)	Lab.No.	Inventory
			choppers, end scrapers, mortars, pestles, bone tools
(Gai and Wang 1983)			
JAPAN			
Araya	13,200±350	GaK-948	two dozen boat-shaped cores, Arraya burins, points, choppers, scrapers, etc.
(Ikawa-Smith 1976, 1978)			
Shirataki			
Locality 13	17,000 (hydration)		boat-shaped cores, end scrapers, burins, hand-axe-like tools
Locality 4	16,000 (hydration)		boat-shaped cores, four conical cores, end scrapers
Horoka I	16,300 (hydration)		boat-shaped cores, burins
Locality 31	15,800±380 14,800±350	GaK-212 GaK-210	boat-shaped cores, hand-axe-like tools
Locality 33	15,200 (hydration)		boat-shaped cores, Yubetsu wedge-shaped cores, Araya burins, bifacial points
Toma H.	14,100 (hydration)		Yubetsu wedge-shaped cores, boat-shaped cores, burins, end scrapers
Locality 30	13,000 (hydration)		numerous Yubetsu cores, end scrapers, points, burins
Okedo I	12,800 (hydration)		Yubetsu cores, boat-shaped and conical cores, burins
Locality 32	12,700 (hydration)		Yubetsu cores, burins, end scrapers, side scrapers, points, Araya burins
Sakkotzu	12,580 (hydration)		Yubetsu cores, scraper
Towarubetsu B	12,500 (hydration)		Oshoroko wedge-shaped cores, burins, keeled scrapers
Oshorokko	12,300 (hydration)		Oshoroko cores, burins, hand axes, points
Okedo II, III	11,800 (hydration)		boat-shaped cores, scrapers
(Morlan 1967a)			
Fukui Cave			
H.2	12,400±350	GaK-949	wedge-shaped cores, scrapers, pottery

Table 1. Chronometric Dates of Microblade Sites in North China, Japan, eastern Siberia, and North America, continued

Site	Date(B.P.)	Lab.No.	Inventory
H.3	12,700±500	GaK-950	wedge-shaped cores, scrapers, pottery
H.4	14,400±400	GaK-945	conical cores
H.7	13,600±600	GaK-951	small blade cores
(Aikens and Higuchi 1982; Hayashi 1968; Ikawa-Smith 1976)			
Senpukuji Cave			
H.9	11,840±740 (thermolum.)		wedge-shaped cores, stone axes, scrapers, pottery
H.10	10,500 to 12,500	?	wedge-shaped cores, backed knives, end scrapers, burins, pottery
(Ichikawa and Nagatomo 1986; Tang 1985)			
	10,190-9380 (thermolum.) or 8850±450 B.C. (fission track)		linear-relief pottery
	7850 B.C. (fission track)		dot-like relief pottery
(Ikawa-Smith 1980, 1986)			
Yasumiba	14,380±700 11,100 (hydration)	GaK-604	conical cores, end scrapers, side scrapers, knives, gravers
(Ikawa-Smith 1976, 1978)			
EASTERN SIBERIA (DYUKTAI CULTURE)			
Ezhantsy	35,600±900 35,400±600	Le-955 Le-954	a few wedge-shaped cores, pebble cores, one bifacial knife
Ust'Mil	35,400±600 33,000±500 30,000±500 23,500±500	Le-954 Le-1000 Le-1001 Le-999	one wedge-shaped core, one massive pebble core, one worked mammoth bone
Ikhine	31,200±500 30,200±300 27,800±500 27,400±800 26,600±900 26,500±540 24,600±380 24,333±200	Gin-1020 Gin-1019 IM-206 IM-205 IM-102 IM-202 IM-153 Le-1131	one wedge-shaped core
Verkhne-Troitskaya			
Layer 6	14,530±160	Le-864	one wedge-shaped core, burins, scrapers,

Table 1. Chronometric Dates of Microblade Sites in North China, Japan, eastern Siberia, and North America, continued

Site	Date(B.P.)	Lab.No.	Inventory
	15,950±250	Gin-656	bifacial points
	17,680±250	Le-906	
	18,300±180	Le-905	
(Michael 1984; Mochanov 1978)			
Dyuktai Cave			
upper	12,100±120	Le-907	wedge-shaped cores, discoid cores, bifacial points
middle	12,690±120	Le-860	
lower	13,070±90	Le-784	
	13,110±90	Le-908	
	13,200±250	Gin-405	
	14,000±100	Gin-404	
Ushki Lake			
Layer 5	8790±150	Mag-231	wedge-shaped cores, end scrapers, burins, bifaces, abraders, bone pendants
Layer 6	10,360±350	MO-345	
	10,760±110	Mag-219	
(Dikov and Titov 1984)			
NORTH AMERICA			
Akmak	9857±155	K-1583	wedge-shaped cores, blade cores, burins, bifaces, chopping tools
(Anderson 1970)			
Trail Creek	9070±150	K-980	microblades, bone projectile points
(West 1981)			
Healy Lake	10,150±280	SI-737	wedge-shaped cores, notched triangular points
(West 1981)			
Tangle Lake	10,150±280	Uga-572	wedge-shaped cores, conical cores of medium size, bifaces, scrapers, a few burins
(West 1981)			
Campus site	8400 (hydration)		wedge-shaped cores, end scrapers, etc.
	2725±125	Beta-7075	
	2869±180	Beta-4260	
	3500±140	Beta-6829	
(Mobley 1984, 1985, 1991; West 1981)			
Dry Creek	10,690±250	SI-156	wedge-shaped cores, end scrapers, etc.
(Powers 1978)			

Table 1. Chronometric Dates of Microblade Sites in North China, Japan, eastern Siberia, and North America, continued

Site	Date(B.P.)	Lab.No.	Inventory
Ugashik Narrows	7675±260	SI-1990	microblade cores, etc.
	8425±115	SI-2641	
	8995±295	SI-2492	
(Dumond 1976)			
Ground Hog Bay	9130±130	I-6304	microblade cores, scrapers, choppers, notched scraping tools
(Ackerman 1980)			
Hidden Fall	9410±70	SI-3778	microblade cores, pebble chopper, scrapers
	9860±75	SI-3776	
	10,005±75	SI-4352	
	10,075±75	SI-4354	
(West 1981)			
Pointed Mountain site	1640±310	S-1256	microblade cores, burins, projectile points, a pebble netsinker
	2150±140	S-798	
	2240±170	S-695	
	2270±75	S-194	
	2820±90	S-699	
	2960±180	S-697	
	3990±120	S-696	
(Morrison 1987)			
Namu Zone II	5170±90	WAT-451	microblade cores, flake cores, core scrapers, projectile points, hand axes, flake scrapers, ground stone
	5240±90	WSU-1943	
	5370±170	WSU-1947	
	5700±360	WSU-456	
	5740±100	WSU-1940	
	6060±100	WSU-1941	
	7800±200	Gak-3120	
	9140±200	Gak-3244	
	9720±140	WAT-452	
(Carlson 1979)			
Queen Charlotte Islands (Lawn Point)	2005±85	S-678	microblade cores, flake cores, pebble choppers, scrapers, hammer stones
	5750±110	Gak-3271	
	7050±110	Gak-3272	
	7400±140	S-679	
(Fladmark 1986)			
Bezya	3990±170	Beta-7839	wedge-shaped cores, burins, scrapers
(Le Blanc and Ives 1986)			

D. MIGRATION AND DIFFUSION OF MICROBLADE TECHNOLOGY

1. Migrationism and Diffusionism in Archaeology

There is a longstanding tradition in archaeology of using the concepts of migration and diffusion to interpret cultural development or to trace historic relationships between cultures (Adams *et al.* 1978; Binford and Binford 1968; Duke *et al.* 1978; Rouse 1986; Trigger 1968, 1978, 1989). Migration refers to the movement of peoples, and diffusion to the spread or transmission of ideas or traits between individuals or social units without population movement or exchange (Binford 1972:257; Childe 1950:1; Trigger 1968:27-28; Rouse 1958:61). Although migration and diffusion are thought to be two different concepts, especially dealing with historical phenomena, Adams *et al.* (1978:486,491) and Trigger (1968:28) argue that in many cases these two concepts cannot be clearly separated because diffusion will not take place without considerable population movements and contacts.

The concepts of migration and diffusion were first used to account for the developmental patterns observed in archaeological data during the 19th century, when these patterns could not be explained by the evolutionary approach which assumed that every culture passed through a general and unilineal process from simplest to most complex and could be divided into equivalent stages or phases (Trigger 1978:98-99).

The early 20th century witnessed growing reliance on migration and diffusion to explain cultural change accompanying the decline of evolutionary archaeology. Archaeologists became more interested in tracing historical relationships between cultures, and viewed cultural processes as being dominated by migration and diffusion. This theoretical development appears to correlate with the prevailing idea that people, especially primitive people, were conservative and resisted alterations in their life styles. Being inherently non-inventive, people were thought rarely to devise new technologies and did not even borrow new devices from their neighbours (Childe 1950:10; Trigger 1978:100-101, 1989:151).

In culture-historical archaeology, cultural changes and developments have been attributed to external influences and interpreted as the result of human movement or expansion of cultural traits. This approach was used by Kossina and Childe to create archaeological cultures of European prehistory during the late 19th and the early 20th centuries, and was followed by most archaeologists throughout Europe and other parts of the world. A similar approach developed independently in American archaeology during the 1950s (Anthony 1990; Childe 1950; Trigger 1978, 1989). Migration and diffusion are still the preferred explanation for prehistoric and early historic change in many parts of the world (Adams 1978; Adams *et al.* 1978).

Throughout the 20th century, migration and diffusion have been gradually in retreat in Western archaeology due to the rise of alternative explanations based on empirical evidence and a systemic model of analysis (Adams *et al.* 1978). Archaeologists realized the weakness and one-sidedness of migrationism and diffusionism, which often ignore the internal structure of the recipient culture in considering the adoption and spread of cultural traits. They became increasingly aware that unless the internal socio-cultural structure or system is understood, external influences, such as the adoption of a trait from another culture, cannot be reasonably explained. Gradual transition from studies of the external relationships between cultures to an additional concern with their internal structure permitted new insights into the operation of migration and diffusion (Trigger 1978).

Western archaeologists also began to pay more and more attention to explaining cultural change in terms of internal factors. Archaeological cultures began to be thought of as functional systems in which cultural change was generated internally as a result of varying systemic response to environmental variations. As a result, many Western archaeologists rejected migration and diffusion as unscientific and untenable paradigms for explaining cultural change (Adams *et al.* 1978; Anthony 1990; Trigger 1984).

Kehoe (1978:28) has mentioned three factors which influenced the rejection of the migrational and diffusional approach in American archaeology. First was the impact of functionalism, which assumed societies to be closed systems. Second was the glamour of the physical sciences, which convinced many American archaeologists that inductive studies in archaeology were trivial and unscientific. Third was the strong and irrational isolationism of American archaeologists, who felt that civilizations in the Old and New Worlds sprang up independently.

Although migration and diffusion theories have been ignored by many current Western archaeologists, these theories are by no means obsolete (Adams 1978; Anthony 1990; Kehoe 1978). In his influential book *Analytical Archaeology*, David Clarke (1978:418-438) discussed the role of migration and diffusion in cultural process and pointed out that cultural change can be achieved either by invention, or development within the system, or by transmission from outside. Clarke defined two kinds of diffusion. One he called primary diffusion, by which cultural traits spread within the limit of the cultural area of origin. The other he called secondary diffusion, by which cultural traits spread beyond the limit of the cultural area of origin. He referred to migration as "relocation diffusion by which the carriers of the information or traits themselves move through new areas" (1978:426). On the basis of radiocarbon dates obtained from 55 sites, Clarke attributed the early spread of agriculture, from the Near East to Europe, to both diffusion and population growth and movement. He estimated that the average rate of such migration and diffusion may have been nearly 1 km per year.

Scepticism about population movements, and a wide-spread questioning of migration hypotheses in archaeology, prompted Collett (1987:105,114-115) to point out that history and process are intimately connected and that the recognition of migration is necessary to understand material change in many areas. His study in the Ngoni and the Kololo sites of south Africa indicated that some aspects of material culture style do reflect migration.

New or Processual Archaeology in North America typically attributes little cultural change to migration and diffusion. In certain specific cases, however, processual archaeologists do interpret cultural change to be the result of outside impact. For instance, in his comment on Mary Leakey's assumption that the

Acheulian industry developed out of the Oldowan industry locally at the Olduvai Gorge, Binford (1972:256) postulated an outside influence causing the change from pebble tool to handaxe industries. Although Binford correctly criticized the idea of unicentral origin of some cultural traits such as agriculture, ceramics, and textiles, he never denied that rapid transmission and integration of these traits from one cultural system to another characterized the post-Pleistocene period in many parts of the world (1968:333).

It is also worth mentioning here that, despite their rejection of migration, processual archaeologists have never ignored mobility and regard it as the extremely important pattern of hunting-gathering adaptation. Binford (1980:19) even criticized as totally untenable the notion he termed "the 'Garden of Eden' principle" which postulates certain environments so well endowed that people need never move within them.

Binford (1980) has defined two kinds of mobility patterning among hunter-gatherers. One is residential mobility, which refers to seasonal movement of the whole group to camps close to key resources, an adaptive pattern characterized by the movement of consumers to resources. The other is logistical mobility, an adaptive pattern whereby resources are moved to consumers occupying a central base or village by specially organized task groups. Mobility is thought by Binford to be a positioning strategy that is responsive to structural properties of the environment (1980:14). Residential mobility is defined as a foraging strategy used by hunter-gatherers to procure various resources they may encounter. Logistical mobility is a collective strategy used by hunter-gatherers to solve the problem of incongruous distributions of critical resources. Binford points out that these two kinds of mobility patterning are not to be viewed as opposing principles but as organizational alternatives. Both patterns might be used in varying mixes by hunter-gatherers in different environmental contexts (1980:19).

While Binford does not discuss the concept of migration itself, his formulation of mobility patterning can be seen as an alternative interpretation of migration in terms of the dynamics of interaction between environment and adaptive strategy. This is especially the case when such mobility patterning has to be investigated to explain the spatial and temporal occurrence of distinctive archaeological remains in a broad geographic area.

Recently, migration and diffusion have re-emerged as a subject of serious study (Anthony 1990; Anthony and Wailes 1988; Mallory 1989; Renfrew 1987; Rouse 1986; West 1989). Anthony (1990:895) argues that the explanatory weakness of migration lies not in any lack of importance, but in its unpredictability and in the difficulty of identifying it archaeologically. Human beings are thought to have been migratory from the lower Paleolithic to the present, thus on theoretical grounds it is improper to ignore migration and diffusion in archaeological interpretation (Anthony and Wailes 1988; Davis 1974; Mangalam 1968; Rolland 1978). Renfrew (1987:85-86) stresses that no one denies migrations, including processual archaeologists. The problem is that archaeological records used to document supposed migration or diffusion are sometimes inappropriate to the task. In his comment on the trend of ignoring migration and diffusion in current research, Sherratt (1988:459) rightly points out that the processual approach is a necessary corrective to older views, but it also oversimplifies many complex issues about the nature of cultural change.

In the recent Indo-European studies, migration and diffusion have resumed their position as a favourite approach used to explain cultural change (Mallory 1989; Renfrew 1988). Renfrew, who has long been a leading antimigrationist, is now a strong proponent of the view that the migration and diffusion of early farmers and the food-producing economy from Anatolia to Europe around 6000 B.C. led to the gradual spread of Indo-European languages (Gimbutas 1988; Renfrew 1987, 1988). Mallory (1989:257,265) also argues that the expansion of the Indo-European languages was an ongoing process from the prehistoric period to the present. He attributes this expansion to the migration of complete populations, infiltration of small groups, and diffusion. Although these authors' works are beyond the scope of my study, it is evident that formerly unfashionable migration and diffusion theories are now being reconsidered by many archaeologists in both prehistoric and historic studies.

2. Migration, Diffusion, and Microblade Technology

The concepts of migration and diffusion have always been central to the interpretation of peopling of the New World (Carlisle 1988; Ericson *et al.* 1982; Shufler 1983; Thompson 1958). In the last sixty years, the idea that the distribution of microblade technologies indicates migration and diffusion has been repeated by different authors and strengthened by new discoveries. The following gives a brief review of how these concepts came to be applied to the microblade data.

Wedge-shaped cores were first discovered in the Gobi desert in Outer Mongolia, Xinjiang, and Northeast China in the 1920s and these discoveries came to the attention of N.C. Nelson during his participation in the American Central Asiatic Expedition in 1925. The French archaeologist P. Teilhard de Chardin had also conducted research in China, and in 1935, when Nelson identified a microblade assemblage including wedge-shaped cores at the Campus site in Alaska, both men considered this to be clear archaeological evidence of early migration from Asia to North America (Nelson 1935, 1937; Teilhard de Chardin 1939). There was, however, no stratigraphic or chronological evidence available at that time to confirm this hypothesis, nor was it possible to fill the great geographical gap between inland Asia and Alaska.

After additional discoveries of microblade sites, both in the Lake Baikal region and North China, Teilhard de Chardin and Pei (1944, see Gai 1985) suggested that microblade technology in North China might have derived from Lake Baikal, southern Siberia. They postulated that these microblade-using groups might have gradually migrated southward and finally integrated with local agricultural complexes in the Central Plain of North China. Pei continued to reiterate this view in his 1954 book. He proposed that microblade-using groups might have been pushed southward by gradually cooling temperatures in southern

Siberia, and settled in the area beyond or around the Great Wall region. Pei considered that microblade industries as a whole represented a Neolithic complex in North China which paralleled the agricultural complex in the Central Plain. Pei's assumption was gradually weakened by subsequent discoveries in North China, and eventually abandoned by Chinese archaeologists.

J. Giddings' excavations of Cape Denbigh from 1948 to 1952 and W. Irving's work on a Denbigh-like assemblage in the Susitna valley of Alaska in 1953 led Irving (1957) to define the "Arctic Small Tool Tradition." On the basis of similarities of microblade cores (Irving called them "tongue-shaped cores") found near Lake Baikal, in the Russian Far East, Outer Mongolia, Manchuria, northern Japan and Alaska, Irving (1962:62,63) thought that microblade technology originated near Lake Baikal and was brought into the New World by way of the Okhotsk-North Pacific region.

Dikov regarded the discovery of the Ushki sites in Kamchatka as an important contribution to the understanding of the peopling of the Americas. Based on the wide-spread occurrence of wedge-shaped cores, he defined an "Asiatic-American Mesolithic Culture Zone" covering the area from Xinjiang to the Maritime Territory, as well as Japan, Kamchatka, and Alaska (Dikov 1965:13, 20). In subsequent articles, Dikov (1978:68, 1987:2-4) has postulated that two material cultures identified at the Ushki sites correspond to two ethnic waves migrating from Northeast Asia to North America. The Early Ushki Culture from Level VI, characterized by large, stemmed, bifacial points, is thought to be connected with the Paleo-Indian projectile point tradition. The Late Ushki Culture from Level V, represented by wedge-shaped cores, is thought to be related to the Denali Complex of Alaska.

The excavation of the Donnelly Ridge site in central Alaska by F.H. West in 1964 yielded a microblade assemblage similar to the one documented by Nelson at the Campus site. West subsequently defined the Denali Complex, consisting of these and several similar assemblages in central Alaska. He preferred a Lake Baikal origin for the Denali Complex and claimed that, since the Gobi cores from the Shabarakh-usu and the Campus cores were different in platform technology, the Denali Complex appeared to be more closely related to sites such as Afontova Gora and Krasnyi lar (1967:378). Recently, West (1981:178,179, 1989:164) has suggested that the Dyuktai people might have been the direct predecessors of the Denali Complex, arguing that the Dyuktai Culture and Denali Complex represent a single culture.

Based on his work at Akmak, Onion Portage in northwestern Alaska, D.D. Anderson (1968) defined the "American Paleo-Arctic Tradition" for the assemblages which yielded Campus-type microblade cores. The comparison between the Campus cores in Alaska and those found in Siberia, Outer Mongolia, and Japan led Anderson (1968:29) to suggest an Asian origin for the Akmak assemblage. He later concluded that the Akmak microblade technology might have developed earlier in Eurasia, and that microblade assemblages throughout eastern Siberia and Alaska must have been parts of a broad interaction network (1984:81-2).

Slightly later, C.E. Borden (1969) defined the "Early Boreal Cultural Tradition" which overlaps Anderson's American Paleo-Arctic Tradition. Borden argued that the distribution of microblades in time and space demonstrated that essentially Mesolithic cultural influences emanating from Asia could have reached the Northwest Coast of North America by way of interior routes through Alaska, the Yukon Territory, and British Columbia. He also emphasized migration as the mechanism by which this cultural tradition spread. Citing radiocarbon dates, he proposed a temporal framework for this migration. He hypothesized that the microblade tradition originated in the Lake Baikal area around 13,000 B.P., and spread to Beringia around 11,500 B.P. It occupied central Alaska about 11,000 B.P., then moved to southwestern Yukon about 9,500 B.P. It reached northern Interior British Columbia and south Central British Columbia about 8,500 and 7,500 B.P., respectively, and finally arrived in the western interior of Washington about 6,500 B.P. (Borden 1969:4).

While several microblade traditions were being identified and defined in northwestern North America, Chinese archaeologists were busy searching for the development of the microblade tradition in their own country. The discovery of the Shiyu site in Shanxi province in North China in 1963 led Jia Lanpo and his colleagues to rethink the potential origin of the microblade tradition. From the Shiyu assemblage, one specimen was identified and classified as a prototype wedge-shaped core, and a few blade-like flakes were also found. In their discussion of the significance of the discovery, Shiyu was considered an important cultural link of the Small Tool Tradition in North China which could be traced back to Locality 1 at Zhoukoudian in the middle Pleistocene on the one hand, and gave rise to the microblade tradition in the late Pleistocene and early Holocene on the other. Jia and his colleagues strongly challenged the origin of the microblade tradition near Lake Baikal and argued that this problem could not be solved until the Upper Paleolithic industries which contain proto microblade technology are found in the mainland of Asia. They supposed that Shiyu might be one such candidate (Jia *et al.* 1972). Reiterating this view in his 1978 article, Jia stated that the microblade tradition might have descended from the Small Tool Tradition in North China and that microblade assemblages found in eastern Siberia, Japan, and North America might have been derived from their counterparts in North China (1978:141-2).

The discovery of large numbers of wedge-shaped cores and microblades at the Hutouliang site in Hebei province, North China from 1972 to 1974 was used to support the hypothesis advanced by Jia and his colleagues in 1972. The Hutouliang assemblage was regarded as a cultural link connecting Shiyu and microblade industries in the Mesolithic and Neolithic (Gai and Wei 1977). Gai and Wei stated that the microblade assemblages characterized by the wedge-shaped cores discovered along the Pacific area from East Asia, Central Asia, Northeast Asia to northwestern North America constituted a specific cultural area called the "Horseshoe-shaped Cultural Zone of the Area of North Pacific Ocean" (1977:300). They were of the opinion that the starting point of this cultural distribution could be placed in North China.

In the late 1960s and early 1970s, a series of microblade sites were found in Northeast Asia, especially from the Lena, Aldan, and Kolyma Rivers, and Kamchatka. The assemblages which contained wedge-shaped cores were grouped by Yu. Mochanov (1978a,b, 1980) into a single complex called "the Dyuktai Culture." He claimed that the Dyuktai Culture might have originated in the region between the Yellow and the Amur Rivers between 40,000 and 35,000 B.P., settled in Northeast Asia between 35,000 to 25,000 B.P., and penetrated into North America about 24,000 years ago (Mochanov 1980:127-8).

In 1974, Smith defined the Northeast Asian-Northwest American Microblade Tradition (NANAMT) and presented a general model of the migration and diffusion of this tradition from Asia to North America. He divided the NANAMT into four sub-traditions which are the Dyuktai sub-tradition in central and most Northeast Asia, the Asian inland-coastal sub-tradition in Japan and Kamchatka, the American Paleo-Arctic sub-tradition in Alaska, and the Northwest microblade sub-tradition in Yukon and Northwest Territory. In 1974, Smith suggested an eastern Siberian origin of the NANAMT. In his model, microblade technology first appeared somewhat after 18,000 B.P., in the area of Lake Baikal and the Aldan River, and spread through the Soviet Far East, Outer Mongolia, northern China and finally reached Japan about 15,000 B.P. It appeared in Kamchatka about 14,000 B.P. and crossed the Bering Sea about 11,000 B.P.

In a more recent paper, some revisions of this model were made (Smith and Smith 1982), and a North China origin was postulated in light of recent discoveries in that region. The date of the origin of the tradition was moved back to about 30,000 B.P.

R. Morlan (1967, 1970, 1976) carried out a comparative study of the typology and technology of microblade cores from Hokkaido in Japan, Shabarakh-usu in Outer Mongolia, and those from North America. Although he was convinced that these widespread circum-Pacific microblade assemblages were historically related, a fairly wide range of variation of core technology among these assemblages made Morlan cautious in his explanation of their distribution. He mentioned that the relationship of microblade assemblages in these regions would come to light when typological analysis of these cores and the total distribution of types are thoroughly examined both spatially and temporally (1967:208, 1970:35). In a more recent article, Morlan (1987:296) reiterated his earlier viewpoint, but suggested that the Dyuktai Tradition in the Lena Basin spread northeastward across Beringia and became the ancestors of Paleoindians. The Dyuktai Tradition had equipped the Paleoindians intellectually and technologically to exploit a wide variety of resources.

Hayashi Kensaku considered the Fukui Cave material very important in the study of the cultural relationship between Japan and mainland Asia (1968:128). He preferred migration and diffusion to explain the origin of microblade technology in Japan. He postulated that a proto-Fukui technology might have originated somewhere in the western part of the Great Wall region or on the Mongolian Plateau. Then, this technology gradually developed into the microblade technology at Shabarakh-usu, and finally became the Fukui technology when it spread to Kyushu (1968:180-1).

Migration is favoured by Irving Rouse in his interpretation of prehistoric archaeology (1958, 1976, 1987), and in his discussion of the peopling of the Americas, Rouse has suggested three stages based on the chronology of cultural complexes along the migration route into North America. The first is called the Lower Lithic age which is represented by the manufacture of irregular flake tools. Rouse assumed that this stage may have started around 30,000 years ago. The second, called the Middle Lithic age, is characterized by bifacial projectile points, and presumably began about 14,000 years ago. The third, named the Upper Lithic age, is marked by the microblade tradition. This tradition was thought to have derived directly from the Dyuktai Complex, and may have reached the Beringian region about 14,000 B.P. (Rouse 1976).

MacNeish (1976) proposed a four stage outline of Paleo-Indian prehistory, attributing the diagnostic material remains of these stages to the arrival of different peoples. Stages I and II were thought to represent unskilled hunters who crossed the Bering land bridge about 70,000±30,000 and 40,000±10,000 years ago, respectively. Stage III, characterized by bifacial projectile points, was thought to represent skilled hunters who migrated from Asia about 25,000-13,000 years ago. Microblade sites in Alaska were classified as Stage IV and were thought to represent people who migrated from Asia between 13,000 and 8,500 years ago. Criticisms of this speculative paradigm, such as that of Ikawa-Smith (1982), have prompted MacNeish (1982:312) to lump the first three stages together to produce a two-stage model.

In his discussion of the origin and distribution of the microblade tradition in East Asia and North America, An (1978) concurred with Jia and his colleagues. He suggested that microblade technology first appeared on the Huanghe drainage during the late Pleistocene, then spread abroad to Northeast Asia and northwestern North America. The decline of the technology along the Huanghe he attributes to the emergence of agriculture during the early and middle Holocene. It persisted, however, on the Mongolian Plateau, in Northeast China, and in Northeast Asia where a hunting and gathering economy continued (1978:313).

In his discussion of the early archaeology of Alaska and the peopling of America, D. Dumond used microblade data to support the claim that the earliest inhabitants of Alaska were obviously derived from Asia, and that wedge-shaped core technology might have represented the latest manifestation of a Paleolithic tradition covering both Northeast Asia and Alaska (1980:984,988).

Xiachuan and Xueguan are two Upper Paleolithic microblade sites found in the 1970s and 1980s. The discovery of these two industries indicated a long history of microblade development in North China (Wang *et al.* 1978, Wang *et al.* 1982). On the basis of techno-typological comparison of microblade cores from both East Asia and North America, Chen found that there existed a gradual change of microblade core typology and technology from the Upper Paleolithic to the more recent periods in North China, and that somewhat similar change in microblade industries can be recognized in the surrounding areas (Chen 1983, Chen and Wang 1989). Such change is the main theme of this study.

3. Homology and Analogy

Although microblades have been widely accepted as clear evidence of prehistoric relationship between East Asia and North America, such morphological resemblances could be challenged by the argument that they are possibly superficial rather than fundamental. Andrefsky (1987:21) claims that morphological similarities of stone artifacts can be explained either as the result of migration and diffusion or as independent invention. Because of the limited plasticity of lithic materials, convergence or independent invention of stone tool forms is highly possible. For this reason, the sources of similarities must be taken into consideration before cultural relationships can be firmly established.

Sheets (1975:372) has used the terms *homologous*, to refer to those artifacts belonging to part of the same cultural and technological tradition, and *analogous*, to refer to similarities that develop because of common usage. Binford has criticized the traditional typological approach for its failure to distinguish accurately between homology and analogy. Binford himself, however, offers no proper guidelines for making such a distinction, simply emphasizing that the formulation of laws of cultural dynamics is the appropriate way to explain differences and similarity in the archaeological record (1968:8-10,27).

Although the culture-historical approach still lacks clear-cut rules to prove that simiiar traits in two culture are historically related, three general criteria have been proposed by Andrefsky (1987) and Trigger (1968), to distinguish superficial from fundamental cultural similarities. These three criteria--complexity of artifacts, context of distribution, and environment--are discussed below.

a. **The Complexity of Artifacts**

Both Andrefsky (1987:22) and Trigger (1968:32) point out that the more complex an artifact type is, the greater the chance of being able to establish a common origin, since complicated artifacts are less liable to have been invented independently. This argument is based on the fact that different cultures generally have several options available to deal with the same or similar problems. Therefore, a complex choice made in one society is extremely unlikely to be repeated in another strictly by chance (Sackett 1977:370-371, Trigger 1968:30).

Microblade technology is an example of a complex artifact class, since it requires a sophisticated reduction sequence involving a great deal of intricate preparation (Andrefsky 1987:33,42). In terms of this criterion, microblades produced from wedge-shaped cores found both in East Asia and North America seem more likely to be the result of migration and diffusion than independent invention.

b. **Context**

It has been suggested that a temporally and spatially continuous distribution of cultural traits can be a good indicator of migration or diffusion. Childe (1950:9) reasoned that cultural similarities occurring in more or less adjacent areas and at basically the same time are more likely to result from migration and diffusion than from independent invention. Trigger (1968:29) argued that if a cultural trait was found within a broad area revealing a continuous distribution and was absent beyond this area, it might be assumed that this trait originated somewhere within that area, and that the distribution of the trait was likely attributable to migration and diffusion. Andrefsky (1987:24) similarly argues that the distribution of similar artifacts in a broad area might be the result of exchange, trade, or population movement. Whatever the mechanism of this distribution, the earliest appearance of an artifact in the recipient area must be slightly later than the first appearance in the donor area.

As far as the distribution of microblades is concerned, their spatial continuity and temporal sequence of occurrence from inland Asia to North America indicates a gradual expansion across these regions (Table 1). In addition, the geographical restriction of distinctive wedge-shaped cores to East Asia and northwestern North America also reveals this trend.

c. Environment

Andrefsky has postulated that artifact similarity might be a response to the exploitation of similar environmental resources. Yet, he points out that the occurrence of microblades in different environments does not support this hypothesis. In his study assessing possible relationships between microblades from Hokkaido and Alaska, this hypothesis had particular difficulties (1987:39-42).

Trigger (1968:30) has stated that varied environmental conditions from one area to another might increase the range of alternative cultural solutions for similar problems thereby increasing the possibility of divergent rather than convergent inventions. According to this notion, it seems extremely unlikely that a complex technology such as wedge-shaped cores could have been independently and repeatedly invented by unrelated groups living in different environments.

In summary, the complex technological traits, the relatively continuous spatial distribution, the west-to-east age gradient, and the diverse environmental contexts of microblade technology--particularly wedge-shaped microblade cores--in East Asia and North America support the hypothesis that their presence was due to migration and diffusion from the Old World to the New World during the late Pleistocene.

4. Biological Evidence of Pleistocene Migration

Although a discussion of the biological data is beyond the scope of this study, it is worth briefly mentioning here some biological evidence for population movement during the late Pleistocene from East Asia to North America.

a. **The Dental Evidence**

Dental evidence is thought to be an important source of direct, diachronic information on histories and affinities of ancient and modern populations, due to the "excellence of preservation, existence of numerous independent traits, genetic determination, and evolutionary conservatism" (Greenberg *et al.* 1986:480). Turner (1979, 1985a, 1985b, 1989) notes that there are two geographic patterns of the Mongoloid dental complex. One is called "Sinodonty" which occurs in northern Asia, including North China, Japan, Outer Mongolia, and northeast Siberia. The other is called "Sundadonty" which occurs in southeast Asia, including Indonesia, Taiwan, and all southeast Asian islands. When these two patterns are compared, some differences are notable. For example, shovelling of upper incisors, one-rooted upper first premolar, and three-rooted lower first molars are all more frequent among Sinodonts than among Sundadonts. The fact that American Indians are all Sinodonts is strong evidence of their Asian origin.

Turner (1989:96) suggests that Sinodonty originated among Sundadont populations of southeast Asia.

> After spreading into China and Mongolia 20,000 years ago, Sinodonty developed among the Sundadont population of the northern frontier. From there the new pattern was carried into the Siberian arctic and eventually across the Bering Land Bridge to North and South America.

In Asia, the western border of Sinodonty lies in the Lake Baikal region and its southern border is in North China. Based on the examination of large dental samples belonging to 6410 individual crania, Turner made several important observations about the relationship between native Americans and North Asians, and proposed three migration waves from Asia to North America (1971, 1985a,b, 1986, 1989).

He found that all the American Indian samples that he examined are closely allied with China-Mongolia and Amur samples The strong odontological affinity with northern Asians and markedly low degree of dental variation among

Amerindian groups indicated that all American Indians were descended from a single and fairly recent small population. Turner further suggested that North China is most likely to be the ancestral homeland of Paleo-Indians (1985a:592, 1985b:31,46, 1989:11; Greenberg *et al.* 1986:480).

Turner identified three dental patterns or groups of native Americans: the American Indian, the Aleut-Eskimo, and the Northwest Coast Indian. He suggested that these three groups might have diverged and developed by isolation in eastern Siberia before moving to the New World. The American Indian group might have derived from the Paleo-Indian population which was the ancestor of all south American and most North American Indians. The Aleut-Eskimo group might have originated near the Amur basin, migrated to the Okhotsk-Sakhalin region, and finally to the American Arctic. The Northwest Coast group might have been descended from the Dyuktai people between the Lena and Amur drainages. This group occupied the area where the remains of the American Paleo-Arctic Tradition have been found (Turner 1985a:591-592, 1985b:31, 1989:95-96; Greenberg *et al.* 1986:485).

Based on the observed dental patterns, Turner proposed three migration waves from northeast Asia to North America. He suggested that these three waves were probably close in time, but differed greatly in size and geographic extent. The American Indians represent the first migration wave, which spread southward at a rate about 16 km per year eventually arriving at the southern tip of Chile. The Aleut-Eskimos represent the second wave which entered the New World about the same time by the way of the now-submerged southern coast of the Bering Land Bridge. The paucity of archaeological information leaves the impression that the Aleut-Eskimo was the latest migration. However, a third wave of late Pleistocene migrations crossed the Bering Land Bridge slightly later than the first two, and, according to Turner's model, it was these people who brought with them microblade technology (Turner 1971, 1985a,b, 1989).

b. **The Genetic Evidence**

Compared to dental data, genetic analysis is presently unable to provide strong evidence to confirm the three migration model. Greenberg and others attribute the inability of genetic studies of biological affinity to resolve this question to several factors such as "evolutionary convergence, unrecognized gene flow, or incorrect character polarity assessment." Therefore, the interpretation of genetic data can only be used as "secondary support" for the three Pleistocene migrations (1986:486-487).

According to her genetic studies, Szathmary made two preliminary observations. First, no apparent gene frequency differences are observable between Asians and American Indians. American Indians and Eskimos share genes of Asian origins, but the very small samples reveal slight differences. Second, although American Indians and Eskimos may have been descended from different Asian ancestors, the New World Eskimos and Northwest Coast Indians seem more closely related than other Indians and Asian Eskimos (Szathmary 1981:58, 1985:91, Szathmary and Ossenberg 1978).

Rychkov and Sheremet'eva (1986) argue that the genetic relationship of the indigenous people of Siberia and America indicates a single tribal stock. Comparing gene frequency distributions, they found the genetic distance between North Asian and Amerindian populations to be no greater than that among Tunguska-Evenka and Tofalara populations of central Siberia. From this they concluded that: (1) genetically, native people in Siberia and America show no more difference in antiquity than two neighbouring groups of a single tribe; (2) the evidence from both living populations and human skeletons reveals that, despite morphological similarities, some genetic divergence can be found, and may be attributable to gene flow rooted in the Neolithic of Siberia; and (3) given the genetic similarities between the people of eastern Siberia and American Indians, both their origins can be traced back to a single Paleolithic gene pool.

5. Summary

Human history is a history of migration which carried people to almost every corner of the world. The monogenesis theory of human origin based on physical anthropology and fossil records proposes that human beings may have originated in Africa, then spread throughout the world. A more recent out-of-Africa model even suggests that all modern humans may have a racially undifferentiated ancestor that evolved in Africa. In any case, beginning in the early Pleistocene, human populations expanded to populate Europe, Asia, Australia, America, and eventually settled the tiny islands of the vast Pacific during the Holocene (Davis 1974, Stringer 1990:98).

Prehistoric migrations are viewed as a structured behaviour of human beings correlating with a subsistence strategy based on mobility (Anthony 1990). Davis (1974:93) has argued that Pleistocene populations were hunter-gatherers who naturally followed their prey and forage. This subsistence pattern encouraged them to exploit both occupied and virgin territories. The possibility of migration was also increased by the human ability to adjust culturally to diverse environments without organic evolution. Equipped with advanced weapons, fire, and skin shelters, humans could adapt readily to almost any new climate and dietary condition they encountered. Anthony (1990:901-902) points out that even random movement of such a subsistence strategy could result in an outward migration of 1 km per year. The societies with focal economies which were based on critical resources would be likely to deplete these resources within a given area more rapidly and to cause long-distance migrations.

In contrast to biological research, which enables paleoanthropologists and geneticists to use the fossil record and genetic evidence to trace human affinities, the idiosyncratic attributes and alternative options and adjustments to diverse environments of human cultures have made it extremely difficult for archaeologists to distinguish cultural affinities. Therefore, migration and diffusion have been often avoided and viewed as a hopeless quagmire in the interpretation of archaeological records. The ignorance of migration and diffusion in current archaeological research is not due to their lack of importance but to the lack of appropriate archaeological theory and methods (Anthony 1990).

Although the general conclusion that the earliest Americans came from northeast Asia is now scarcely disputed, the elusiveness of when, where, and how these events took place has made many archaeologists deal with this issue by simply talking about "peopling of the New World" without specifying population migrations and cultural diffusion. These earliest inhabitants are thought to be mobile hunting groups who primarily placed their reliance on faunal rather than floral resources. Morlan (1987:268) claims that due to relatively few edible plants and no clear evidence for fishing and sea mammal hunting prior to the Holocene, Pleistocene Beringia in general was a land for hunting societies who relied mainly on land mammals. Kelly and Todd (1988:234) stress that land fauna were easier to locate, procure, and process for migrating foragers than plants in an unknown region. The advantage for hunting groups to adapt to new environments without much technological and cultural adjustment would increase the possibility of further movements.

Linguistic (Greenberg 1987; Greenberg *et al.* 1986) and odontological researchers favour three prehistoric migration waves from northeast Asia to North America, although many archaeologists, including myself, prefer a multi-wave model. A single wave model has also been proposed and supported by researchers such as G.S. Krantz who has claimed that hunter-gatherers cannot migrate through territory which is already occupied (Krantz 1976; see Adams *et al.* 1978:489).

Having reviewed Greenberg, Turner, and Zegura's article (1986), West has claimed that the three migration model based on linguistic and dental evidence was suggestive and provocative. He prefers a two migration model, one wave represented by Anangula, the other by the Beringian Tradition which West refers as a single tradition occurring in Northeast Asia and northwestern North America.

Both Clovis and Denali peoples are regarded by West as the descendants of this tradition (West 1989).

Mochanov and Fedoseeva's three migration model is slightly different. They claim that the first migration was by people of the Dyuktai Culture who might be the ancestors of North American Paleo-Indians. The second was by people of the Sumnagin Culture which became the Eskimo-Aleutian population in Alaska. The third was by people of the Belkachi Culture, believed to be an ancestral branch of the Protoathapasks (1986:668).

Giddings (1954:88), Morlan (1987:267), and West (1989:164) have postulated that the arrival of the earliest inhabitants in northwestern North America might have been more like a gradual expansion rather than a directed and purposeful migration. The younger generation hunted beyond the range of their fathers but never really left home. West uses the term "drift" to describe such movements.

As far as the distribution of microblades is concerned, migration and diffusion have been the explanations most favoured by archaeologists in China, Russia, Japan, and North America. The complexity, continuous distribution, west-to-east temporal gradient, and diverse environmental contexts of microblade technology all support the interpretation of technological homology. It follows, then, that microblades originated somewhere in inland Asia, and spread from North Asia to North America by means of population migration and/or cultural diffusion. Unfortunately, as the archaeological evidence is rather meagre, the nature of this process remains unclear.

E. RESEARCH STRATEGY

This study will use microblade cores found in East Asia and North America to determine the nature of cultural relationships between these areas. For a comparative perspective on the cultural relationships, it is necessary to trace developmental sequences of microblade core typology and technology between different regions. In order to do so, the study will first attempt to build a spatial and temporal framework, and to trace lines of continuity and development from a regional perspective. An inter-regional comparison will then be conducted.

Chapter Two will summarize the principal microblade discoveries in East Asia and North America in the last sixty years, and the histories of microblade research in different countries.

Chapter Three will first review the methods of microblade research and the experimental reconstructions of microblade technologies conducted by various archaeologists. Then, problems in interpreting the significance of microblade data will be discussed. These problems include: stratigraphic and chronological uncertainties of many microblade discoveries; the scarcity of faunal remains found in association with microblade assemblages; variation in the environmental context of these assemblages in different regions; and functional explanations of microblades. The method to be used to explore the significance of core variation by techno-typological analysis and comparisons will be discussed. Finally, the analytical procedure will be outlined.

Chapter Four will analyze and compare microblade cores from North China. Microblade assemblages will be analyzed and compared according to their chronological order. The study intends to show techno-typological change or cultural development from the late Pleistocene to the early Holocene or more recent times in North China.

Chapter Five will focus on microblade cores found in northwestern North America. The analysis and comparison will be conducted in terms of traditions or regional complexes or assemblages. These traditions, complexes, and assemblages are organized in chronological order by region and the study will reveal techno-typological change within these regions.

Chapter Six will analyze and compare published microblade core data from both the Dyuktai Culture of eastern Siberia and from southern and northern Japan. The study will give an outline of microblade technologies and their developments in these regions, and provide reference information for the comparison of materials between North China and northwestern North America.

Chapter Seven will summarize the distribution in time and space of microblade cores in East Asia and northwestern North America. The patterns observed during analysis and comparison will reveal: how microblade technologies in different regions developed; what kinds of similarities or parallels are culturally connected; what kinds of differences existed between different regions; and what are the probable reasons for these similarities and differences. This chapter will conclude that wedge-shaped cores from North China Upper Paleolithic industries and the American Paleo-Arctic Tradition in northwestern North America are more similar than those from the Dyuktai Culture and Japan. It will suggest that migrations of microblade-using groups from East Asia to North America were taking place prior to the full development of the Dyuktai Culture in Northeast Asia. It will support the hypothesis that migration and diffusion are the most reasonable explanations of microblade distribution, and that North China is the most likely homeland of this microblade technology. It will also state that this study, although "traditional" in orientation, provides the best possible explanation for the widespread distribution of these characteristic microblade cores.

CHAPTER II. - MICROBLADE RESEARCH IN EAST ASIA AND NORTH AMERICA

A. MICROBLADE DISCOVERIES IN CHINA

Microblades were first reported in China over sixty years ago. These early archaeological investigations and microblade discoveries were made by foreign scholars from America, Japan, Sweden, France, and Russia. From the early 1920s, the American Central Asiatic Expedition carried out investigations in Outer Mongolia, parts of Inner Mongolia, and Hebei Province, leading to the discoveries of many stone age remains (Maringer 1950; Nelson 1926). Since then, additional microblade materials have been collected from provinces in North China.

After 1949, increasing numbers of microblade remains were found and were defined as a regional variant of the Neolithic culture in China due to their association with pottery or ground stone tools. This "Microlithic Culture" was thought to have flourished beyond the Great Wall region in North China. In many cases, these discoveries were overlooked or even ignored by Chinese archaeologists because most were surface collections. In the 1970s, several Upper Paleolithic microblade industries were discovered *in situ* along the Huanghe valley. This led Chinese archaeologists to suggest that they might represent an age-old tradition rooted in the Chinese Paleolithic.

In the last two decades, an increasing number of microblade discoveries have been reported from the Qinghai-Tibetan plateau, southwestern China, suggesting that microblades constitute a significant component of prehistoric culture in the area. At the same time, a few sporadic microblade assemblages were reported in three southern Chinese provinces: Yunnan, Sichuan, and Guangdong. From 1979 to 1984, microblade sites were also reported in two eastern Chinese provinces: Shandong and Jiangsu. These newly accumulated microblade data have changed the idea that microblade remains only occur in the steppe-desert region or are confined to the northern frontier of China. At present, microblades have been reported from nineteen out of thirty provinces, autonomous regions, and municipalities (Figs.1,2). The following pages will provide summary descriptions of those sites for which we have relatively detailed reports.

1. Inner Mongolia, Xinjiang and Northeast China

Inner Mongolia, Xinjiang, and the three provinces of Northeast China are the five northernmost provinces in China. Inner Mongolia borders Outer Mongolia and Russia on the north and Heilongjiang, Jilin, Liaoning, Hebei, Shanxi, Shaanxi, Ningxia, and Gansu on the east and south. The region is mostly located on the Mongolian Plateau, about 1000 m above sea level, with vast grasslands in the east and the Gobi desert in the west. The Great Bend of the Huanghe flows through the centre of this region.

Xinjiang Uygur Autonomous Region, located in northwestern China, borders Outer Mongolia, Russia, Afghanistan, Pakistan, and India on the north and west, and Gansu, Qinghai and Tibet on the east and south. The topography of the region is characterized by desert, two large mountain ranges, and two huge inland basins.

Heilongjiang, Jilin and Liaoning are three provinces of Northeast China called Dongbei (Tongpei) in Chinese. Before 1949, they, along with part of Inner Mongolia, were called "Manchuria." This region is characterized by a mixture of hills and plains. Some areas are covered by virgin forests.

a. The American Central Asiatic Expedition and the Sino-Swedish Scientific Expedition

In 1922-30, the American Central Asiatic Expedition under the leadership of R.C. Andrews made two expeditions to central Asia. They started from Zhangjiakou (former Kalgan) in Hebei, passed through Inner Mongolia, and

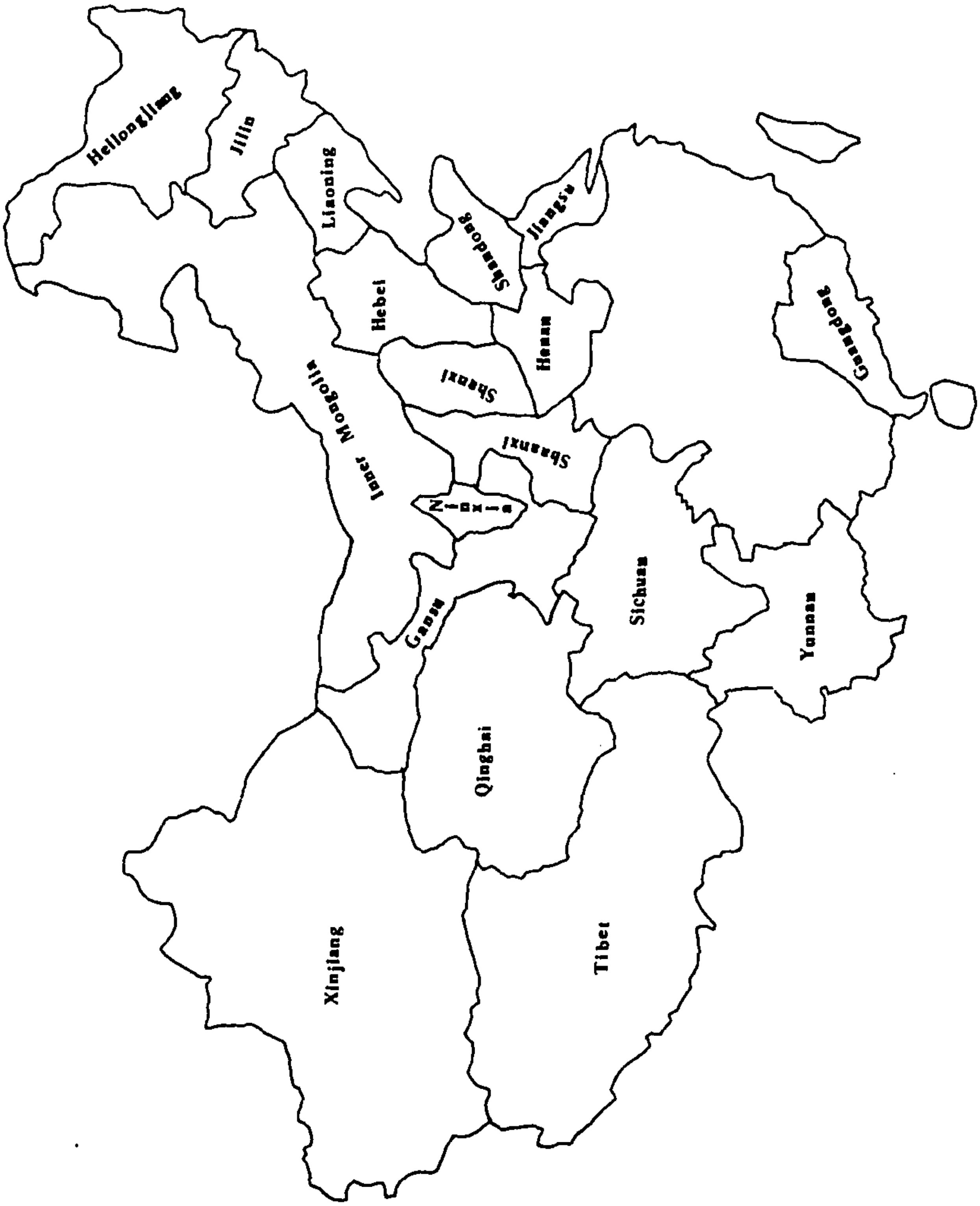
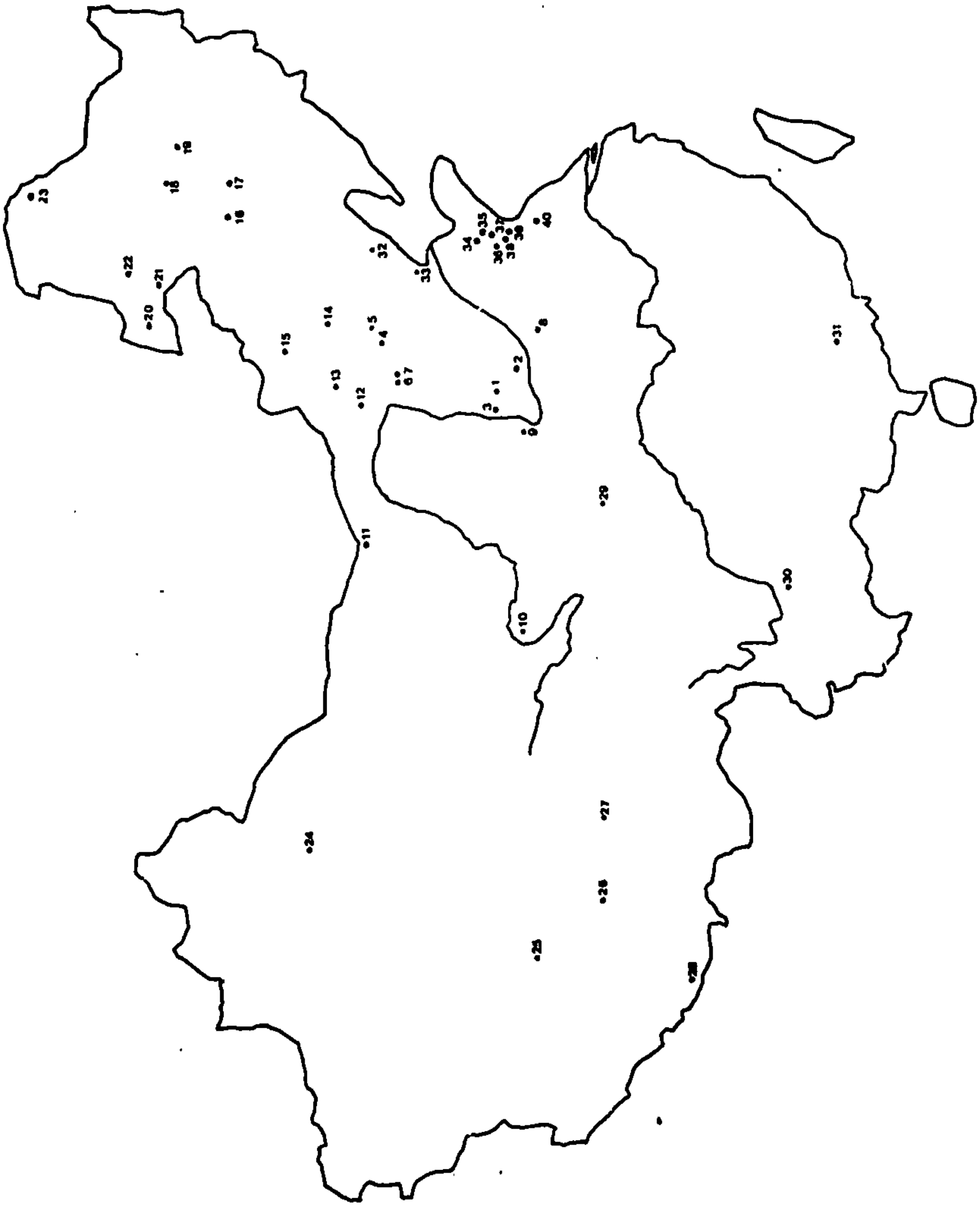


Figure 1: Provinces Yielding Microblade Remains in China



1. Chaishi 2. Xiachuan 3. Xueguan 4. Hutouliang 5. Youfang 6. Yaozhitou 7. Gaoshanzheng 8. Linjing 9. Shayuan 10. Layihai 11. Yingen 12. Dayao 13. Dayifaquan 14. Duolun 15. Abaga Banner 16. Keiqinyou Middle Banner 17. Dabusu 18. Angangxi 19. Guxiangtun 20. New Baihu Right Banner 21. New Baihu Left Banner 22. Hailar 23. Shibazhan (the 18th Post) 24. Chikouchingtse 25. Shuanghu 26. Shenja 27. Heihe 28. Nielamu 29. Zhongzhipu 30. Yuanmou 31. Xiqiaoshan 32. Donghuishan 33. Huanghua 34. Yishui 35. Zhaike 36. Junan 37. Heilongtan 38. Linyi 39. Fenghuangling 40. Malingshan

Figure 2: Distribution of Major Microblade Sites in China

reached Uliassutai in Outer Mongolia. Nelson outlined this research area as lying between 97 and 115 degrees east longitude, and 45 and 46 degrees north latitude. This area covers the arid expanses of what is now Alashan League, Inner Mongolia. Surface collections of lithic remains were made from 122 localities. Out of 200,000 lithic remains, 50,000 were conserved for scientific study. Most of the lithic collections consist of discarded microblades and microblade cores (Maringer 1950).

In 1927-35, the Sino-Swedish Scientific Expedition under the leadership of Sven Hedin started from Zhangjiakou, passed through Inner Mongolia, and reached Hami in Xinjiang (Sinkiang). Maringer defined this zone on the map as being approximately between 94 and 115 degrees east longitude and 41 and 43 degrees north latitude. A total of 327 archaeological localities were reported. The number of items collected, not including the collection by the Chinese participants in the expedition, was estimated at no less than 50,000 specimens. Microblades and microcores were the main component of the collections. According to Maringer, "the majority of these consists likewise of cores or nuclei in various stage of utilization, ranging from raw cores to entirely consumed nuclei, further of flakes of various size and form, often small, slender and prismatic" (Maringer 1950:2-3).

b. **Hailar, Inner Mongolia**

Songshan, not far from Hailar City, is one of the first microblade sites to be discovered in Northeast China. In 1928, some pottery and stone artifacts were found by the Research Association of Culture Relics of Northeast Province. In the 1940s, Japanese archaeologists Mizuno Seiichi, Komai Kazuchika, and Mikami Tsugio visited Songshan and collected artifacts that consisted mainly of pottery from the sand dunes along the bank of the Hailarhe (An 1978:289). In 1956, Wang Yuping (1956) conducted a field survey at Songshan, and published a brief report. In 1962, An Zhimin reinvestigated Songshan and identified 16 localities. Microblade remains, other chipped stone tools, and potsherds were collected from deflated surfaces in the sand dunes. Although the collections were identified as representing a mixture of different periods, An suggested that microblade remains may be assigned to the Mesolithic (An 1978).

c. Yingen, Inner Mongolia

Yingen is located on the China-Mongolia border, about 350 km to the north of the city of Yinchuan, capital of Ningxia Province. Hundreds of cultural remains, mainly stone artifacts, were collected by Chinese geologist Yuan Fuli in 1932, but these materials were never reported. The cultural remains at Yingen were surface collected for the most part, and included microblades, microcores, bifaces, end scrapers, and other stone tools (Chen 1984).

d. Angangxi (Ang-ang-hsi), Heilongjiang

Angangxi is located in the valley of the Nunjiang (Nonni), a tributary of the Songhuajiang (Sungari). In 1928, A.S. Lukashkin, a Russian employee of the former Chinese Northeast Railway, discovered several microblade localities at Angangxi, near the city of Qiqihar. In 1929, and between 1932 and 1939, Lukashkin visited Angangxi repeatedly and identified six Neolithic localities. The site was then investigated by Liang Siyong (Liang Ssu-yung) in 1939. A total of 26 microblade localities were identified. During World War II, a Japanese expedition conducted surveys in the area and collected some microblade remains. The cultural remains were embedded in the so-called "black soil" of lake and swamp sediments. They included: microblades and microcores of wedge-shaped and conical forms; artifacts made on blades and microblades; pottery; polished stone tools; bone and antler implements; and ornaments (Komai 1959, Larichev 1964, Liang 1957).

In 1960, a reinvestigation was conducted by the Heilongjiang Provincial Museum. The researchers reported that microblade industries at Angangxi could be assigned to an earlier period (Heilongjiang Provincial Museum 1974). Then, in order to clarify the cultural sequence of the site, an archaeological survey was conducted by the Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences in 1982. This led to the discovery of an Upper Paleolithic site at Daxingtun, 18 km south of Angangxi. One microblade core of conical form was identified among 60 lithic artifacts. A single radiocarbon date gave an age of 11,800±150 B.P. (PV-369) to this newly discovered assemblage (Huang *et al.* 1984).

e. **Guxiangtun (Ku-Hsiang-Tun), Heilongjiang**

Since the turn of the century, Guxiangtun has been well known for its abundance of mammalian fossils. The site is located on the Wenquanhe (Wen-Chuan-ho), a tributary of the Songhuajiang, on the outskirts of Harbin, the capital of the province. In 1931, Chinese scholars conducted the first excavation at the site. Between 1933 and 1938, Japanese and Russian archaeologists conducted field surveys and test-excavations there. Tokunaga Shigeyasu and Naora Nobuo (1936) excavated the site in 1933 and 1934, and found large numbers of bone, antler, ivory, and stone tools, mammalian fossils, and plant remains. One interesting feature is that the stone tools were few in number in comparison with those made of animal products. Two excavations uncovered 24 stone tools and 232 implements made of bone, antler, and mammoth ivory.

In 1935, Teilhard de Chardin (1939) saw a wedge-shaped core, found by V.V, Ponosov, in the course of his excavations in what he thought to be final Pleistocene sediments of Guxiangtun. This microblade core was unearthed from a depth of about 8 m below the surface, and was found in association with mammals such as woolly rhinoceros and mammoth.

The date of the Guxiangtun site has been controversial for a long time. In the 1950s and 1970s, Chinese scholars conducted several investigations and excavations there. Two suggestions were made: first, that all cultural remains belong to the Upper Paleolithic, and second, that the Guxiangtun collection represents cultural remains from the Upper Paleolithic to Mesolithic, and even the Neolithic periods (Lu 1968).

f. **The Nunjiang Valley, Heilongjiang**

In the 1950s, the archaeological teams of the Heilongjiang Provincial Museum had conducted extensive surveys along the Nunjiang valley. More than one hundred localities yielded microblade remains. Unfortunately, most of them were surface collections. Only a few were unearthed *in situ* from the fine sandy surface deposits. Since modern dating methods were not yet available, they were tentatively assigned to the Neolithic or even historical periods (Heilongjiang Province Museum 1961).

g. **Shibazhan (The 18th Post), Heilongjiang**

In 1975 and 1976, the northernmost Paleolithic site in China was excavated at Shibazhan, Huma County. The site contained five localities. Microblade remains, end scrapers, burins, and some heavy-duty tools were found in the second terrace of the Humahe, a tributary of the Heilongjiang (Amur River). Both litho- and bio-stratigraphic data suggested that a late Pleistocene date for the site. A detailed report is pending (Wen 1986; Ho and Jiang 1991).

h. **Dabusu, Jilin**

In 1985, Dong Zhuan conducted an archaeological survey and test-excavation in the area of Lake Dabusu, and found a microblade assemblage in the second terrace which is about 20-30 m above the Lake. Lake Dabusu, a large inland brackish lake of about 56 square kilometres, is located at Qianan County, in the western part of Jilin, and within the drainage area surrounded by the Nunjiang, Songhuajiang and Liaohe. A total of 486 stone artifacts were unearthed, including: four microblade cores, 121 microblades, eight end scrapers and side scrapers, one ground stone, and 352 pieces of debitage. Results of chronometric dating are not yet available. According to stratigraphic and cultural comparisons, the assemblage was tentatively dated to 10,000 B.P., or the end of the Upper Paleolithic (Dong 1989).

2. Shaanxi, Shanxi, Hebei, and Henan Provinces

These four provinces are located on the Loess Plateau and the North China Plain. This region borders on Inner Mongolia and Jilin to the north, Ningxia and Gansu to the west, and Shandong and Anhui to the east. The topography of the region is characterized by thick loess deposits in northern Shaanxi, most of Shanxi, and northwestern Hebei, while alluvial plains predominate in southern Shaanxi, southeastern Hebei, and most of Henan. This region is commonly called Zhongyuan (Chong-yuan) or the "Central Plain" of China.

a. **Shayuan, Shaanxi**

The Shayuan site is located in Dali County, Shaanxi Province. In 1955, an archaeological survey conducted by An Zhimin and Wu Ruzo led to the discovery of fifteen microblade localities. More than 3000 stone artifacts were collected on the deflated surfaces of sand dunes, and only 519 specimens were selected for detailed study. Because of the absence of Neolithic items, the microblade assemblage was tentatively dated to the Mesolithic (An and Wu 1957). Reinvestigations were conducted by an archaeological team from the Banpo Museum (1983) in 1972, 1979 and 1981. Cultural remains were found scattered over the entire area. One fragment of human skull and more than 8600 cultural items were collected. The stone artifacts include: microblades and microcores, stone axes, stone balls, end scrapers, various side scrapers, burins, backed knives, and projectile points or arrowheads with diverse base shapes such as round, concave, or tanged. There were seventeen microblade cores found in 1955, and 123 found in 1973, 1979 and 1981. According to more recent research, the microblade assemblage might represent a relatively long cultural sequence. Such sequences may have started at the end of the late Pleistocene and persisted well into the Holocene, or from about 10,000 to 8000 B.P. Unfortunately, no radiocarbon dates were available. Two polished stone tools were regarded as more recent. Several potsherds were identified as belonging to the Han dynasty

(206 B.C.-A.D.220). English language summaries of the finds appeared in Chang's descriptions (1960:51-55, 1986:83).

b. **Linjing (Ling-ching), Henan**

In 1965, another undated microblade site, Linjing, was discovered during construction near the city of Xuchang (Hsu-ch'ang). A total of 1353 stone items were collected. They included: microblade cores of wedge, conical, and semi-conical forms; various types of scrapers; points; and chopping tools. The microblade cores were rather crude in appearance and technique. The absence of Neolithic items suggested that the assemblage might be assigned to the late Pleistocene. Unfortunately, the stratigraphy was totally destroyed in the course of digging a pond, thus the site was not datable (Chang 1986:84; Chen 1984; Zhou 1974).

c. **Xiachuan (Hsia-ch'uan), Shanxi**

This Upper Paleolithic microblade site is located at the village of Xiachuan, Qingshui County, in the southern part of the province. In 1970, some stone artifacts were collected by a local botanist. Shortly thereafter, a field survey was conducted by the Provincial Institute of Archaeology in 1972. Excavations and large-scale field surveys were conducted during the field seasons of 1973-1975. Other excavations were conducted by a joint team from the Provincial Institute of Archaeology of Shanxi and the Institute of Archaeology, Chinese Academy of Social Sciences, in 1976-1978. A large quantity of microblade remains and other stone tools was discovered (Chen and Wang 1989; Wang *et al.* 1978).

d. **Xueguan (Hsueh-kuan), Shanxi**

Xueguan was first recognized as a lithic locality in 1964. In 1979 and 1980, reinvestigations and excavations led to the discovery of a microblade assemblage and mammalian fossils (Chen and Wang 1989; Wang *et al.* 1983). A very brief description in English is available in Chang's book (1989:60).

e. **Hutouliang, Hebei**

From 1972 through 1974 extensive field surveys and excavations took place along the middle course of the Sangganhe, Yangyuan County, about 80 km west of Beijing. The Hutouliang site, consisting of nine localities, was discovered along 10 km of the river bank. A large quantity of stone artifacts, including abundant microblade remains and late Pleistocene fauna, were unearthed from the sandy loess and gravel deposits on the second terrace (Chen and Wang 1989; Gai and Wei 1977; Gai 1985; Tang and Gai 1986). Chang gives a brief description of Hutouliang in his book (1986:60).

f. **Chaishi Loc.7701 at Dingcun, Shanxi**

Dingcun is a well known Middle Paleolithic site in North China. Since 1976, successive archaeological investigations and excavations have been conducted around the site by the Provincial Institute of Archaeology in Shanxi. In 1977, a microblade assemblage was discovered at the bottom of the second terrace of the Fenghe, a main tributary of the Huanghe. The locality is located on the west bank, facing the Dingcun site across the river. Microblade remains, other chipped stone tools, clam shells, and mammalian fauna were unearthed. The full excavation report is not yet published. A charcoal sample gave a ^{14}C date of over 40,000 B.P. and a sample of freshwater clam shell gave a date of 24,450$\pm$800 B.C.(ZK 653-1) (Institute of Archaeology 1983:17; Wang 1986:175).

g. **Gaoshanzhen, Datong, Shanxi**

The microblade site at Gaoshanzhen was first discovered by Li Xingxue in 1950, and investigated by Pei Wenzhong and Chen Mengjia in the same year. Reinvestigations were conducted by Chen Zheying and others from the Provincial Institute of Archaeology of Shanxi in 1977 and 1983. The site, located about 30 km west of the city of Datong in the northern part of the province, is situated on a loess terrace about 15 m above the riverbed. Stone artifacts and potsherds were scattered over the surface. More than 1500 stone artifacts were collected.

They include: four microblade cores that are conical and wedge-shaped forms, 282 microblades, 53 retouched microblades, and microcore fragments. Other stone tools include: end scrapers, side scrapers, backed knives, arrowheads, denticulates, one perforator, flake cores, and much debitage. The site was not dated because most of the cultural remains were surface collected. Chen Zheying has tentatively assigned the site to a late Neolithic age (Chen, Wang, and Xie 1985).

h. **Yaozitou, Shanxi**

The Yaozitou microblade locality was discovered during a archaeological survey in 1981. Reinvestigations were conducted by Chen Zheying from the Provincial Institute of Archaeology in Shanxi in 1982 and 1983. The site is located at Yaozitou Village, Huairen County, in the northern part of the province. The locality lies on the Dongshanhe which is separated from the well-known Emaokou lithic workshop to the west by a creek.

Most of the microblades are made of one of two raw materials: chert and tuff. The latter ones are quite similar to those found at the Emaokou workshop. The lithic inventory comprises ten microblade cores of conical, and boat-shaped forms, and one side scraper made from a microblade. Other stone tools include: end scrapers, side scrapers of diverse forms, burins, perforators, points, one arrowhead, chopping tools, one ground stone tool, and much debitage. Some potsherds were also collected.

No absolute dates are available for the Yaozitou locality. Chen Zheying suggested that microblade remains at Yaozitou might be assigned to the Neolithic. They were regarded as a part of the Emaokou lithic workshop because of the lack of a clear boundary between these two localities (Chen and Ding 1984).

i. **Youfang, Hebei**

The Youfang microblade site was found in 1984 and excavated in 1986 by Xie Fei and Cheng Shengquan. The site is situated at the village of Youfang, Yangyuan County, in the northwestern part of the province. A total of 3372 stone artifacts and a possible hearth with ash, burnt clay, and animal bone were discovered from the Datianwa terrace about 170 m above the Sangganhe. Most of the lithic artifacts were made of chert or raw materials of volcanic origin. The stone inventory includes: 13 microblade cores of wedge-shaped, boat-shaped and conical forms, 92 microblades, and other stone artifacts such as side scrapers of diverse forms, end scrapers, hammerstones, choppers, burins, backed knives, one perforator, and numerous exhausted cores and debitage. Although the site has not yet been dated, a stratigraphic correlation suggests that the microblade assemblage probably belongs to the late Pleistocene (Xie and Cheng 1989).

j. **Donghuishan, Hebei**

The Donghuishan microblade site, located in Luan County, was discovered in 1985 and excavated in 1986. The lithic assemblage was embedded in a greyish-white sand layer on the second terrace of the Luanhe, about 4 m below the surface. A total of 101 lithic artifacts, including three microblade cores of wedge-shaped, boat-shaped, and cylindrical form, were found along with microblades, various scrapers, one point, one burin, and debitage. The age of the assemblage is unknown. It was tentatively assigned to the late Pleistocene based on geological placement (Institute of Cultural Relics of Hebei 1989).

k. **Huanghua, Hebei**

In 1987, one lithic locality, about 50 km from the coast line of Bohai, was found in Huanghua County near Tianjing. About 100 lithic artifacts were collected from disturbed sandy soil about 1.5 - 2.0 m in thickness but their original context is unknown. Most stone tools are small, including side scrapers of various forms, end scrapers, points, and burins. One boat-shaped microblade core was identified, but no microblades were reported. No chronometric dates are available. An Zhimin suggests that the age of the assemblage may have been earlier than the Neolithic due to the absence of pottery and polished stone tools (An 1989).

3. Qinghai-Tibetan Plateau

This area, situated in the southwestern China, consists of huge mountain ranges and high plateaus. The altitude ranges between 2500 to 4500 m above sea level. It borders Xinjiang and Gansu on the north, Sichuan and Yunnan on the east, and is the highest plateau in the world as well as in China.

a. Heihe, Tibet

During a geological reconnaissance on the Qinghai-Tibetan Plateau in 1956, two lithic artifacts were surface collected on the river bank about 2 km west of the Heihe by Zhao Zongfu. One of them is a conical microblade core. Neither ground stone tools nor potsherds were found in association with them. The Heihe locality is more than 4300 m in altitude. This was the first time that microblade remains and flaked stone tools were discovered in the area (Qiu 1958).

b. Nielamu, Tibet

The Nielamu microblade site was discovered in 1966 by the Scientific Investigation Team of the Chinese Academy of Sciences to Tibet. The site, with two localities on the first terrace of the Qupohe, is located at the village of Yali, Nielamu County, on the southern slope of the Himalayan Mountains, about 4300 m above sea level. A total of 27 stone artifacts were found both from the upper calc-sinter sediment and on the surface. They include six microblade cores of wedge-shaped, semiconical, and conical forms, one scraper and some debitage. No radiocarbon dates are available. The site was tentatively suggested to be Mesolithic due to the absence of potsherds and ground stone tools (Dai 1972).

c. **Shenja and Shuanghu, Northern Tibet**

An inter-disciplinary survey conducted by the Qinghai-Tibetan Plateau Team of the Chinese Academy of Sciences in 1976 led to the discovery of 18 lithic localities bearing microblade remains and flaked stone tools in the Shenja and Shuanghu areas of northern Tibet. All these localities lie on lakeshore plains, river terraces and diluvial deltas at the foot of mountains, or the banks of ancient streams on the rims of basins. The altitude of these localities ranges between 4500 and 5200 m above sea level.

All the stone artifacts were collected from the surface. In addition, 19 microblade remains were donated by local residents who had collected them earlier from 11 localities at Shenja and two at Shuanghu. The collection consists of flakes and microblade remains which were obtained from 18 localities. They include 94 wedge-shaped, 48 conical and semiconical, 7 cylindrical cores, core fragments, some scrapers, and debitage. At Locality 8, five brown sandy potsherds were found with microblade materials. A piece of an iron arrowhead was also found. The authors suggest that potsherds and the iron arrowhead might belong to a later period than the microblades.

The dates of these microblade remains are unknown due to the absence of datable materials and contextual information. The authors suggest that these collections might belong to the Mesolithic or early Neolithic (An *et al.* 1982).

d. **Layihai, Qinghai**

In the summer of 1980, an extensive archaeological survey was conducted by a field team from Qinghai Province in the Gonghe Basin, upper Huanghe valley, in the eastern part of the province. Six microblade sites were found at Layihai, Guinan County, Hainan Tibetan autonomous district. The sites are located on the second terrace of the Huanghe about 70 m above the riverbed. A total of 1489 stone and bone items, including 39 microblade cores of wedge-shaped and conical forms, and 306 microblades, has been unearthed mainly from ash layers or hearths along with debitage and burnt bones. The Layihai assemblage was assigned to the Mesolithic based on technological characteristics while a single radiocarbon date gave an age of 6745±85 B.P. (Gai and Wang 1983).

4. Yunnan, Sichuan, and Guangdong, South China

Yunnan Province is situated on the southwestern Yunnan-Guizhou Plateau. It borders Tibet, Sichuan on the north, Guizhou and Guangxi on the east, and Vietnam, Laos and Burma on the west and south. The topography is characterized by highland and plateau. The average altitude is 4000 m above sea level. Sichuan is located on the upper reaches of the Changjiang. It borders Qinghai, Shaanxi on the north, Tibet on the west, Yunnan and Guizhou on the south and Hubei and Hunan on the east. The topography is characterized by a huge basin about 300-700 m above sea level on the east and the plateau about 3000 m above sea level on the west. Guangdong is the southernmost province in China and borders the South China Sea on the south. The topography is characterized by mountains and hills in the northwest and plains in the southeast. The altitudes average about 1000 m above sea level in the mountainous areas and less than 100 m above sea level in the hills and plains.

a. **Yuanmou, Yunnan**

A microblade locality in Yuanmou County was found in 1973 (Zhou and Zhang 1980). The lithic inventory, including three microblade cores of wedge-shaped and conical forms, scrapers, points, burins, and flake cores and debitage, was surface collected. The date of this assemblage is unknown.

b. **Zhongzhipu, Sichuan**

In the spring of 1990, one microblade workshop was discovered and investigated at Zhongzhipu, Guangyuan County, in the northern part of the province. More than 1000 lithic artifacts were collected from the surface. An extensive excavation was conducted during the fall of the same year, leading to the discovery of more than 10,000 microblade remains and other small stone artifacts. The lithic assemblage was unearthed from the upper part of the top layer about 30-60 cm in thickness.

According to the preliminary report, the lithic inventory includes more than 60 microblade cores of wedge-shaped, conical, cylindrical, and funnel-shaped form, abundant microblades and segments, side scrapers, end scrapers, core scrapers, and much debitage. The raw materials are mainly chert and a small amount of quartzite. Polished stone tools and red-brownish potsherds were also found. The age of the assemblage is tentatively assigned to the Neolithic. Radiocarbon dating results are pending (Wang 1991).

c. **Xiqiaoshan, Guangdong**

Xiqiaoshan, located at Hainan County, about 40 km southwest of Guangzhou, is a large quarry and lithic workshop excavated in 1958 by an archaeological team from Zhongshan University and the Guangdong Provincial Museum. From 1973 to 1974, four excavations concentrating on its geoarchaeological aspects were conducted. Excluding a spur which protrudes toward the southeast, the Xiqiaoshan site is almost 4 km in diameter and 13 km in circumference, covering a total area of 12 square kilometres.

The lithic artifacts at Xiqiaoshan are numerous, but stone cores are remarkably rare and complete stone tools relatively few. Most are preforms and debitage. In 1977, more than 1000 microblade remains, including microblade cores of wedge-shaped, conical, cylindrical and irregular form, were collected at the eastern foot of the hill. In addition, a large number of chipped and polished stone tools such as scrapers, projectile points, burins, backed knives, arrowheads, chipped stone axes, hammerstones, stone polishers, as well as polished stone axes and pottery were found.

The age of the site is still unclear. Some archaeologists suggest that it was occupied during the Mesolithic and early Neolithic given the predominance of chipped stone artifacts. However, because of the presence of a few sherds of impressed pottery, Zeng (1981) and Huang *et al.* (1982) have suggested that the Xiqiaoshan site should be assigned to the end of the Early Neolithic or the beginning of the Middle Neolithic periods. Radiocarbon dates at Xiqiaoshan range from 6000 to 4500 B.P.

5. Shandong and Jiangsu, East China

Shandong Province is located on the eastern North China Plain and the lower reaches of the Huanghe. It borders Hebei and Henan on the northwest and west, Anhui and Jiangsu in the south, and Bohai and Huanghai on the northeast and east. The topography is characterized by hills about 200-500 m in altitude, and alluvial plains less than 50 m above sea level. Jiangsu Province is situated on the southern part of the North China Plain and on the alluvial plain of the lower reaches of the Changjiang. It borders Shandong in the north, Anhui in the west, and Zhejiang in the south. Like Shandong, it is characterized by alluvial plains and a few hills. The average altitude is less than 50 m above sea level.

a. **Malingshan, Jiangsu**

Malingshan is a mountain range running from north to south. It extends over one hundred kilometres from Linyi County in Shandong Province to Suqian County, Jiangsu Province. In 1978, the Daxianzhuang microblade site at Donghai County in the northern part of the province was first discovered by Liu Zechun from Nanjing University. In 1979, an extensive investigation was conducted in the area by a team from the Provincial Culture Bureau, principally on the hill top of Malingshan about 90 m above sea level. This led to the discovery of 252 stone artifacts including 21 microblade cores of wedge-shaped, conical and boat-shaped forms as well as core fragments, 4 microblades, 12 end scrapers, 7 side scrapers, 5 arrowheads with round bases, 4 burins, 3 denticulates, 2 perforators, and abundant debitage. The age of the Daxianzhuang assemblage is unknown because it was surface collected. Based on the absence of potsherds and polished stone tools, however, it has been tentatively assigned to the Mesolithic age (Ge and Lin 1985).

In the spring of 1984, Zhang Zhufang from the Nanjing Museum conducted a further field survey covering an area about 3 x 20 km in northern Jiangsu Province along the middle section of the Malingshan. Many lithic sites containing microblade remains were identified, but only four yielded relatively abundant materials (Zhang 1985). Because of the similarity of the raw materials, lithic technology, and artifact attributes, the cultural remains from these four sites were treated as a single complex in the report. The collection consists of 159 stone artifacts, including 26 microblade cores of wedge-shaped, boat-shaped, cylindrical, and funnel-shaped forms as well as core preforms, 100 microblades, 9 end scrapers, 8 core scrapers, 5 side scrapers, 2 perforators, 1 arrowhead, and a few large flake tools and debitage.

Owing to the heavy erosion in this mountainous area, all prehistoric materials occur either in thin alluvial deposits or on the surface of the bedrock. The ages of these collections are unknown. On the basis of the absence of potsherds and polished stone tools, Zhang has suggested that they might belong to the end of the Upper Paleolithic.

b. **Fenghuangling, Shandong**

A microblade site was discovered in 1982 during a salvage archaeological survey for railway construction in the southern part of the province. The site is located on a small hill of sandy soil about 10-20 m in height called Fenghuangling, in Linyi County. More than 700 stone artifacts including microblade remains were collected on and around the hill in association with other chipped and polished stone tools, potsherds, and animal bones. The lithic inventory includes 17 microblade cores of wedge-shaped, boat-shaped, conical, cylindrical and funnel-shaped form, 25 microblades, many other stone tools such as side scrapers of various forms, end scrapers, burins, abundant debitage, and four polished stone tools. In addition, many Longshan phase potsherds were also found. The age of the site is unknown. Xu (1984) has indicated the cultural remains found at the site might have belonged to different periods.

c. **Yishui, Shandong**

In the spring of 1984, three months of field survey conducted in Yishui County, in the southern part of the province, led to the discovery of 27 localities with chipped stone tools and microblade remains. Most of the sites occur in an area of about 32 by 21 km along the Yihe. More than 300 stone artifacts were collected, including 16 microblade cores of wedge-shaped, boat-shaped and funnel-shaped forms, 3 microblades, and other stone tools such as end scrapers, burins, arrowheads, scrapers, choppers, and debitage. The age of these collections is unknown. Typologically, the microblade remains were reported to be very similar to those found at Fenghuangshan (Xu and Kong 1985).

d. **Junan, Shandong**

In 1987, two archaeological field surveys conducted by Yuan Xiaofeng, Xu Shubin and Wu Ruiji led to the discovery of two sites bearing stone tools, microblades, and other remains in Junan County, southern Shandong. One site called Yandunling is located on the second terrace of the Suhe. Stone artifacts were scattered on the surface. The other site, Lianhuashan, is located on the second terrace of the Bianshanhe. Most artifacts were discovered above the plough zone. A total of 151 stone artifacts were collected, including 4 wedge-shaped cores, some side scrapers, end scrapers, choppers, one burin, and much debitage.

Because they are surface collections, the chronological placement of these two sites is problematic. Based on the absence of potsherds and polished stone tools, Yuan, Xu and Wu (1989) suggested that they might belong to the end of Upper Paleolithic period.

e. **Heilongtan, Shandong**

The Heilongtan microblade locality is located on the western slope of Malingshan about 1 km on the south of Daxiangzhuang, Tancheng County which is a border town near Jiangsu. The locality was found in 1982. More than three hundred lithic artifacts, including 21 wedge-shaped, conical cores, 16 microblades, end scrapers, side scrapers, core scrapers, points, arrowheads, choppers, and debitage, were found in the top brownish-grey and yellowish-brown sandy soil of about 1.2 m thickness. The stone artifacts were made of quartz, chert, and jade. The age of the assemblage was suggested by the researchers to be the late Pleistocene due to the absence of pottery and polished stone tools (Xu and Xu 1986).

f. **Zhaike, Shandong**

In 1986 and 1987, extensive field surveys were conducted along the Yihe following the discovery of microblades in Yishui County in 1984. This led to the discovery of a microblade assemblage at the village of Zhaike, about 12 km south of the town of Yishui. A total of 250 microblade remains and other lithic artifacts were collected on the surface. The raw materials included quartz, chert, and jade. The lithic inventory contained microblade cores of wedge-shaped, boat-shaped, and conical form, microblades, side scrapers, end scrapers, points, burins, and perforators. The age of the assemblage is unknown. Based on the comparison of the lithic typology, the researcher suggests that the Zhaike assemblage may be closely related to the microblade assemblages found at Huanghua in Hebei, Daxianzhuang in Jiangsu, and Linyi, Tancheng in Shandong (Kong 1990).

6. Summary

Since the 1920s, microblade remains have been intermittently discovered throughout the vast area of China. Most sites and localities are concentrated in five northernmost provinces: Inner Mongolia, Xinjiang, Heilongjiang, Jilin, and Liaoning.

The provinces of Shaanxi, Shanxi, Hebei, and Henan in North China are well known for the discoveries of many important early to late Paleolithic and Neolithic sites. Since microblade remains were first discovered at Shayuan, Shaanxi in 1957, several Upper Paleolithic microblade assemblages were found in the 1970s, and similar industries were recovered from the vast area of the Loess Plateau in the west to the coast of Bohai and Huanghai in the east through the 1980s.

In the frontier region of Qinghai-Tibetan, microblade cores and many chipped stone tools were discovered for the first time in 1956. As more archaeological materials are discovered, it appears that microblade technology might have been important to prehistoric people in this region as well.

Microblade assemblages have also been reported in the southern provinces of Yunnan, Sichuan and Guangdong. The discovery of the Xiqiaoshan site in 1958 indicated that microblade remains occurred in the subtropical climatic zone. The abundant microblade remains found at Zhongzhipu, Sichuan, are particularly significant. This is the first large microblade site found in the Changjiang drainage.

A large number of new microblade assemblages in Shandong and Jiangsu on the eastern seaboard discovered during the late 1970s and the 1980s were regarded as having a close cultural relationship with their counterparts in North China, although their chronological placement is poorly known.

B. MICROBLADE RESEARCH IN CHINA

Since the first discoveries of microblades in the 1920s, large numbers of them have been found in China. In spite of this, however, the developmental history of this technology remains rather poorly understood because many of the discoveries lack adequate chronological and stratigraphic control. Chinese archaeologists have been concerned primarily with establishing the origin and geographic distribution of microblades; migration and diffusion have long been the favoured explanations for prehistoric cultural change. Before the 1980s, comparative studies traditionally focused on the gross morphological attributes of stone artifacts. Recently, however, increasing attention has been paid to technological attributes.

For a long time microblades were regarded as a component of typical Neolithic industries beyond the Great Wall region in North China and called the "Microlithic Culture." Except for a few examples, microblade industries of the late Pleistocene are still poorly known in Northeast China, Inner Mongolia, and Xinjiang. This may have been due to a shortage of qualified archaeologists specializing in Paleolithic research in these provinces. For example, there is only one archaeologist who is in charge of Paleolithic studies in Inner Mongolia. In contrast, the Neolithic industries containing microblade remains in these regions are more fully investigated and better understood. Unfortunately, Neolithic archaeologists focus only on pottery and polished stone tools, and pay little attention to associated microblade remains. This is because they think that microblade technology, using direct or indirect percussion to make stone tools, is a vestige of Paleolithic culture. Therefore, detailed reports on microblade remains of the Neolithic are extremely scarce.

A unilinear developmental approach has dominated archaeological analysis in China since the turn of the century. In the early 1950s, Pei Wenzhong first attempted to organize known microblade assemblages into a chronological sequence. He proposed three stages of microblade development in North China based on site distributions from north to south. They were Longjiang (Lung-Chiang), Linxi (Lin-Shi), and Chifeng, which corresponded approximately to the early, middle and late periods of the Neolithic (Pei 1954). This model was based on the assumption that microblade technology originated in the area of Lake Baikal and was brought southward by migrants who later became nomadic inhabitants of the grassland and desert region beyond the Great Wall.

During the 1970s, several assemblages were found, at Middle and Upper Paleolithic sites in North China, which led Jia Lanpo to hypothesize that at least two major, parallel lithic traditions had persisted from the Lower Paleolithic into the Neolithic period. One is called the Large Triangular Point and Chopper-Chopping Tool Tradition, or the Large Tool Tradition for short, that evolved into polished stone industries of the Neolithic. The other is the End-scraper and Burin Tradition, or the Small Tool Tradition, that evolved into the microlithic tradition of the Neolithic (Jia *et al.* 1972; Jia and Wei 1976).

Although it is commonly accepted that at least two broad and distinctive Paleolithic technologies coexisted in North China, it is hard to imagine that these separate Paleolithic traditions developed side by side for more than one million years without any exchange or contact. As yet, the archaeological record in this region is still not fine-grained enough to test such a model. Based on his research on cultural development, Jia made several observations regarding these two major traditions. As regards the Small Tool Tradition, Jia pointed out that lithic assemblages reveal a general trend toward reduction of tool size from early to late. In addition, the most diagnostic artifacts in microblade industries, such as points, end scrapers, perforators, burins, and arrowheads, characterize the Small Tool Tradition but are not found in the Large Tool Tradition.

The discovery of the Shiyu site in 1963 in Shuoxian County, Shanxi Province, led Jia and his colleagues to suggest that the industry found at this site represented the antecedent of the microblade tradition. The lithic inventory included bipolar and flaked cores, scrapers of various forms, end scrapers, burins, one small axe-like stone knife, and one arrowhead. One rather interesting artifact was a fan-shaped or wedge-shaped core, which showed a bifacially worked edge and a fluted surface (Jia *et al.* 1972). Technologically, this wedge-shaped core was probably an accidental product resulting from bipolar percussion rather than from purposeful indirect or pressure flaking. The absence of microblades is also of significance. Animal bone samples were radiocarbon dated at 28,945$\pm$1370 B.P (ZK-109-0) (Institute of Archaeology 1983:19). More contextual information is needed to properly assess the significance of this site.

In analyzing archaeological remains at the Xujiayao site, dated by the uranium series method to 100,000 years ago (Chen *et al.* 1982, 1984), Jia called attention to the similarities of inventories at Xujiayao and Shiyu. He mentioned that "if some advanced tools such as a wedge-shaped core, a small axe-like knife, and an arrowhead are excluded from the Shiyu Culture, the rest of the assemblage shows little difference from the tool inventory of the Xujiayao site" (Jia and Wei 1976:109-110, my translation). The tool inventory of Xujiayao included side scrapers, end scrapers, points, burins, perforators, stone balls, and related implements. Jia felt that several small proto-prismatic cores discovered at Xujiayao were of particular interest. Long and narrow flakes were removed from the perimeter of the platform, which consists of cortex or flake scars. Some platforms show traces of preparation. Jia proposed that these proto-prismatic cores may have developed into the cylindrical and conical cores of later microblade traditions. It should be mentioned, however, that a purely morphological comparison of artifacts does not constitute an adequate argument for cultural affinity. What is needed is more precise information to explain the origin and differences between conical and wedge-shaped cores in microblade manufacture. In addition, Jia also strongly favoured the migration and diffusion of microblade technology from Asia to North America (Jia 1978).

An Zhimin also preferred a unilineal approach to interpret cultural relationship between Asia and North America. An compiled the following chronology for migration and diffusion of the microblade tradition from East Asia to North America (An 1978:312):

China:	ca. 30,000 to 1000 B.P.
Outer Mongolia:	16,500 to 8500 B.P.
Southern Siberia:	18,000 to 5000 B.P.
Japan:	15,000 to 8000 B.P.
Kamchatka:	14,000 to 3500 B.P.
Yukon:	8000 to 3500 B.P.
British Columbia:	9000 to 3500 B.P.
Northwest Territory:	7000 to 4000 B.P.

Influenced by microblade research in Japan and North America, technological analysis gained popularity in the early 1980s. Taking advantage of a large collection of microblade cores and core fragments discovered at the Hutouliang site, Gai Pei has paid special attention to the technology and manufacturing process of wedge-shaped cores. He has argued that a dynamic typology of microblade cores is the most appropriate approach in microblade core classification. According to Gai, dynamic typology was first advanced by R. Schild (1969) and refers to a lithic classification based on analysis of the technological aspects of stone tool manufacture (see Gai 1984). On the basis of the analysis of 236 wedge-shaped cores, 54 core fragments, 15 core preforms, and 10 core tablets, Gai proposed four wedge-shaped core techniques, namely the Yangyuan, the Hetao, the Hutouliang and the Sanggan (Gai 1984; Tang and Gai 1986). Gai's definitions closely parallel the core techniques previously identified in Hokkaido. A description of these four techniques follows (Chen and Wang 1989:144):

(1) The Yangyuan Technique

> Natural chunks or thick flakes were unifacially worked to prepare a preform more or less D-shaped in cross section. A series of blows were directed from lateral edges to shape a flat platform, then longitudinal blows were delivered from front to back or a tablet was removed and stopped at a notch which was transversely prepared on the upper edge of the platform, thus creating an effective platform (Fig.3:2).

(2) The Hutouliang Technique

> By this technique, wedge-shaped cores were unifacially prepared to make the preform D-shaped in cross section. The platform was trimmed by transverse blows from one side and was usually bevelled. Rejuvenation of platform was a successive process carried out in the course of microblade reduction (Fig.3:3).

(3) The Hetao Technique

> This technique employs bifaces as core preforms. The platform is prepared by the removal of several ski-like spalls to shape a smooth plane passing through the entire lateral edge. Then microblades were detached from one end of the cores without any further

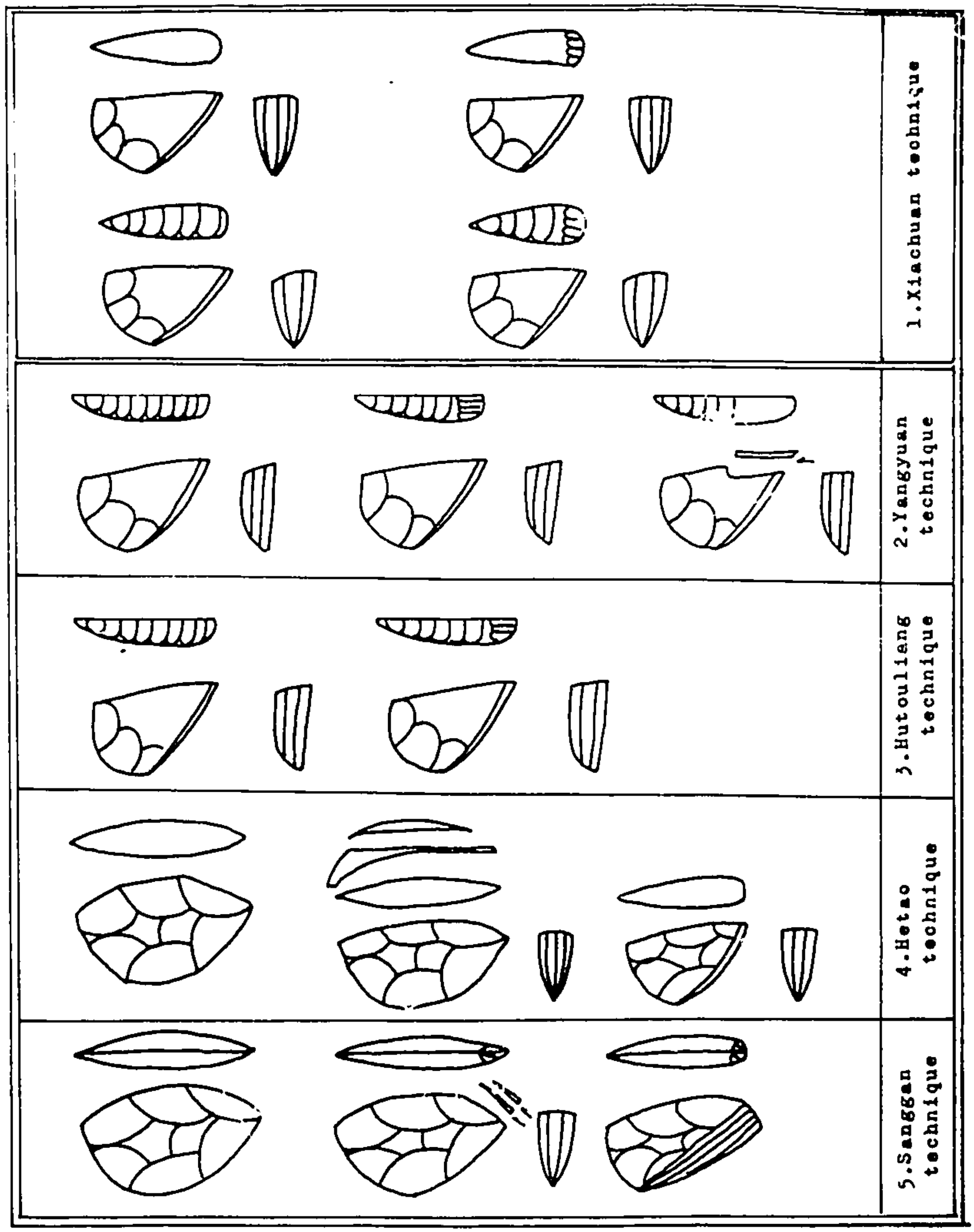


Figure 3: Wedge-shaped Core Techniques from the Upper Paleolithic Sites of North China

platform rejuvenation (Fig.3:4).

(4) The Sanggan Technique

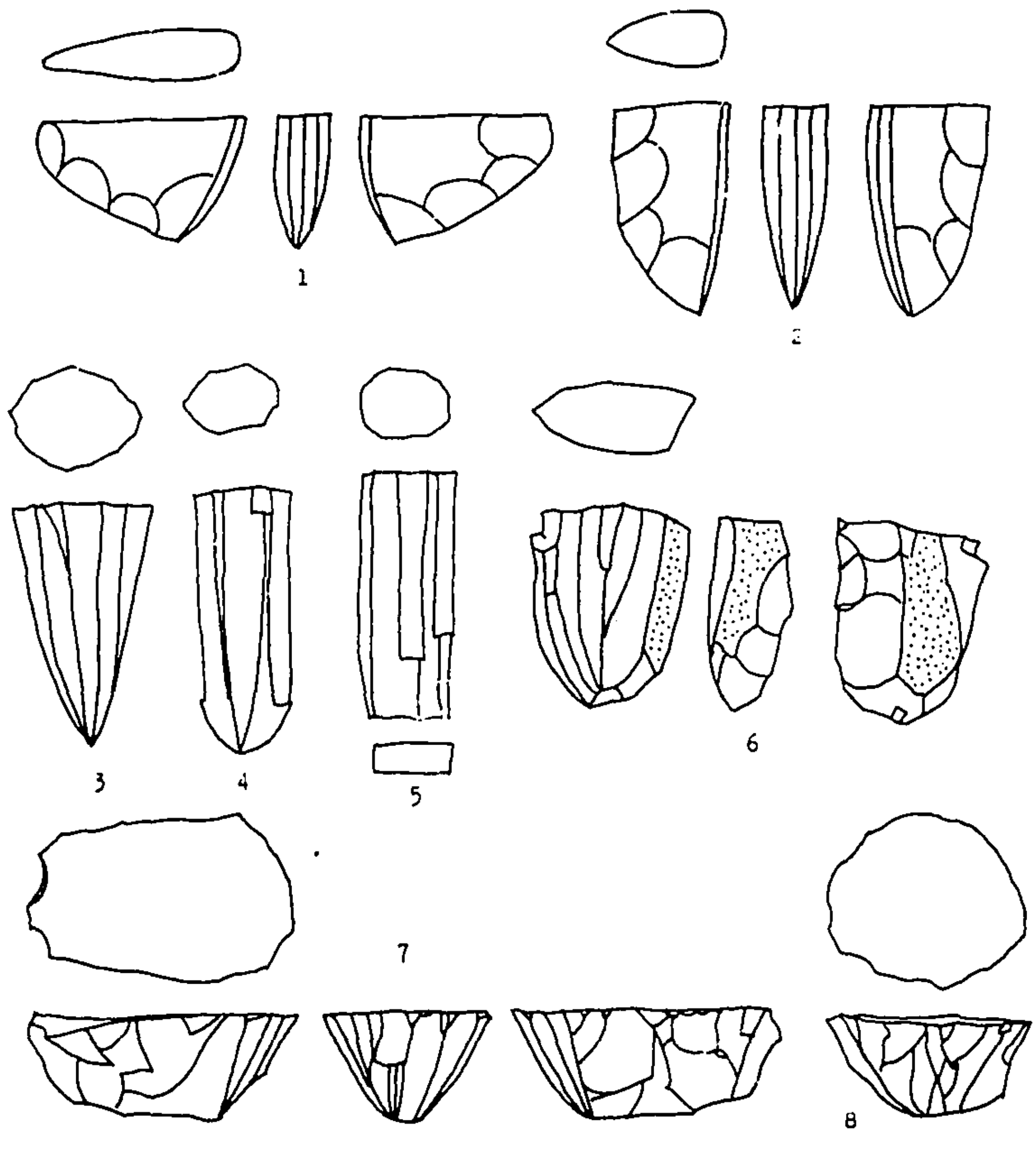
> Core preforms were bifacially worked to form a biconvex shape (like a biface). Small spalls were taken off the tip of the blank to form a narrow platform. Microblades were removed from the front of the platform. Successive rejuvenation of the platform was carried out during microblade reduction (Fig.3:5).

On the basis of the examination of the microblade cores found from Xiachuan, Xueguan and the comparison with those found in Japan, eastern Siberia, and North America, I identified six major types of microblade cores: wedge-shaped, boat-shaped, conical, semiconical (tabular), cylindrical, and funnel-shaped (Chen 1983) (Fig.4). Recently, Chen and Wang defined an additional Xiachuan technique based on wedge-shaped core technology at the Xiachuan and Xueguan sites:

> Small chunks or flakes were prepared unifacially or bifacially to form a keel edge. Natural planes (cleavage or flake scar) or transversely flattened surfaces were used as platforms and then trimmed from the front to adjust the edge angle (Chen and Wang 1989:145) (Fig.3:1).

Wang and Wang (1991) discussed five forms of microblade cores from the Xiachuan assemblage: conical, wedge-shaped, boat-shaped, cylindrical, and semiconical. This research is the extension of the excavation report of the Xiachuan site in 1978. and focuses on the relationship of forms and techniques of these cores. Like Kobayashi (1970) and Morlan (1970), they identified two manufacturing processes, whereby: (1) the facial element of the core was formed first, and (2) the platform element was formed first. They discussed dynamic changes of core appearance and verified that these core types are based on different manufacturing processes.

On the origin of microblade technology, Tang Chung (1989) has recently suggested that it may have originated in South China during the Middle Paleolithic period. Four stone chunks or cores bearing blade-like scars were found at the



1. broad-bodied wedge-shaped core 2. narrow-bodied wedge-shaped core
3,4. conical cores 5. cylindrical core 6. semi-conical or tabular core
7. boat-shaped core 8. funnel-shaped core

Figure 4: Schematic Drawings of Six Microblade Core Types

Guanyingdong site, a well-known Middle Paleolithic site in Guizhou Province (Li and Wen 1986). One artifact looks like a boat-shaped microblade core. Tang also mentions a core found in the Baiyanjiao cave, Puding County, Guizhou Province. This core contains two scars described by the authors as similar to the fluted scars of microblade cores. The Baiyanjiao assemblage was dated to the Upper Paleolithic with a range of radiocarbon dates from 14,630±220 and 14,220±200 to 12,080±200 and 11,740±200 B.P. (Li and Cai 1986:164). It seems still too early to confirm the southern origin of microblade technology on the basis of such isolated samples from small scale excavations.

In summary, Chinese archaeologists have primarily relied on a traditional culture-historical approach to interpret archaeological data. They have divided industries or sites into several groups, then established a cultural sequence or stages and traced lines of continuity and development according to their relative chronology.

C. MICROBLADE DISCOVERIES AND RESEARCH IN OUTER MONGOLIA

Outer Mongolia has remained relatively unknown archaeologically since the American Central Asiatic Expedition under the leadership of Andrews. These surveys are closely connected with the name of N.C. Nelson, the former Associate Curator of Archaeology, American Museum of Natural History, who joined the expedition staff in 1925.

The most important discovery of the expedition is the Shabarakh-usu site in the Gobi desert. The stone artifacts, especially the microblade remains were regarded by Nelson as resembling the Azilian industry in Western Europe. Two cultural strata were assigned to the Mesolithic and the Neolithic, respectively. The Mesolithic stratum contained numerous microblade cores and microblades described by Nelson as long, slender, and often very delicate. The upper stratum was Neolithic in age. Microblade remains and other chipped stone tools were found in association with potsherds. Nelson first named the wedge-shaped cores from Shabarakh-usu the "Gobi core" (Nelson 1926a,b).

In 1947, A.P. Okladnikov visited the Shabarakh-usu site and found that potsherds occurred in both strata. The lower stratum contained Neolithic potsherds with net and mat impressions. Therefore, a Mesolithic age for the lower component at Shabarakh-usu was rejected (Maringer 1963).

In 1960, a Soviet archaeological expedition reexamined Shabarakh-usu. It was confirmed that there are two cultural strata separated by a sandy deposit, and the lower one does not contain a "Mesolithic culture" as Nelson believed. This survey confirmed Okladnikov's 1947 observations (Chard 1961).

However, Maringer (1963) has questioned whether these two layers surveyed by Soviet scholars were the same as those investigated by the American expedition, because the presence or absence of potsherds is so obvious that it would hardly have been overlooked, especially since the American archaeologists' work there was apparently not merely a brief field survey. Maringer tended to believe the observations of the American scholars pertaining to the Mesolithic culture of the Gobi desert.

Other reports on the Paleolithic and the Mesolithic sites containing microblade remains in Outer Mongolia are extremely rare and fragmentary. One stratified site on the Orkhon River, near Erdeni-Dnu, was excavated by Okladnikov in 1960. Three levels were identified. The upper level yielded wedge-shaped and prismatic cores in association with heavy-duty artifacts made of pebbles. This level was assigned to the epi-Paleolithic or the Mesolithic (Chard 1962).

In 1961-1962 important achievements were made by the Soviet-Mongolian Expedition in Outer Mongolia. Several localities, regarded as Terminal Upper Paleolithic or possibly Mesolithic, were found on river terraces, 140 km to the south of Sukhe-Bator. Large numbers of flakes, microblades, prismatic and conical cores, and other remains were reported. In the Pestrol valley, not far from Tugriken-shiret, a site near an ancient lake contained wind-eroded hearths among the lower dunes which were surrounded by microblade cores, flakes, and blades (Chard 1964).

In 1967, a Mesolithic site was investigated by an archaeological expedition at Mt. Khereul on the Khalkin-Gol River, eastern Outer Mongolia. Microblades and cores, flake cores, and ski spalls were identified and described as very similar to preceramic Japanese ones (Chard 1971).

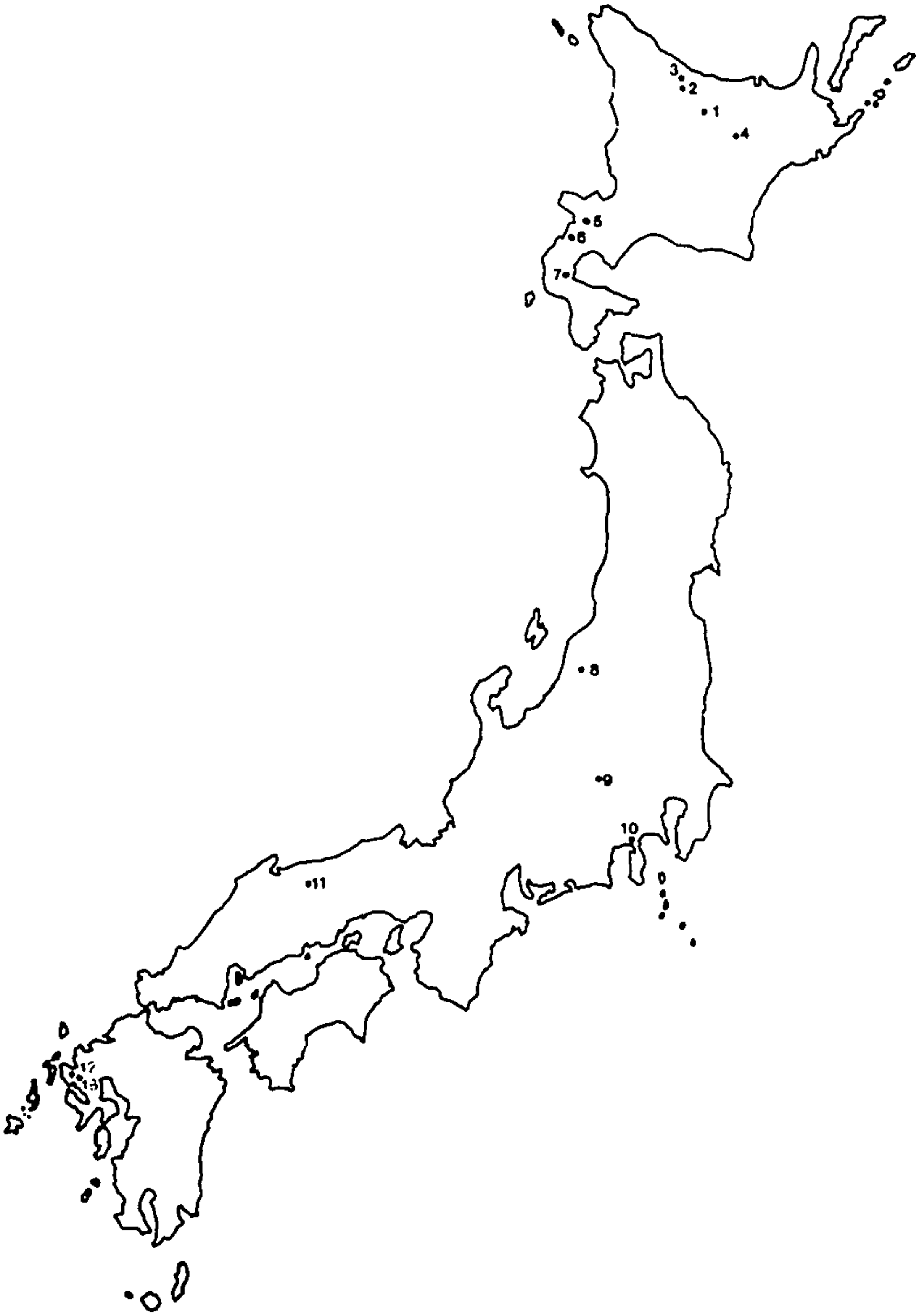
As in Inner Mongolia, microblade remains are widely distributed in Outer Mongolia but are limited to poorly dated sites. Most of them are surface collections from dune blowouts. Because very few sites or assemblages have been thoroughly explored, and detailed reports in English are not available, it is at present impossible to comment on the materials from this region.

D. MICROBLADE DISCOVERIES IN JAPAN

Microblade remains are widespread over almost all of the Japanese archipelago and persist from the late preceramic to the early ceramic periods (Fig.5). Microblade technology appeared in Japan approximately 14,000-13,000 B.P. and was abandoned in the early Jomon period (Aikens and Higuchi 1982; Ikawa-Smith 1980). Unfortunately, I am unable to present a comprehensive discussion of the discovery and distribution of microblade remains in Japan, as I do not read the language in which the original data are presented. The brief description of research presented here is based on current English-language sources.

As early as the 1930s. Yawata Ichiro called attention to the Mesolithic characteristics of Early Jomon artifacts, especially in the very small artifacts or "microliths" from Hokkaido and Nagano Prefecture. The artifacts, which Yawata called "Early Jomon," are now believed to belong to preceramic cultures (Serizawa and Ikawa 1960:2).

After the existence of the Paleolithic in Japan was firmly established by the excavation of the Iwajuku site in 1949, the problem of preceramic cultures became



1. Shirataki 2. Oshorokko 3. Sakkotsu 4. Okedo 5. Togeshita 6. Tachikawa
7. Towarubetsu 8. Araya 9. Yadegawa 10. Yasumiba 11. Onbara
12. Fukui Cave 13. Senpukuji

Figure 5: Distribution of Major Microblade Sites in Japan

a topic of serious discussion and investigation in Japan. The Yadegawa site in Nagano Prefecture was investigated twice by separate teams in the 1950s. The lithic inventory, which corresponded to the uppermost part of the loam bed, consisted mostly of microblades and conical cores (Serizawa and Ikawa 1960:3).

The materials similar to those from Yadegawa were also found at Yasumiba, in the city of Shizuoka, central Honshu. The excavation conducted in the early 1960s yielded many microblades and other specimens (Aikens and Higuchi 1982).

The Shirataki site was the most productive and best studied site found in the 1950s and is located on the system of five river terraces along the Yubetsu River and its tributaries, in and around the village of Shirataki in Monbetsu County, northeastern Hokkaido (Ikawa-Smith 1976; Morlan 1976a).

Many dated and undated microblade sites have also been found in Hokkaido. The Oshorokko site at the village of Nishiokoppe, Monbetsu County, yielded wedge-shaped cores of Oshorokko form, points, burins, blades, and handaxes.

Tachikawa I, at Rankoshi Town, Isoya County, southern Hokkaido, produced microblades, wedge-shaped cores of Oshorokko and Rankoshi forms, large blades, scrapers, knives, choppers, and variety of burins. Because of the absence of the Yubetsu technique at the site, an age comparable to that of the Oshorokko assemblage, about 12,300 B.P., was suggested for the Tachikawa I assemblage.

The Togeshita site at Kucchian Town, Abuta County, southwestern Hokkaido, yielded microblade cores of Togeshita, Yubetsu, Horoka, and conical forms. Blades, microblades, burins, and some ground-stone tools were also found. Most tools were attributed to the preceramic period, although no chronometric dates were available (Morlan 1976a).

In 1958, microblade remains were discovered at Araya, Nigata Prefecture, northern Honshu. More than 2000 stone artifacts were uncovered. Reinvestigation of the site is now under way (Aikens and Higuchi 1982; Serizawa and Ikawa 1960; Ikawa-Smith 1991 personal communication).

Fukui cave, located at Nagasaki Prefecture, northern Kyushu, was investigated and excavated several times during the 1960s under the direction of Kamaki Yoshimasa and Serizawa Chosuke. A single continuous stratigraphy reveals that microblade technology persisted from the preceramic to the early Jomon periods (Aikens and Higuchi 1982; Ikawa-Smith 1978).

From 1970 to 1979, systematic excavations were conducted in the Senpukuji Cave, Sasebo City, Nagasaki Prefecture, Kyushu, revealing the occurrence of microblade remains and very early pottery in a stratigraphic sequence very similar to Fukui Cave. Twelve cultural layers ranging from Paleolithic to historic periods were identified. Microblade remains were found from Layers 11 to 6. Wedge-shaped cores, microblades, thick biface blanks, spall flakes, and backed knives, which were all associated with pottery, were dated by various methods to 12,500 to 10,500 B.P. Layer 9, dated by the thermoluminescence method to 12,170±1170 B.P., 11,980±280 B.P., and 11,360±760 B.P., yielded wedge-shaped cores, core blanks, microblades, scrapers, stone axes, and pottery. Microblade remains were absent in Layer 4 and were replaced by typical arrowheads (Aikens and Higuchi 1982; Ichikawa and Nagatomo 1978; Ikawa-Smith 1980, 1986; Tang 1986).

Since 1984, large scale field surveys and excavations have been conducted at the Onbara site, Okayama Prefecture, southwestern Honshu. Wedge-shaped cores found from the top cultural layer M were made using the Yubetsu technique. Other stone tools include Araya burins, scrapers, and points (Inada 1990:248).

It is noteworthy that some backed blades, geometric in shape, were reported in Japan. Akazawa and others classify them into three categories: (1) pieces of either simple backed or backed form; (2) pieces of simple truncated, simple truncated with snapped end, truncated backed, or bitruncated form; and (3) points of simple backed, backed with a retouched base, bilaterally backed, or bitruncated form. These geometric backed blades occurred in the horizon below the microblade cultural layer at the Ishima site, which is situated on an island in the Inland Sea. Obsidian hydration dates obtained from the Nishiniodai and Maehara sites are 17,000 B.P. and 15,000 B.P., respectively (Akazawa *et al.* 1980:30,31, 91-95; Oda 1969:237-238; Serizawa and Ikawa 1960:47).

E. MICROBLADE RESEARCH IN JAPAN

Special attention has been paid by Japanese archaeologists to microblade technology, particularly on the analysis of core and platform preparation. As Hayashi (1968:128-129) argues, technology is most important to the reconstruction of prehistory, and technological analysis can provide a better basis for comparison than a statistical analysis which relies on mere morphological observation. He indicates that two technological aspects--production and consumption--were determined or constrained by cultural behaviour and traditions. Therefore, technology can be used to trace cultural relationships between different microblade assemblages or industries.

The best known wedge-shaped core technique is the Yubetsu technique, which was defined by Yoshizaki Masakazu in 1961 based on his study of cores, microblades and spalls from the Shirataki site in Hokkaido (see Morlan 1967a:177). This was the first core technique defined and reconstructed in terms of its manufacturing process (Fig.6:3). The definition of the Yubetsu technique had a significant impact on the study of microblade technology both in the Old and New Worlds.

Several other techniques were described by Morlan (1967a), including the Horoka technique, which he define based on his examination of microblade cores in Japan. Hayashi defined the Fukui technique on the basis of his study of reduction sequences of microblade cores from the Fukui cave assemblages of Kyushu (Fig.6:1).

Ambiru Masao (1969) lists five major techniques in his analysis of microblade cores in Japan. First is the Yubetsu technique which is subdivided into two core types: Shirataki and Sakkotsu. The difference between these two types is that the Shirataki core exhibits abrasions or striations on its effective platform.

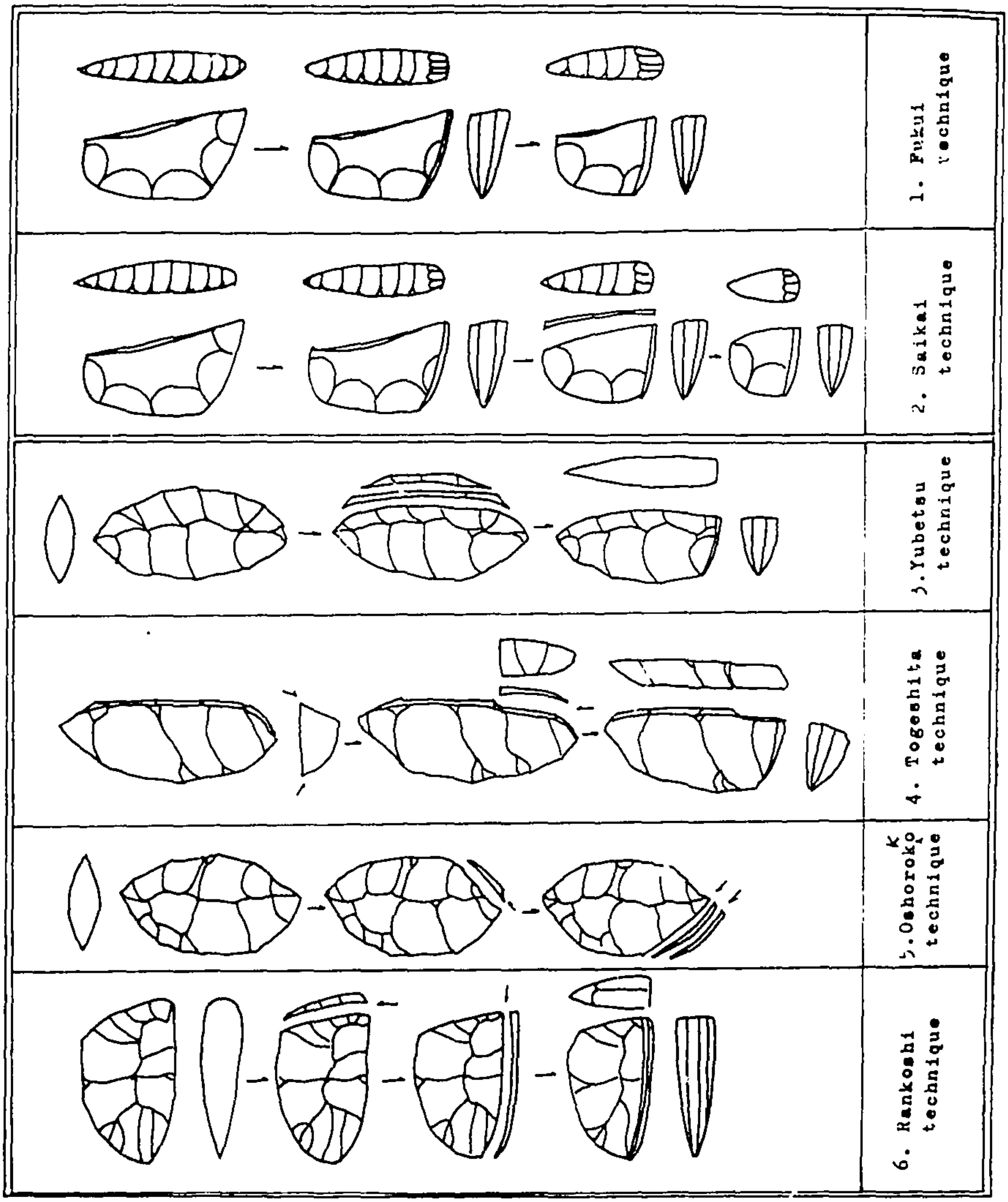


Figure 6: Wedge-shaped Core Techniques from Southern (1,2) and Northern (3-6) Japan

Second is the Togeshita technique (Fig.6:4). Third is the Saikai technique, which is equivalent to the Fukui technique defined by Hayashi (Fig.6:2). Fourth is the Horoka technique, which was named by Morlan. The fifth is the Yadegawa technique, which is a conical core technique identified at the Yadegawa and Yasumiba sites.

On the basis of his study of preceramic culture in the southwestern part of Japan, Oda Shizuo (1969) classified two technological categories of the Japanese archipelago. One is backed blade and the other is microblade, the former being earlier than the latter. Two main forms of microblade cores--conical and boat-shaped--were defined and subdivided into semi-conical and semi-boat-shaped forms. As regards the boat-shaped cores, Oda pointed out that two streams or separate developments could be followed, one with the Yubetsu technique, ranging from Hokkaido and Tohoku to the northern Chubu area, and the other with the Saikai or Fukui technique, spreading from northwestern Kyushu to the Inland Sea coast. As regards the conical cores, Oda also identified two main types, one conical or semi-conical, extending from Kanto and southern Chubu to Kyushu, (the Yadegawa site being its representative site), and the other exemplified by the beautiful conical cores found at the Okedo-Azumi and Momijiyama sites in Hokkaido. These microblade industries replaced backed blade industries in southwestern Japan. In Hokkaido, the tradition of microblades gradually faded out with the appearance of industries characterized by large artifacts, apparently associated with the change in vegetation.

In a more recent article, Oda and Keally (1979) divided the Japanese Paleolithic into four Preceramic Phases. Backed tools and microblades characterize Phases II and III respectively. They also suggest an *in situ* origin for conical and semiconical cores from Kanto to Kyushu, and a Siberian origin for wedge-shaped cores in Hokkaido.

Tsurumaru Toshiaki (1979) has described four major wedge-shaped core techniques in Hokkaido: Yubetsu, Togeshita, Oshorokko, and Rankoshi (Fig.6:5,6). In addition, he has named nine different core types after sites, defining them by various technological processes. There is some confusion about the techniques and core types in Tsurumaru's description. To most Japanese archaeologists, specific core types were produced by distinctive techniques. In Tsurumaru's definition, however, some core types seem to be produced by essentially the same technique with slight differences in certain processes of preparation and reduction, while others don't seem to have any corresponding techniques.

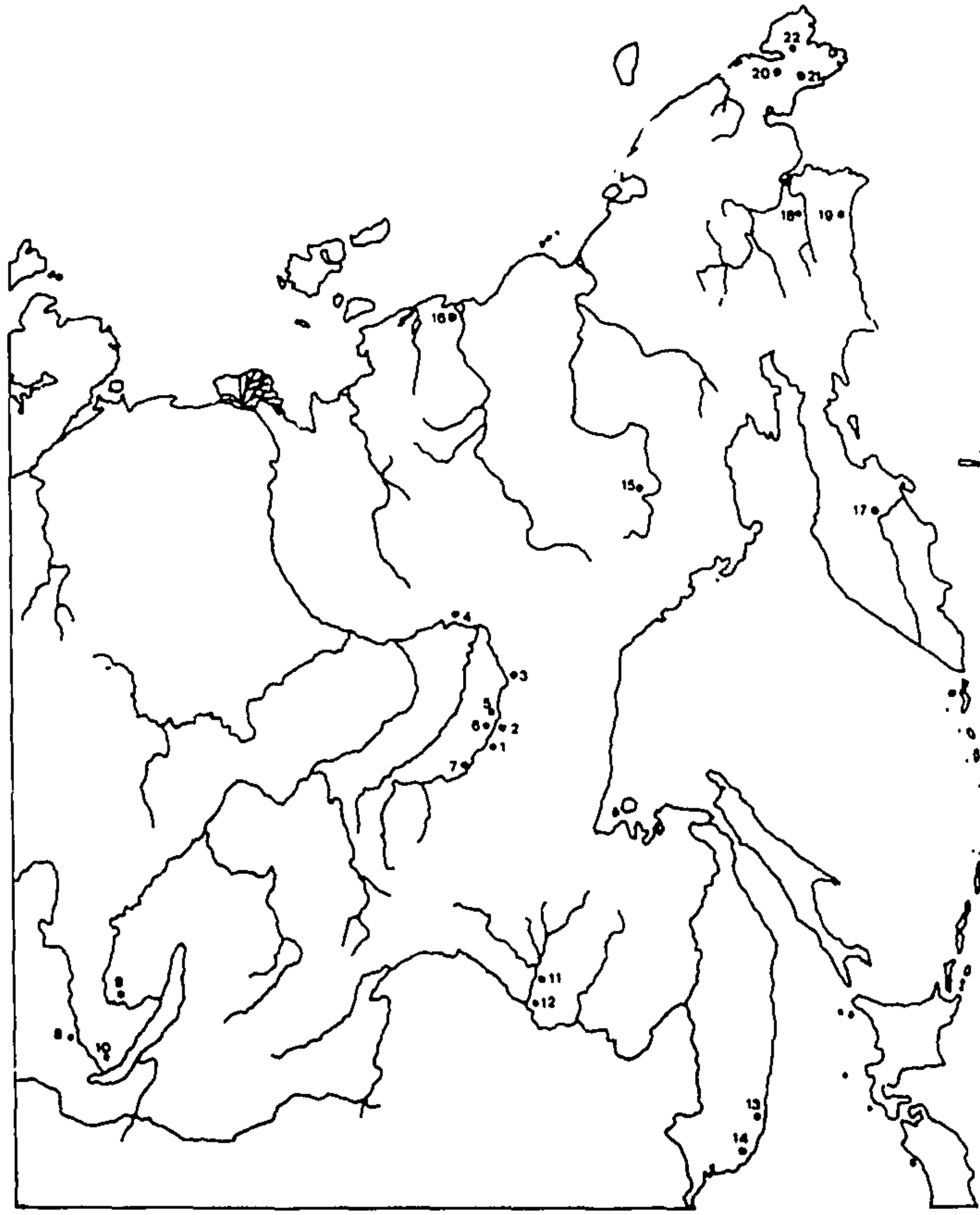
In her M.A. thesis research, I-Jen Chin-Yee (1980) analyzed the Yubetsu technical process and concluded that the Yubetsu technique is highly specialized and that there are no significant differences between the Shirataki and Sakkotsu cores, regarded by some archaeologists as representing different processes of the Yubetsu technique. She claimed that the presence of the Yubetsu technique in Hokkaido and Honshu was due to the spread or contact of microblade-using groups in Northeast Asia.

In summary, although there is some typological disagreement among Japanese archaeologists, their research has contributed significantly to microblade studies in Japan and beyond.

F. MICROBLADE DISCOVERIES IN EASTERN SIBERIA

Eastern Siberia, as discussed here, includes both eastern Siberia and the Russian Far East (Fig.7). It covers the area east of the Yensei River to the coast of the Okhotsk and Bering Sea.

On the basis of the evidence available at present, we may consider the distribution of microblade sites in eastern Siberia within three major geographic regions: (1) the Lena Basin, (2) the Amur River valley and the Maritime Territory, and (3) the Northeast.



1. Dyuktai cave 2. Verkhne-Troitskaya 3. Ezhantsy 4. Ikhine 5. Ust'Mil
6. Bel'Kachi 7. Tumuluur 8. Ust'Belaya 9. Makarovo 10. Verkholenskaya Gora
11. Gromatukha 12. Novoptrovka 13. Ustinovka 14. Osipovka 15. Maiorych
16. Berelekh 17. Ushki 18. Talyain 19. Inas'Kwaam 20. Kymynanonvyvaam
21. Kurupka 22. Chaatamye

Figure 7: Distribution of Major Microblade Sites in Eastern Siberia

1. The Lena Basin

The Lena Basin refers to the area consisting of the Cis-Baikal region and the upper and middle reaches of the Lena and Aldan Rivers.

a. **Verkholenskaya Gora**

Verkholenskaya Gora was the first microblade site to be found in eastern Siberia. There, in 1895, M.P. Ovchinnikov picked up some flakes in a ploughed field. The first excavations were conducted in 1923, and from that time until 1928, investigations were carried out fairly regularly. From 1934 to 1953, the site was restudied by many archaeologists and geologists. Intensive excavations at Verkholenskaya Gora were conducted in the summer of 1959 under the direction of M.M. Gerasimov. These excavations provided a more accurate definition of the site. Medvedev (1964) determined that the site was a colluvial deposit on a riverine terrace and represented basically a single layer which can be assigned to the Mesolithic.

From 1963 to 1965, new surveys were conducted at Verkholenskaya Gora by Irkutsk University and the Irkutsk Museum. Three clear horizons of the Iron Age, Mesolithic, and Upper Paleolithic were identified. The microblade remains appear to belong to the Mesolithic, dated to between 10,000 and 9000 B.P. In 1966, further excavations were conducted on the summit of a hill 500 m from the original excavation. It was called Verkholenskaya Gora II and yielded wedge-shaped and prismatic microblade cores and other stone tools (Chard 1971). The age of the site is a matter of debate, and it contains a number of assemblages representing different periods.

b. **Makarovo I and II**

In 1941, A.P. Okladnikov discovered Makarovo I in the area of the Upper Lena within the Cis-Baikal region. In 1966, an expedition of the Irkutsk Provincial Museum under the direction of M.P. Aksenov re-excavated the site. Five layers were identified. Layer IV, which was dated to the Mesolithic, yielded one wedge-shaped core, many stone artifacts, and mammalian and fish bones. Aksenov claimed that Makarovo I was similar to Verkholenskaya Gora.

In 1967, Makarovo II was discovered by the geologist S.M. Tseitlin about 100 to 120 m east of Makarovo I. In 1968 and 1969, the site was surveyed and excavated by the Lena Archaeological Team under the direction of M.P. Aksenov. Four distinct cultural layers were identified ranging from Upper Paleolithic to Neolithic. Microblade remains were the main component of the Mesolithic and Neolithic layers. They were thought by Aksenov to be similar to the middle Mesolithic finds of Verkholenskaya Gora (Powers 1973).

c. **Krasnyi Iar**

In 1957, the Bratsk Archaeological Expedition under the direction of Okladnikov discovered Krasnyi Iar on the upper Angara, a short distance downstream from the mouth of the Ob River. The site is located on the third terrace of the river, about 16-20 m above the riverbed. Extensive excavation in 1959 led to the discovery of two cultural complexes. Microblade remains occurred in both upper and lower components (Abramova 1965; Michael 1984). In 1964 and 1965, Krasnyi Iar was reinvestigated by Irkutsk University. Hearths, microblades, wedge-shaped cores, and other artifacts were unearthed from two lowest levels, VI and VII (Chard 1971, 1974; Medvedev 1969a).

d. **Ust'Belaya**

Ust'Belaya is a Mesolithic site located on the Belaya River near its confluence with the Angara. It is on the first terrace about 6-7 m above the riverbed. It is one of the best studied sites in the Angara basin. From 1958, Ust'Belaya was investigated and excavated. Sixteen Mesolithic cultural layers were identified by Medvedev ranging from the Mesolithic to the Bronze Age. Microblade remains dominated the stone artifacts. In addition, scrapers, whetstones, punches, awls, arrowheads, chopping tools, some polished stone tools, and many bone artifacts such as points, knives, fishing hooks, needles, and ornaments were found. Two radiocarbon dates, 8960±60 B.P. (GIN-96) for Levels III and IV and 9850±500 B.P. (GIN-483) for Level XIII, are available for the site (Medvedev 1969b; Michael 1984).

The years 1963 and 1964 saw the conclusion of eight years of work at Ust'Belaya. Chard (1971) reported that microblades and cores were the principal components of the assemblage, and that there was a gradual replacement of conical to wedge-shaped cores in microblade production.

e. **Ikhine I and II**

Ikhine I and II were discovered by Yu. Mochanov in 1963 and 1966, respectively. They are located on the Aldan, 284 km upstream from its confluence with the Lena. Only one wedge-shaped core, a few stone tools, and flakes were found with some animal bones (Mochanov 1978a, 1980, 1986; Michael 1984; Power 1973; Tseitlin 1979).

f. **Tumuluur**

In 1965, one microblade assemblage was discovered at Tumuluur on the Aldan by a team from the Aldan Archaeological Department of the Yakutsk-Branch under the direction of Mochanov. The site is located on the Aldan River 1449 km upstream from its confluence with the Lena (Michael 1984; Powers 1973).

g. **Dyuktai Cave**

Dyuktai cave was discovered and excavated in 1967 by a field crew of the Lena Archaeological Expedition of the Yakutsk Branch under the direction of Mochanov. The site lies on the Dyuktai River, 112 km from the Aldan. Fourteen cultural layers (I-XIV) were identified extending from the Upper Paleolithic to early Iron Age. About 10,000 stone artifacts were recovered from the cave, including microblade remains and many other stone tools. In addition, one point made of mammoth ivory was also found. According to Powers, the blade industry at the

Dyuktai cave is weakly developed. Most stone artifacts were made on pebbles or pebble fragments (Mochanov 1978a, 1980, 1986; Powers 1973; Tseitlin 1979).

h. **Ust'Mil II**

The Ust'Mil II site was discovered by Mochanov in 1968 at the mouth of the river Mil, a tributary of the Aldan. The Upper Paleolithic finds, which were embedded in the third terrace 16-18 m above the mean river level, included a small wedge-shaped core, a few worked stone artifacts, and a transversely split mammoth bone (Mochanov 1978a, 1980, 1986; Michael 1984).

i. **Verkhne-Troitskaya**

Verkhne-Troitskaya, discovered by Mochanov in 1970, is located on the middle Aldan 10 km from the mouth of the Mai River, and 2.5 km above the village of Troitskaya. Wedge-shaped cores and some stone and bone artifacts were found in association with mammoth, rhinoceros, and horse remains (Michael 1984; Mochanov 1978a, 1980, 1986; Tseitlin 1979).

j. **Ezhantsy**

The Ezhantsy site, found by Mochanov in 1970, is located on the Aldan, 45 km down stream from the mouth of the river Mai. It is situated on the third terrace 16-18 m above the river level. Wedge-shaped cores, other stone tools and flakes, and many animal bones were found (Mochanov 1978a, 1980, 1986; Michael 1984).

k. **Bel'kachi**

Bel'kachi was found and excavated in 1964 by the Aldan Archaeological Expedition, Yakutsk Branch under the direction of Mochanov. The site is located on the middle reaches of the Aldan, 1 km above the mouth of the Ulakhan-El'ge River at the southwest edge of northern Bel'kachi. The cultural layers lie in the flood plain facies of the high flood plain of the Aldan.

Twenty-three cultural layers were identified by Mochanov (see Tseitlin 1979:11). The most ancient is the Sumnagin Culture with C14 dates approximately ranging from 9190±80 (LE-763) to 5900±70 B.P. (LE-678). This preceramic component was thought to represent a "single cultural complex." Microblade remains, characterized by conical and cylindrical cores, as well as many stone and bone artifacts were discovered. Some of them occurred around hearths (Powers 1973).

2. The Amur and Maritime Territory

The region referred to here as the Amur and Maritime Territory is the southern part of the Russian Far East. The area comprises the Amur Province, the southern part of the Khabarovsk Territory, and the Maritime Territory.

a. **Osipovka**

In 1927 and 1928, a team of the east Siberian Branch of the Russian Geographical Society and Irkutsk University under the direction of M.M. Gerasimov discovered eight sites near Khabarovsk, just below the confluence of the Ussuri and the Amur Rivers. Two of them were said to have "Paleolithic characters." One is the Osipovka site. Four geological layers were identified. Stone artifacts, but no pottery and no faunal remains, were recovered from the third layer, about 75-100 cm below the surface. The stone inventory included wedge-shaped cores, microblades, bifacial leaf-shaped knives or points bearing what was described as "Solutrean" retouch, scrapers, burins, pointed tools, and an adze-like implement made on a pebble.

More recently, Osipovka and sites similar to it in the Khabarovsk region have been integrated into the Osipovka Culture. This culture is considered to be Mesolithic, although at present no chronometric dates are available. Derevianko suggested that these materials might be dated to the Early Neolithic or between 10,000 and 8000 B.P. (Michael 1984; Powers 1973).

b. **Ustinovka**

Ustinovka, discovered by V.F. Petrun in 1954, is located on the Tadusha River at a distance of 30 km above its mouth and 4 km below the village of Ustinovka. The site was systematically excavated by A.P. Okladnikov between 1963 and 1968. Five geological layers, from the top to the bottom, were separately identified by Okladnikov and M.N. Alekseev, however, their layer designations do not exactly correspond to each other. Stone artifacts were concentrated in two layers. One, which Alekseev considered to be Mesolithic, is immediately below the turf in Layer 1. The other is in Alekseev's Layer 3 or Okladnikov's Layer 4, which Okladnikov thought to be Upper Paleolithic.

The lower cultural level, or Ustinovka I, yielded 1470 objects, including "epi-Levallois" cores, wedge-shaped cores, microblades, stone tools, and debitage.

The upper cultural level, or Ustinovka II, yielded "epi-Levallois" cores, sub-prismatic and prismatic cores, other stone tools, and debitage. The prismatic cores in this level are not microblade cores at all.

In spite of these differences between Ustinovka I and II, both Okladnikov and Derevianko viewed them as belonging to a single culture. No radiocarbon dates are available for the site. Derevianko suggested that Ustinovka I dates to about 20,000-15,000 B.P., and Ustinovka II 15,000-9000 B.P. (Michael 1984; Tseitlin 1979; Powers 1984).

c. **Novopetrovka**

Novopetrovka was discovered in 1962 by the Far Eastern Archaeological Expedition under the direction of Okladnikov. Work in the area was continued in 1963. The site is located on the Amur River near the village of Konstantinovka. The site consists of a workshop and several dwellings.

The workshop was situated in the northern corner of the excavation. At a depth of 40 cm, in a layer of sand, an accumulation of stone artifacts was found together with three stone anvils. The artifacts include two wedge-shaped and one conical core, microblades, tools made on microblades, other stone tools, and debitage. Two dwellings yielded wedge-shaped and cylindrical cores, microblades, and other stone artifacts (Derevianko 1965, 1969).

Okladnikov defined a Novopetrovka Blade Culture based on the fact that most artifacts were made from blades and microblades. Novopetrovka was first dated by Derevianko to the Mesolithic in 1965. Afterwards, it was dated to the Early Neolithic Age due to the presence of pottery (Chard 1974; Okladnikov 1969).

d. **Gromatukha**

Gromatukha, discovered by Okladnikov in 1966, is located on the Gromatukha River at its junction with the Zeia River. The lithic industry contains prismatic and conical microblade cores, microblades, arrowheads, end scrapers, laurel-leaf knives, and some heavy duty artifacts. The assemblage was dated to the Early Neolithic (Chard 1971; Michael 1984; Powers 1973), although Chard (1974) suggests that the Gromatukha Culture was probably more recent than the Novopetrovka.

3. The Northeast

This region is located in the northeastern most part of the former U.S.S.R., including the Chukchi and Kamchatka peninsulas.

a. **Ushki Lake**

The Ushki Lake sites, discovered by N.N. Dikov in 1961, are located in central Kamchatka. Four localities, Ushki I, II, IV, and V were found on the southern shore of Lake Ushki. According to Dikov's recent report (1987), several Paleolithic sites were found in the extreme east of the Chukchi peninsula. All of them contain wedge-shaped cores. Dikov mentions that they were closely similar to the Upper Paleolithic Ushki Culture in Kamchatka.

b. **Berelekh**

Berelekh was found in 1970 by the Lena Archaeological Expedition of the Yakutsk Branch under the direction of Mochanov. The site is located on the Berelekh River, a tributary of the Indigirka River. Situated at 71 degrees north latitude, it is the northernmost Paleolithic site in the world.

The site lies on the second terrace. The position of the cultural layer is not clear. It was described by different authors as occurring between 1.5 and 2.5 m below the surface. Paleolithic artifacts include wedge-shaped cores, microblades and other stone tools.

The radiocarbon dates from the site look confused owing to their reversed sequence. Two C14 dates obtained from the upper and lower parts of the section are 11,830±110 (LU-147) and 12,240±160 B.P. (LU-142) respectively. The samples obtained from the middle part of them yielded three ^{14}C dates of 10,600±90 (LE-938), 12,930±80 (GIN-1021), and 13,420±200 B.P. (IM-152) (Powers 1973; Tseitlin 1979).

c. **Maiorych**

Maiorych was found in 1970 by the Lena Archaeological Expedition under the direction of Mochanov. It is located on a small stream called Maiorych which is a tributary of the Kolyma River. One wedge-shaped core and a few stone tools and flakes were found on the surface (Michael 1984; Powers 1973).

G. MICROBLADE RESEARCH IN EASTERN SIBERIA

The introduction to microblade research in eastern Siberia that can be provided here is very superficial owing to the inaccessibility of up-to-date and original sources. According to the data available at present, microblade research in eastern Siberia conducted by Soviet archaeologists has mainly attempted to establish regional chronologies and developmental stages.

As early as the 1960s, Okladnikov (1961:486) assumed that the trans-Baikal region might be an area where the blade tradition of European origin and the pebble tool tradition of eastern Asian origin had been in contact from the earliest period. Since several microblade sites with very early radiocarbon dates were found in the Aldan region, the close similarity of their lithic inventories led Mochanov to conclude that they must have represented a distinctive cultural unit, the Dyuktai Culture, which he believed was flourishing in eastern Siberia during the late Pleistocene. The technology of the Dyuktai Culture, according to Mochanov, included bifacial knives and spear points, Levallois and wedge-shaped cores, massive *skreblos*, various burins, end scrapers, and a spear point made from mammoth ivory (Mochanov and Fedoseeva 1986:670; Powers 1973:69).

The age of the Dyuktai Culture was originally thought to range between about 18,000 to 10,000 B.P. Then its age was extended back in time by Mochanov as a result of the discoveries and early radiocarbon dates obtained from Ikhine, Ust'Mil II, and Ezhantsy. Mochanov established a sequence of the Pleistocene sites of the Aldan as follows:

Proto-Dyuktai: Ezhantsy, Ikhine II(B,C), Ust'Mil II(B,C);

Dyuktai: Ikhine I (A), Verkhne-Troitskaya, Dyuktai Cave (A,B,C); Ust'Mil (A) Berelekh, Ushki (5-7) (Mochanov 1978a, 1986).

Mochanov also suggested that: (1) the Dyuktai Culture was formed in the region between the Huanghe and the Amur Rivers (Heilongjiang) about 40,000-35,000 B.P.; (2) it occupied the area of the middle Lena basin about 35,000 B.P.; (3) it finally migrated to the New World about 25,000 B.P.; and (4) about 10,500 years ago, the Dyuktai Culture disappeared and was replaced by the Sumnagin Culture (Mochanov 1980:127,128).

Mochanov's proto-Dyuktai Culture or early chronology of the Dyuktai Culture was challenged by Yi and Clark (1985:7-10) from a techno-typological and geochronological perspective. Yi and Clark pointed out that Mochanov's early dates of the Dyuktai Culture were partly derived from the geological survey of S.M.

Tseitlin. In the late 1970s, reexamination of the stratigraphy at Ikhine II and Ust'Mil led Tseitlin to conclude that Ikhine II was older than 30,000 B.P.

Yi and Clark suspected that this conclusion was incorrect. They argued that at Ust'Mil, Dyuktai artifacts occur both above and below the disconformity in Mochanov's Beds 3 and 4. In the temporal span from 23,500 to 12,000 years, there is no discernible change in the character of the lithic assemblage across this disconformity. Therefore, geological agencies may have been responsible either for the movement of the artifacts themselves or for the translocation of the dated materials. In other words, erosion, solifluction, tectonic, and cryogenic disturbances could have translocated artifacts and fossil wood into the early strata. Hopkins (1985:372) shared the opinion that Ust'Mil II and Ikhine could be detrital sediments of wood, fossils, and lithic remains enclosed in alluvium.

Yi and Clark also pointed out that except for Dyuktai cave, the number of artifacts found from the proto-Dyuktai sites was extremely small. This lead to a consideration of possible effects of geological process during the site formation and post depositional dispersion.

The microblade assemblages found in the Amur-Maritime Territory are still too small to provide a clear picture of late Pleistocene technological development. The beginning of the heavy use of blades and microblades is exemplified by Ustinovka I. Many wedge-shaped cores and core blanks were found in this horizon. Wedge-shaped cores were conspicuously absent in the upper horizon, Ustinovka II, and were replaced by prismatic cores which were very rough in appearance. Another microblade site, Osipovka, contrasts sharply with Ustinovka with respect to a heavy reliance on bifacial points or knives. These two sites were considered by Russian scholars to represent two distinctive cultures.

The development of microblade technology in the Kamchatka and Chukchi peninsulas is based primarily on the stratified sequence at the Ushki Lake sites. Dikov (1978:68) suggested that well stratified Paleolithic sites at Ushki Lake revealed at least two distinct Paleolithic complexes belonging to different ages: one from Layer VII, the other from Layer VI. Dikov argued that these complexes apparently correspond to two ethnic migration waves of the peopling of America. Dikov saw a link between the assemblage from Layer VII, characterized by stemmed arrowheads, spears, and knives, and the Paleo-Indian culture, especially with a stemmed point from Marmes Rockshelter in Washington State. Dikov suggests that the assemblage from Layer VI, represented by wedge-shaped cores and narrow leaf-shaped points, may be related to the proto-Eskimo-Aleut culture in Alaska.

In his earlier studies, Dikov (1965) preferred a Hokkaido origin for the microblade culture of Ushki Lake, and postulated a diffusion route on which wedge-shaped cores were originally derived from central Asia and spread to Japan, then penetrated to Kamchatka, and finally reached Alaska. This model was then revised by Dikov (1978) who suggested that wedge-shaped cores in the lower layers of the Ushki Lake sites were derived neither from the preceramic Japan nor from the Aldan valley but rather from southern Siberia.

In contrast, Mochanov considered layers V and VI at Ushki to represent the concluding stage in the development of the Dyuktai Culture. He argues that the area of the Dyuktai Culture covers the territory to the east of the Lena, to the north of the Amur, including Kamchakta as well as the island of Sakhalin and a large part of Hokkaido (Mochanov 1980:127; Powers 1973:71).

In summary, different views are held by Russian archaeologists pertaining to the origin of late Pleistocene cultures and microblade technology in eastern Siberia. For example, Okladnikov (1961:486) was of the opinion that the Siberian blade tradition might be Eurafrican in origin. Mochanov (1980:128) proposed that the area between the Huanghe and the Amur River was probably the cradle of the Dyuktai Culture. In contrast, Derevianko (1978:70) suggested that blade technology was formed on a foundation of the late Levallosian tradition in the region of eastern Mongolia, Trans-Baikal, and in the southern Far East about 20,000 years ago.

H. MICROBLADE DISCOVERIES IN NORTH AMERICA

Although microblade remains are widespread throughout the Arctic and sub-Arctic regions of North America, microblade assemblages with relatively early dates are found mainly in Alaska and the Pacific Northwest (Fig.8). This section will focus on the assemblages that are considered to be closely related to those in northeast Asia.

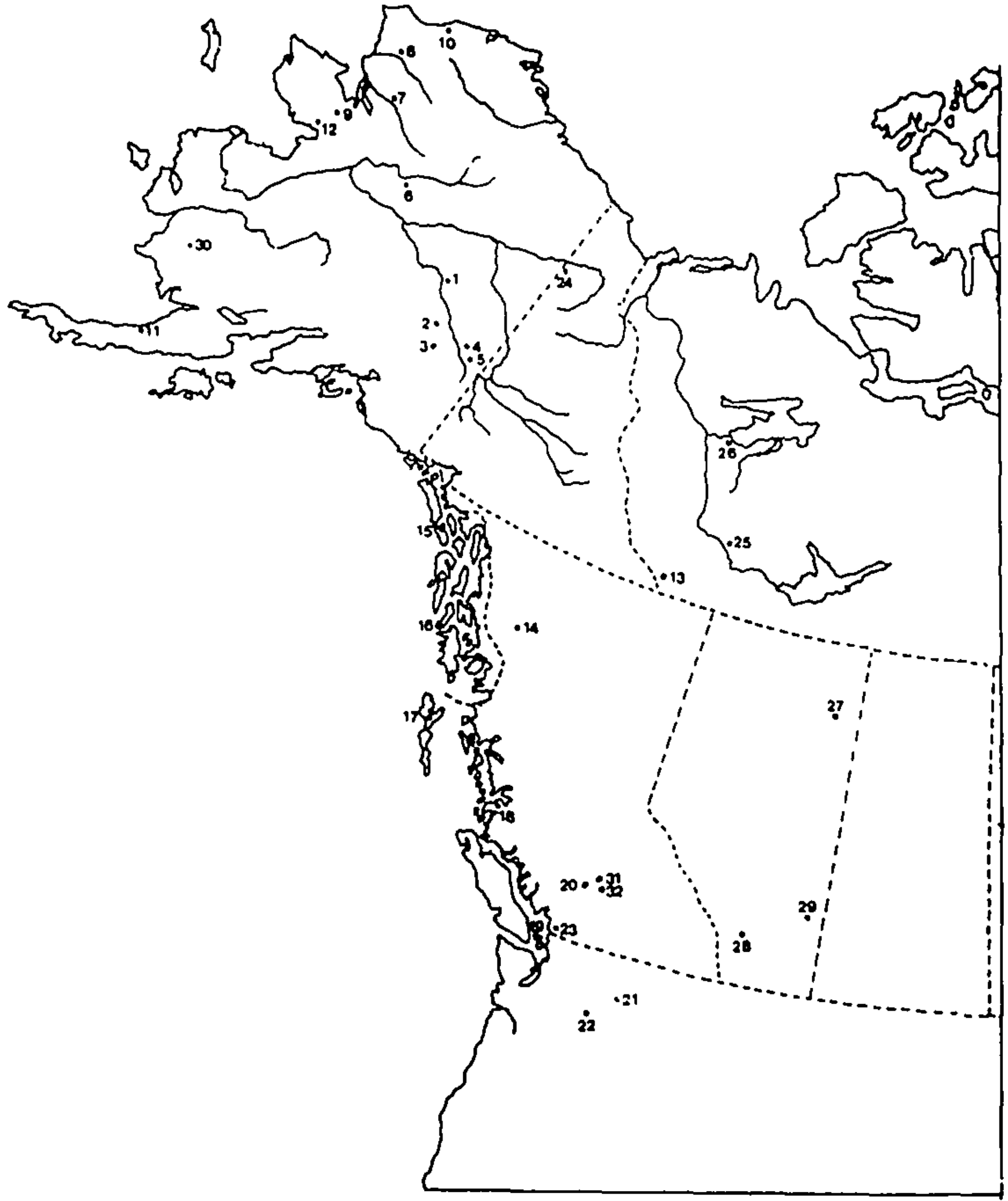
1. Alaska

a. **Campus site**

The discovery of the Campus site in Alaska in 1933 marks the beginning of microblade research in North America. The excavations supervised by Dr. C.E. Bunnell and conducted by J.B. Dorsch in 1934 and 1935 led to the recovery of microblades and cores. N.C. Nelson (1935, 1937) called attention to the wedge-shaped cores, which he felt were remarkably similar to several thousand specimens obtained by the American Central Asiatic Expedition of 1925 and 1928 from Mongolia (Nelson 1935, 1937). Recently, a comprehensive study of the Campus site has been published (Mobley 1991).

b. **Dixthada**

Dixthada is located near the present Mansfield Village by the confluence of the Tanana and Yukon Rivers (Rainey 1940; West 1967). Stone artifacts found in the lower level were thought by Rainy to be related to some of artifacts at the Campus site. Only one single radiocarbon date of 2500 B.P. was given to this microblade industry (Dixon 1985:49).



1. Campus site 2. Dry Creek 3. Donnelly Ridge 4. Healy Lake 5. Dixthata
6. Batza Tena 7. Akmak 8. Noatak Drainage 9. Trail Creek 10. Small Sites
11. Ugashik 12. Denbigh 13. Pointed Mountain 14. Ice Mountain
15. Ground Hog Bay 16. Heceta Island 17. Queen Charlotte Islands 18. Namu
19. San Juan 20. Lochnore-Nesikep 21. Windy Springs 22. Ryegrass Coulee
23. Whalen Farm 24. Blue Fish Caves 25. Mackenzie 26. Great Bear Lake
27. High River 28. Bezya 29. Little Gem 30. GDN 31. Lehman 32. Drynoch Slide

Figure 8: Distribution of Major Microblade Sites in Northwestern North America

c. **Alaska Highway**

In 1944, F. Johnson (1946) along with a group of botanists and geologists, conducted an archaeological survey of the region traversed by the Alaska Highway. This survey resulted in the discovery of three microblade segments at the Little Arm site, Kluane Lake, Yukon Territory and two microblade cores at Mile Post 1013.

d. **Cape Denbigh**

In 1948, 1949, 1950, and 1952, Giddings excavated Iyatayet, Nukleet, and Makjujuinuk at Cape Denbigh in Alaska. The assemblages encountered at these localities were named the Denbigh Flint Complex by Giddings (1951:193, 1964, 1967), and later this area was regarded by W. Irving as a type locality of the Arctic Small Tool Tradition (Irving 1957). The presence of blades, microblades, and many burins was considered by Giddings unlike any complex yet reported in the New World.

e. **Trail Creek Caves**

The caves were first discovered in 1941-42. In 1949 and 1950, H. Larsen and his associates investigated a series of caves and fissures and excavated some of them in the limestone area on Seward Peninsula. In two field seasons, they obtained a wide range of stone and bone artifacts from two caves at the site. Microblades were dominant elements in both caves, although microblade cores were absent. Layer 2, which yielded microblade remains at Trail Creek Cave 2, was dated to 9070±150 B.P. and 7402±155 B.C. (K-980) (Dumond 1980:989; Larsen 1968; West 1981:95).

f. **Noatak Drainage**

The years 1961, 1964, 1965 and 1966 witnessed tremendous achievements in archaeology of the Noatak River valley, northwest Alaska. Surveys and brief excavations conducted by D.D. Anderson (1972) led to the discovery of numerous sites of different ages. The earliest sites are related to the American Paleo-Arctic Tradition while others belong to the Arctic Small Tool Tradition.

g. **Localities in Northwestern Alaska**

During the field seasons of 1962, 1966 and 1967, R.E. Ackerman and several assistants from Washington State University conducted archaeological surveys along the coastline of Bristol and Kuskokwim Bay of southwestern Alaska. In 1978, they carried out surveys of three major lake and river valley systems between the Eek and Kweethiuk Rivers, and of the Akhlun-Kilbuck Mountain in the same region. Many microblades and cores were found. Ackerman suggested that the microblade and core industry in the Eek and Kweethiuk Rivers region ranged between 8000 and 6000 years ago. Those from the Akhlun-Kilbuck Mountain region were thought to date from 10,000 to 8000 B.P. (Ackerman 1978).

h. **Donnelly Ridge**

The Donnelly Ridge site was discovered by M. Brandy in 1963 and excavated by F.H. West in the summer of 1964. The site is located just south of Donnelly dome in the northern foothills of the Alaska Range. The dominant elements are microblades and cores (West 1967, 1981).

i. **Tangle Lakes**

One region in Interior Alaska containing microblade remains is the Tangle Lakes. The sites yielding microblade remains are located on or near the old lake shoreline which is about 30 m above present lake level (Dixon 1985:51; West 1980:166-7, 1981:100, 1985).

j. **Akmak**

In 1964, Giddings began excavations at Onion Portage on the Kobuk River. After his untimely death in the same year, D.D. Anderson continued his work, leading to the discovery of the Akmak site in 1965. The Akmak wedge-shaped cores and microblades were central to Anderson's definition of an American Paleo-Arctic Tradition in the region of the Brooks Range. The site has yielded a radiocarbon date of 7907±155 B.C.(K-1583) (Anderson 1968, 1970a, 1970b:4).

k. **Ground Hog Bay 2**

In 1965, an archaeological survey team from Washington State University found and tested a site named Ground Hog Bay 2 in southeastern Alaska. The radiocarbon dates from the stratum yielding microblade remains are 7545±185 B.P.(I-7057), 8230±130 B.P.(I-6395), and 8880±125 B.P.(I-7057) (Ackerman 1980:191; Ackerman *et al.* 1979:201-2).

l. **Batza Tena**

In 1969 and 1970, Batza Tena was discovered on the Koyukuk River of western central Alaska. Many projectile points, fragmentary point bases, and microblade remains are the most significant artifacts from this site. They were found on the surface and may have been derived from several components of different ages (Clark 1972).

m. **Healy Lake**

In the late 1960s, a series of excavations were conducted at a relatively shallow but stratified site at Healy Lake, Alaska. The microblade assemblage found at the site was assigned to the American Paleo-Arctic Tradition (Cook 1969; Dixon 1985; West 1980).

n. **Ugashik, Alaska Peninsula**

Beginning in 1960, the University of Oregon undertook a program of archaeological research on the Alaska Peninsula and completed a tenth field season in 1975. Excavations and surveys conducted in the Ugashik River drainage discovered a tool complex obviously similar to the Akmak Complex. Two general phases were defined. One is the Ugashik Narrows phase yielding wedge-shaped cores and microblades. The radiocarbon dates are 7675±260 B.P. (SI-1998), 8425±115 B.P. (SI-2641) and 8995±295 B.P. (SI-2492). The other is the Ugashik Knoll phase, in which the microblade cores completely lack the wedge-shaped style. The radiocarbon dates are 4810±85 B.P. (SI-2641), 4840±80 B.P. (SI-2643), and 5055±70 B.P. (SI-2494) (Dumond 1976:19, 1980:989; Henn 1978; West 1981:102-3).

o. **Dry Creek**

The Dry Creek site, about 180 km southwest of Fairbanks in Alaska, was discovered by C.E. Holmes in 1973. More archaeological surveys and excavations were conducted by Powers, leading to the discovery of many wedge-shaped cores, core tablets, and other stone tools (Dumond 1980; Powers 1978; Powers *et al.* 1983; Powers and Hoffecker 1989; West 1981).

p. **Small Sites in Northern Alaska**

In the summer of 1980, a U.S. geological field survey team conducted an archaeological survey of an ancient shoreline bluff in northern Alaska. Many wedge-shaped cores and microblades occurred on the surface (Geriarch 1982).

Another ocean shoreline bluff site in this region is the Tunalik site, about 15 miles southeast of Icy Cape. The microblade cores and fragments recovered at the site show a variety of forms which can be assigned to a number of technological traditions. No radiocarbon dates are available (Gal 1982).

2. Yukon Territory

a. **Bluefish Caves**

The Bluefish caves are located in the foothills of the Keele Range, just to the north of the Bluefish basin. Three small caves were recognised at an altitude of about 600 m along the western portion of a ridge of limestone and dolomite overlooking the middle course of the Bluefish River. Excavations in 1978, 1979 and 1981 led to the discovery of microblade remains, stone artifacts, and many mammalian fossils. Cave 1 yielded a burin spall, an out-of-context microblade fragment, and a variety of chert flakes some of which may have been detached from bifaces. Cave 2 yielded a wedge-shaped core, core tablets, microblades, burins, burin spalls, and flakes.

Sixteen radiocarbon dates, on bones from the loess, range between 12,000 and 25,000 years ago. Morlan (1987:287) indicated that Bluefish Cave 2 is apparently the oldest assemblage containing microblades and cores in North America (Cinq-Mars 1979; Morlan and Cinq-Mars 1982; Morlan 1987).

3. British Columbia

a. Gulf of Georgia Region

In 1949, a shell midden site, Whalen Farm, was found at Boundary Bay in the Gulf of Georgia region, central British Columbia. An assemblage containing microblade remains was uncovered in the uppermost component of the site. Since 1962, archaeological investigations in the Gulf of Georgia region have led to the discovery of the Montague Harbour I, Helen Point I and II, and False Narrow sites. All contained some microblades and cores. These discoveries indicate that microblade technology persisted in the Gulf of Georgia region from at least the 12th century B.C. to the 4th century A.D. (Mitchell 1968; Sanger 1968a).

b. Lochnore-Nesikep

The Lochnore-Nesikep locality, a cluster of sites along the banks of the Fraser River midway between Lytton and Lilloet on the interior plateau, was investigated and excavated between 1961 and 1965. The microblade remains from this locality constitute the largest collection in the Pacific Northwest. The locality was thought to range in age between 6000 and 2000 years ago (Sanger 1968a, 1970a).

c. **Ice Mountain Site**

In 1969 and 1970, interdisciplinary investigations were conducted in the Stikine-Tahltan region of the Ice Mountain area. Three sites were identified and excavated by J. Smith. Eight microblade cores and other stone artifacts were discovered (Smith 1971). During the summer of 1981, a comprehensive survey was made by K.R. Fladmark in the same region. He called the site Mt. Edziza which is a native American name for the Ice Mountain. A detailed report was published (Fladmark 1985), covering the history, Quaternary geology, environment, ethnography, site survey, excavation, and artifacts. The microblade cores, all made of obsidian, are very distinctive in both morphology and technology. Fladmark called them the Ice Mountain Microblade Cores. Smith (1971) suggested that the peak industrial use of microblades in this area occurred at about 4500 B.P., having been initiated prior to 10,000 B.P. Fladmark (1985), however, disagrees with Smith's conclusion. The age of the Ice Mountain microblade industry remains unclear.

d. **Namu**

Namu was first excavated in 1969 and 1970. In 1977 and 1978, R. Carlson undertook further excavations at Namu, leading to the discovery of a lithic industry which is primarily comprises microblades (Carlson 1979).

e. **Queen Charlotte Islands**

Microblade remains were recovered in 1969 by Fladmark from the Queen Charlotte Islands on the coast of British Columbia. Fladmark excavated two sites on the islands, Lawn Point on the east coast of Graham island, and Kasta on northern Morsby island (Dumond 1980:990; Fladmark 1986a; Sanger 1970b:107).

4. **Northwest Territories**

a. **Pointed Mountain**

A microblade site was discovered and tested by MacNeish in a series of archaeological investigations from 1949 to 1950 in the Northwest Territories. The Pointed Mountain site, located about 20 miles north of Fishermans Lake, was regarded by MacNeish (1954) as both a workshop and a habitation area owing to the occurrence of a large quantity of stone cores and flakes. Almost 66% of the artifacts are microblades and cores. In 1967, the site was revisited by Millar. Further work in 1972 led Miller (1981) to identify four components at the site. Only one (the largest) related to the Northwest Microblade Tradition. Nine radiocarbon dates are available for the Pointed Mountain component, ranging from 3990±120 B.P. (S-696) to 380±100 B.P. (I-3189). Nevertheless, Millar felt that the Pointed Mountain component might be dated to a period between 6000 and 4000 B.P. (Morrison 1987:53-4).

b. **The Mackenzie River Drainage**

In 1951, an archaeological survey conducted by the National Museum of Canada in the Mackenzie River drainage area led to the discovery of many sites. One of them, Site 42 located on the third or forth terrace of a lake, yielded nine microblades, two burins, three end scrapers, and abundant debitage. The age of the site is unknown. MacNeish thought the presence of the microblades indicated its relationship with Alaska, the Yukon, and northeast Asia (MacNeish 1953).

c. **Great Bear Lake**

During the summer of 1952, two sites, Franklin Tank and Great Bear River, were excavated by a team of archaeologists from the National Museum of Canada at the west end of Great Bear Lake. At the Franklin Tank site, three cultural complexes of different ages were identified. The more recent one, the N.T. Docks, yielded one side notched projectile point, nine microblades, various scrapers, one burin-like tool, and many other stone artifacts. No microblade cores were found. MacNeish thought the complex was perhaps a development from a complex like Pointed Mountain. Radiocarbon dates suggests that the N.T. Docks Complex dates to about 3500 B.P. (MacNeish 1955:69).

5. Alberta

a. **High River**

Sanger (1968b) analyzed and described 69 obsidian microblades and ridge flakes collected by D.R. King from a blowout one mile east of the town of High River, approximately 30 mile south of Calgary. No cores are known to be associated with the microblades. Based on the evidence derived from the microblades, the High River microblade cores were probably cylindrical or tabular. The striking platform, which may or may not have been based on a weathered surface, was not faceted or ground. The presence of ridge flakes was thought to be distinctive evidence of the core technology.

b. **Bezya**

During the late 1970s and the early 1980s, northeastern Alberta was the scene of considerable archaeological activity. Ronagha's 1980 survey led to the discovery of two wedge-shaped cores at the site called Bezya. Three test excavations during 1982 unearthed an assemblage including microblades and cores. Le Blanc and Ives concluded that the core technology at Bezya was close to the Pointed Mountain Complex but is different from those in the Northwest Territory and British Columbia (Le Blanc and Ives 1986).

6. Washington

a. Ryegrass Coulee

This site was excavated in 1966 by a team from Washington State University at the Ryegrass Coulee near Vantage on the Columbia River. Microblades and many other stone artifacts were discovered (Browman and Munsell 1969; Sanger 1970b).

b. San Juan Island

In the early 1950s, Carlson conducted archaeological surveys on San Juan Island in the Fraser delta, and collected some obsidian microblades and microcores of quartz crystal (Carlson 1960, 1983). The age and cultural affiliations of the microblade remains from San Juan Island are not certain.

c. Windy Springs

Excavations in the lower Ground Coulee region of central Washington resulted in the discovery of several microblade sites. The most important is the Windy Springs site which was excavated in 1957 under the direction of D. Osborne (Browman and Munsell 1969; Sanger 1970b).

I. MICROBLADE RESEARCH IN NORTH AMERICA

Research on microblade industries in North America has followed two major approaches. One is to focus on traditions and use microblade remains as index fossils to set up local chronological sequences or regional cultures. The other is to reconstruct manufacturing processes. An exploration of cultural relationships within North America, and between North America and the Old World, is an important element in both perspectives.

1. The Tradition Approach

The term *tradition* has been used by many authors with different meanings. Sanger (1969:191) states that a tradition can refer to a single artifact-manufacturing technique; to clusters of associated artifact classes and manufacturing techniques; and to entire ways of life or culture. In dictionaries of archaeology, it is variously defined as either "the persistence of cultural traits through time" (Whitehouse 1983:518) or "a continuing development of style" (Champion 1980:133). Various archaeologists also gave their own definitions. Willey and Phillips (1958:37) have defined a tradition as "a temporal continuity represented by persistent configurations in technologies or other systems of related forms." Speaking of Arctic assemblages, Irving (1962:55) noted that "a tradition is an aggregate of type complexes which, by virtue of their sharing distinctive artifact types and other distinctive features such as styles of decoration and geographic distributions, give the appearance of having been derived from a common predecessor." Anderson (1968:27) defined a tradition as "a continuity of cultural traits that persist over a considerable length of time and often occupy a broad geographical area." The term "tradition" is used by Dixon (1985:48) "to delineate configurations of associated cultural traits which persist over a long temporal interval and over a broad geographical area."

From the above discussion it is clear that tradition--literally that which is handed down--is used by archaeologists in a wide range of conceptual contexts. In its most inclusive sense, tradition has been used to refer to the entire complex of traits that characterize any given culture, particularly with regard to the continuity of those traits through time and space. In a narrower sense, it has been used to refer to continuity in a specific corpus of cultural knowledge as reflected, for example, in distinctive stone tool manufacturing technologies. In this study, the term *tradition* will be primarily employed in the latter sense. It should not be assumed, however, that such a narrow definition was necessarily conceived by the various researchers who originally defined and named the many stone tool "traditions." Several microblade traditions have been defined in northwestern North America according to their geochronological positions. These traditions include Anderson's American Paleo-Arctic Tradition, Irving's Arctic Small Tool Tradition, West's Denali Complex, MacNeish's Northwest Microblade Tradition, Sanger's Plateau Microblade Tradition and Nesikep Tradition, and Smith's Northeast Asian and North American Microblade Tradition.

a. **American Paleo-Arctic Tradition**

This is the earliest North American microblade tradition and was defined by Anderson (1968, 1970a) on the basis of the Akmak assemblage in Onion Portage and layer III of Trail Creek cave II on Seward Peninsula. This tradition was later extended to cover interior Alaska. What the collections have in common is that they are dominated by microblade technology in which the wedge-shaped cores produced microblades which commonly did not exceed 5 cm in length. They have sometimes been referred to as "Campus-type" cores.

According to Anderson's definition (1970a:8), the diagnostics of the wedge-shaped cores of the tradition are:

(1) The core is formed by unifacial or bifacial retouching of a thick flake.

(2) They have elongate sub-rectangular or sub-triangular platform outlines.

(3) The striking platform is formed by the initial unifacial or bifacial flaking of the top of the core, and subsequent detachment by a transverse blow from the intended fluted end. The transverse striking platform often terminates in a hinge fracture.

(4) A keel opposing the striking platform is either bifacially or unifacially flaked.

(5) The lateral surfaces have had a variety of treatments, ranging from shaping by large randomly-placed flake scars emanating from the keel, to careful bifacial flaking. On one core tablet from the Brooks Range, wide parallel flake scars are in evidence along both lateral surfaces, but this treatment is uncommon.

(6) The striking platform is prepared for subsequent removal of microblades by 'crushing' or 'battering' to remove the overhang.
(7) Cores are occasionally rejuvenated by the removal of the entire fluted surface, apparently in an attempt again to produce flatter, wider microblades.
(8) New platform surfaces are occasionally created by removal of the entire original platform area through a transverse blow from the fluted end.

The assemblages assigned to this tradition include those form Dry Creek, Donnelly Ridge, the Campus site, Akmak, Tangle Lake, Healy Lake and Ugashik. The American Paleo-Arctic Tradition in Alaska has been dated from 10,000 to 8000 B.P. (Anderson 1970a:2) or 10,600 to 5000 B.P. (Dixon 1985:47).

b. **The Denali Complex**

The Denali Complex was first defined by West (1967) to refer to a group of microblade and core industries flourishing in the interior of Alaska between 12,000 to 8000 B.P. It includes the assemblages from the Campus site, component II of Dry Creek, Donnelly Ridge, Healy Lake, Tangle Lake, and Tokhanika West and Tekhanika East in Denali National Park. It has since been suggested that the Denali Complex be understood as a regional variant of the American Paleo-Arctic Tradition (Dumond 1977; West 1981). The essential elements of the Denali Complex include the following:

(1) bifacial biconvex knives, randomly flaked and of variable size;
(2) flat-topped end scrapers on thick blade-like flakes often bearing graver spurs;
(3) large blades and blade-like flakes likely derived from roughly prepared pebbles;
(4) wedge-shaped microblade cores of a distinctive type which may be bifacially shaped, are faceted at one end only, and show a distinctive one-stroke platform preparation;
(5) core tablets resulting from the latter technique, faceted at one end and displaying a hinge fracture opposite;
(6) microblades derived from these cores;

(7) burins manufactured on small, flat flakes of irregular outline which may show minute marginal retouch on alternate edges and spall facets on several edges;
(8) burin spalls, usually rectangular or triangular in cross section and often bearing some trace of the marginal retouch (West 1967:372).

c. **The Arctic Small Tool Tradition**

The Arctic Small Tool Tradition was defined by Irving (1957) to refer to a far-flung microblade tradition now known to have expanded from the Bering Sea southward to approach, but not reach, the Alaska Peninsula. In the north it expanded eastward to Greenland. One manifestation of this tradition is the Denbigh Flint Complex at the Iyatayet site on the Seward Peninsula of Alaska (Dumond 1987; Giddings 1951).

The distinctive features of the tradition, according to Irving (1962:56), are:

(1) large numbers of microblades struck from conical cores;
(2) burins of several types with extensive retouch on one or both faces and preparations for hafting ('tanged burins');
(3) burin spalls retouched for use as minute engraving tools;
(4) many, very small, bifacially retouched, inset side blades, less than 4 cm long, with distinctive crescentic (not rectangular) shapes;
(5) many, very small biface points without stems or notches, but of specialized form;
(6) medium size (4-10 cm long) biface points and knife blades, without stems or notches;
(7) scarcity or absence of implements made by grinding or polishing, and of large implements;
(8) at most sites, an absence of pottery;
(9) a unique style and technique of fine workmanship, which at most sites appear on most of the implements.

The Arctic Small Tool Tradition was estimated to range from 6000 to 3000 B.P.

d. **The Northwest Microblade Tradition**

This tradition was proposed by MacNeish (1954) on the basis of his study of the microblade industry discovered at the Pointed Mountain site. This was regarded as an interior microblade tradition represented by the Campus site, the Pointed Mountain site, and a number of other sites scattered over much of the Northwest, Yukon territories, and southern British Columbia (Irving 1962). The cultural characteristics include: tongue-shaped microblade cores, a series of modified microblades, microblades set in antler shafts, large and small end scrapers, large side scrapers, burins, notched net sinkers, and various other tools. MacNeish saw many of its component parts as coming from widely different sources (MacNeish 1959).

MacNeish put the beginning of the tradition as far back as 7000 B.P. The end dates for the tradition were thought to be between 5000 and 4500 B.P. (Irving 1962:59; MacNeish 1959).

The Northwest Microblade Tradition seems to be based primarily on its geographic continuity. The inclusion of some microblade industries in interior Alaska such as the Campus site makes this tradition overlap to a certain extent with the American Paleo-Arctic Tradition. No explicit boundary or criterion is given to separate these two cultural entities. As regards the microblade remains, it is not clear what kind of technological characteristics mark this tradition.

e. **The Plateau Microblade Tradition**

The microblade industries occurring in south central British Columbia, Washington, and the Columbia Plateau have been placed within a single technological tradition, known as the Plateau Microblade Tradition. This tradition includes sites such as Ryegrass Coulee, Lehman, Windy Springs, Marron Lake, San Juan Island, the Gulf of Georgia region, Lochnore-Nesikep locality, and others (Sanger 1968a, 1970b).

The diagnostics of the tradition are defined by Sanger as follows:

(1) Microblade cores utilize a weathered surface for a striking platform which is usually modified only at the core edge. Multiple blow striking platform preparation is scarce, and core rejuvenation tablets are not known.
(2) Microblades are usually removed from only one end of the core.
(3) Core rotation, resulting in more than one striking platform, is very unusual.
(4) Fluted surfaces commonly contrast to a wedge- shaped keel.
(5) The technique of preparing the fluted surfaces is currently unknown, but the apparent absence of ridge flakes may be very important in this respect (Sanger 1968a:114, 1970b:108).

The Plateau Microblade Tradition lasted at least 5000 years, appearing on both the Canadian Plateau and the Columbia Plateau as early as 7000-6500 B.P., and evidently not ending until about A.D. 500 (Sanger 1970b).

f. The Nesikep Tradition

The Nesikep Tradition was defined by Sanger (1969, 1970a) to represent the movement of an early microblade-using population from the Columbia Plateau and Washington into British Columbia which introduced a characteristic stone chipping technique. The earliest known component of this tradition, Nesikep Creek Zone VII, contains side-notched projectile points, microblades and cores, and woodworking tools. The Nesikep Tradition is thought to have commenced around 7000 B.P.

g. The Northeast Asian-Northwest American Microblade Tradition (NANAMT)

The NANAMT was proposed by J. Smith (1974) on the basis of research on a microblade industry discovered at the Ice Mountain site, northern British Columbia. Smith has lumped all microblade industries occurring in North China, Outer Mongolia, Japan, eastern Siberia and North America into this single tradition. Technologically, Smith defined three specific core preparation systems for the NANAMT, and each contains several subsystems which are basically similar to core techniques. Initially, Smith (1974:363) suggested a central Siberian and Mongolian origin for the NANAMT, although later suggested a North China origin (Smith and Smith 1982).

2. The Technological Perspective

Morlan has used a techno-typological approach to analyze microblade cores from North America in light of his knowledge of microblade cores in Japan (Morlan 1967a). Based on an examination of 293 microblade cores from 58 sites in North America, Morlan (1970) identified four major core types scattered through a long temporal span of about eight millennia and over a broad geographic area; they are conical, cylindrical, tabular, and wedge-shaped cores.

In analyzing wedge-shaped cores, Morlan defined four elements: the face, the flute, the wedge, and the platform. He went on to distinguish two manufacturing sequences of wedge-shaped cores on the basis of the order in which the various elements of a core were formed. In the first sequence, the face elements were formed first and the platform second. In the second, the platform is formed first and the face elements second. Wedge-shaped cores made by the first sequence are usually made from biface and flake blanks. Those worked by the second sequence are made from pebbles or chunks.

Morlan defined the manufacturing technique which follows the first sequence as the Campus technique. He further divided the technique which follows the second sequence into two major groups. The one, characterized by a platform on the ventral surface of a flake, he called the Denbigh technique, due to its popularity in the Arctic Small Tool Tradition. The other, characterized by a platform on the weathered surface of a nodule, he called the Lehman technique. This technique is very common in the Plateau Microblade Tradition. Morlan has suggested that similarities in wedge-shaped cores throughout East Asia and northwestern North America indicate close cultural connections (Morlan 1967a, 1976).

A very recent study of microblade technology is provided by Mobley (1991). His book, *The Campus Site,* is the first comprehensive analysis of the whole lithic collection from the site since it was discovered in 1933. In order to reconstruct the sequence of manufacturing steps, Mobley collected all the samples, including microcores, microblades, initial spalls, a trifaced ridge flake, rejuvenated tablets, and so called gull-wing flakes. The analysis examined raw material selection, shaping of the core blanks, preform and platform preparation, and platform rejuvenation and constitutes a major contribution to the understanding of Campus assemblage technology.

It is commonly accepted that microblades contain fewer diagnostic traits of manufacturing process than do the cores. However, a quantitative analysis of microblades from the Dorset Culture made by McGhee (1970) has proved to be informative. The Dorset Culture found in the central and eastern arctic is dated to a period between 900 B.C. and A.D. 900. It is considered to have developed from an indigenous variant of the Arctic Small Tool Tradition (McGhee 1970:89). A total of 974 microblades were selected for the analysis and comparison. Most were broken, either accidently or as a result of deliberate modification. Comparison of breakage patterns suggests that microblades were selected and prepared for hafting and specialized use.

Another statistical examination of microblades was conducted by Wyatt (1970) who argued that significant variation in microblade form, manufacture, and use could be revealed by attribute analysis. Ten microblade samples from five traditions, comprising a total of 1145 microblades, were selected for analysis. Of the ten samples, two (Akmak and Kobuk) represent the American Paleo-Arctic Tradition, six (all from the Denbigh Flint Complexes) the Arctic Small Tool Tradition, one the Dorset Culture, and one the Plateau Microblade Tradition. Five quantitative and seventeen qualitative attributes were categorized by Wyatt. The five quantitative attributes are length, thickness, width, thickness/width index, and index of curvature. The seventeen qualitative attributes fell into seven principal classes: (1) outline (complete microblade, proximal fragment of microblade, distal fragment, and medial fragment); (2) cross section (triangular and nontriangular); (3) retouch (present and absent); (4) use (present and absent); (5) edge of retouch (retouch on one edge and retouch on both lateral edges); (6) face of retouch (dorsal, ventral, and both); and (7) material (obsidian and chert).

Synthesizing the analysis and the comparison, Wyatt observed the following. First, the American Paleo-Arctic Tradition includes a large proportion of non-triangular microblades produced from wedge-shaped cores. Subsequent microblades used as side insets show a high percentage of medial sections, a low curvature index and frequent steep lateral retouch on the ventral surface. Second, the Plateau Microblade Tradition produced a relatively high proportion of triangular microblades. Microblade use was possibly multi-purpose. Lateral retouch was common. Proximal sections are the most common outline form, dorsal retouch is predominant, and there is a relatively high curvature index. Third, the Arctic Small Tool Tradition contains microblades with non-triangular cross sections, broken distal ends, and a relatively high curvature index (Wyatt 1970).

J. CONCLUSION

In the foregoing pages, the history of microblade research has been outlined for five geographic areas: China, Outer Mongolia, Japan, eastern Siberia, and North America. The distribution of microblade remains extends from the arctic coastal area in Northeast Asia and North America to the Himalayas in Tibet, and Guangdong Province in south China. Due to their vast spatial distribution and the absence of a standardized methodology and reliable chronology, the origin, development, and affinities of these core technologies remain unclear.

Research on microblade remains, by most Asian and North American archaeologists, has been limited to the materials discovered in their own countries or regions, even though some attention has always been paid to similar discoveries in the surrounding areas, and comparative studies conducted to investigate their relationships. Yet, these attempts are often limited by factors such as the language of reports from other countries, inaccessibility of original materials, and limited numbers of academic exchanges.

In the present state of research, Asian and North American archaeologists specializing in microblade traditions generally adopt traditional culture-historical and techno-typological approaches. In the case of the tradition approach, microblade cores are regarded as highly-specialized and diagnostic artifacts for the establishment of local cultural sequences or the definition of cultural relationships between different regions. In contrast, in the techno-typological approach, microblade core manufacturing processes are used to trace cultural similarities and cultural change in time and space. These two approaches should be considered complementary rather than conflicting. Only through studies based on the detailed analysis of various techniques and their development, will microblade traditions or cultural relationships be more convincingly defined and established.

Subsistence and settlement patterns are by far the least known aspects in research on these microblade assemblages, although microblade technology presumably reflects a hunting, gathering, and fishing lifestyle in steppe, semi-desert and tundra environments. It seems likely, however, that such technology also persisted in the societies where the major subsistence activity was agriculture.

CHAPTER III. - METHODOLOGY

A. ANALYTICAL METHODS USED IN ASIAN AND NORTH AMERICAN MICROBLADE RESEARCH

This chapter briefly reviews the methods employed in microblade research over the last sixty years as well as several related issues. An understanding of established methodological approaches and their various limitations is essential to the development of an appropriate analytical strategy. Moreover, a firm grasp of methodological issues is necessary in order to deal with the constraints imposed by the various data sources to be examined.

This project represents a synthesis of research conducted over a long time by many different researchers in many different countries. Examination and reanalysis of original sites, materials, data, and, sometimes, primary published results is now logistically difficult or impossible. As a result, the study is forced to deal with data and interpretations generated within several different traditions of archaeological method and theory, many of which do not approach modern standards. Indeed, several modern avenues of investigation, such as taphonomy or certain paleoecological approaches, had not been developed when the original investigations were conducted. It therefore is necessary to adopt a methodological approach which is basic enough to deal with these many constraints yet capable of producing meaningful results.

1. Morphological and Technological Approach

Investigation of the similarity in form and manufacturing sequence of microblade cores has been regarded as the most direct means of tracing cultural relationships (Hayashi 1968:129, Morlan 1970:33-34, Sanger 1968b:191).

Analytical methods used in microblade research have not changed significantly in the last sixty years, but have become increasingly elaborate; a strictly morphological approach has been supplemented by a more involved technological analysis.

In the early years, morphological analysis was the only method used for the identification and comparison of microblade assemblages. Manufacturing processes were considered, but were inferred solely on the basis of visible features. Wedge-shaped cores were given various names such as Nelson's "polyhedral" or "semi-polyhedral cores" (1937:270), and Teilhard de Chardin's "rostrated implements" (1939:335). Their manufacturing process was postulated and described by Nelson (1937:270) on the basis of flake scars on both faces and along the lateral margins. F. Bergman, the archaeologist of the Sven Hedin Expedition who collected most of his artifact samples in Mongolia, gave microblade cores various names such as "edge-implements", "axe-like implements", "nucleus-like picks", "nucleus-like hoes", "triangular pyramid-shaped object", and even "oblong triangular flint blocks" (Maringer 1950:172). Based on Bergman's primary catalogue, Maringer divided microblade cores into two large groups, one called multifaceted and subspherical forms, the other cylindrical and conical forms. Specific names such as "celt-shaped" or "tongue-shaped" nucleus were used by Maringer to refer to wedge-shaped cores (1950:170).

It was on the basis of morphological similarities of wedge-shaped cores and end scrapers, found both in Mongolia and Alaska, that Nelson asserted that the microblade cores and the end scrapers from the Campus site were similar in several respects with thousands of specimens found in the Gobi Desert by the American Central Asiatic Expedition in 1925-1928 (Nelson 1935:356). Having examined the wedge-shaped cores from Guxiangtun near Harbin, Heilongjiang Province, Chikuochingtse near Turfan, Xinjiang Province in North China, and those from the Campus site near Fairbanks in Alaska, Teilhard de Chardin claimed that these cores exhibited such remarkable similarities that they "cannot have been designed twice independently by man. Their occurrence therefore detects the existence, and it can help to trace the distribution of a strictly defined sheet of human culture" (1939:335).

Microblade cores found at Pointed Mountain, the Great Bear Lake sites, and San Juan Island were defined by MacNeish (1954, 1955) and Carlson (1960) as polyhedral cores. Those from the Pointed Mountain site were subdivided by MacNeish into "conoidal" and "tongue-shaped" forms based on slight morphological differences. Irving called cores of the Arctic Small Tool Tradition "conical" and followed Nelson (1937), MacNeish (1954), and others in describing wedge-shaped cores in North America as tongue-shaped cores. He characterized these tongue-shaped cores as having a 90 degree striking platform edge angle, a narrow fluted surface, and a knife-like edge opposite the platform (Irving 1962:56,59).

Giddings described two microblade cores from Cape Denbigh as "cubical" or "semi-polyhedral" forms. He thought these cores resembled wedge-shaped cores from the Arctic, the Campus site, and Mongolia and he sought their origin in the early Neolithic of Siberia (1964:203,243).

In many cases, core types were named after locations, such as "Gobi", "Campus", and "Shirataki" cores, or after postulated functions such as "core scraper", "core burin" and "engraver." These terms were gradually abandoned (Morlan 1967a:175). Although the term "wedge-shaped core" appeared quite early in some reports, it did not become a commonly accepted and widely used term until the publication of M.Z. Panichkina's article in 1959 (Abramova 1965:125, Derevianko 1965:137, Dikov 1965:13). Morlan (1976a:175) also prefers terms such as "wedge-shaped" and "boat-shaped" cores as they are descriptive, causing, in his view, less confusion.

Both Jia Lanpo and An Zhimin divide microblade cores into two large groups. In Jia's typology, one group comprises wedge-shaped, fan-shaped and boat-shaped forms, the other includes prismatic and conical forms. An names his two groups "flat-bodied" and "circular-bodied cores." Jia (1978:140) postulates that both fan-shaped and wedge-shaped cores were made of discarded tongue-shaped tools. Fan-shaped cores were made by snapping a tongue-shaped tool into four pieces while wedge-shaped ones were made by splitting it into halves. An (1978:293) divides his flat-bodied cores into three forms: boat-shaped, flat-conical, and wedge-shaped. According to An's description, and my observations, his boat-shaped cores are broad-bodied, wedge-shaped cores, his flat-conical cores are broad-bodied cores with a fluted surface on two ends, and his wedge-shaped cores are narrow-bodied wedge-shaped forms. Many Chinese archaeologists have followed these classifications in their own reports although there are slight differences from case to case.

Analyzing the Xiachuan assemblage, Wang Jian identified several distinctive morphological features which he thought to be related to specific manufacturing techniques. First, he pointed out that broad-bodied and narrow-bodied wedge-shaped cores are two subtypes which were produced from flakes and small chunks. Second, he suggested that semiconical cores should be classified into a separate category due to differences in their manufacturing process from conical ones. He also observed that some wedge-shaped cores might change to a semiconical form after microblade removal (Wang *et al.* 1978:267, Wang and Wang 1991).

Although two large groups of microblade cores, conical and cylindrical on one hand and wedge-shaped on the other, are identified by many archaeologists, some of these morphologically defined core types are probably specimens of the same type at different stages of reduction. Various morphological terms such as fan-shaped, boat-shaped, tongue-shaped, wedge-shaped, pencil-shaped or conical, cylindrical, funnel-shaped, tabular, have been widely used in core typologies. These terms are the most important in core classification because they objectively reflect the most diagnostic core attributes.

Since Yoshizaki defined the Yubetsu technique, by reconstructing the manufacturing process of one group of wedge-shaped cores in the early 1960s, technological considerations have become an important trend in core classification, analysis, and comparison. It has become clear that wedge-shaped cores cannot be treated as a single category, and that typological classification based only on morphology is not sufficient for comparative analysis. Archaeologists have realized that many wedge-shaped cores, which look morphologically similar, could have been manufactured by different techniques. Furthermore, as Morlan and Gai Pei have each pointed out, core shape tends to change in the course of microblade reduction.

> A specimen which begins as a thick wedge-shaped core with a flat wedge element will, through successive microblade removal, undergo foreshortening of the platform element until the long axis of the platform shifts from the plane of the face elements to that of the fluting chord (Morlan 1970:19).

> Change in appearance is one of the intrinsic attributes of microblade cores which are continuously in the process of morphological modification. It is necessary to study the whole process of preform preparation and core consumption. Each specimen must be seen as a representative of a specific episode of manufacture rather than as a final product. The morphological modification of a microblade core should be examined from the perspective of microblade reduction sequences (Gai 1984:245, my translation).

The recognition of the importance of manufacturing processes has re-oriented core analysis and classification. This new technological approach is a sequential analysis based on careful examination of large numbers of artifacts representing various stages, from preforms to discarded specimens including debitage, in order to reconstruct the total range of manufacturing processes.

Hayashi has defined two stages for the manufacture of wedge-shaped cores. First is the preparation and removal of flakes to produce a preform. Second is the retouch of the preform and platform to shape a blank. He emphasizes the importance of reconstructing the order of the manufacturing sequence by means of examining both the formation and retouch of the sides, and the preparation and direction of faceting on the platform (1968:130,135,140-141).

Morlan (1978:97) has suggested three ways to reach the goal of reconstructing manufacturing technique: first, to duplicate specimens by means of experimental practice; second, to refit the products and by-products together; and third, to infer the flaking process from the orientation and condition of flake scars. At present, the combination of refitting waste by-products and microblades onto discarded cores and inferring reduction sequences from the orientation and condition of flake scars is the most common approach employed to analyze and reconstruct manufacturing sequences or techniques. The latter is primarily used as a supplementary technique when diagnostic by-products, such as tablets, spalls, and debitage are absent in the assemblage.

As far as wedge-shaped cores are concerned, various techniques have been identified using the above approach, which currently represents the best way to differentiate fundamental from superficial similarity. As Crabtree (1972:3) has pointed out: "a study of technology is pertinent to typology, for careful analysis of the various stages of the manufacturing process can give clues to the technique and the functional need."

Since Yoshizaki's early influential work, technological analysis has gained in popularity in Japan, North America, and China. A number of special core techniques have been reconstructed and defined. They include the Fukui (Hayashi 1968), the Horoka (Morlan 1967a), the Togeshita, the Oshorokko (Tsurumaru 1979), and the Yadegawa (Ambiru 1979) techniques in Japan; the Dyuktai technique (Flenniken 1987) in eastern Siberia; the Campus, the Denbigh, and Lehman techniques (Morlan 1970) in North America; the Hetao, the Hutouliang, the Sanggan, the Yangyuan (Tang and Gai 1986), and the Xiachuan (Chen and Wang 1989) techniques in China. These techniques constitute a series of typological units in which microblade cores manufactured by the same technique are grouped or classified. Within these classes there is a certain degree of confusion because some were defined in different countries and in fact refer to similar core types. Nevertheless, core typology and classifications are now based on a more consistent framework than ever before.

A combination of morphological and technological approaches now offers the most appropriate way to distinguish the attributes of cores and to potentially determine prehistoric cultural affinities in time and space. As Sheets has pointed out the "technological analysis can increase the sophistication of archaeological comparison between specimens or types assessed in terms of how similar they are" (1975:372).

2. Archaeological Concepts

This section gives a brief review and discussion of certain archaeological concepts commonly used by archaeologists in microblade research, including *culture*, *tradition*, *complex*, and *industry*. These concepts are not always used consistently by different workers, hence it is necessary to review and operationalize the terminology.

a. **Culture**

Culture is a widely used concept with varied definitions. Although a comprehensive discussion of archaeological culture is beyond the scope of this thesis, a brief review of the concept in archaeological interpretation is helpful. In archaeological study, the term *culture* has commonly referred to "a consistent patterning of assemblage" (Fagan 1978:85-86). More specifically,

> An archaeological culture may be defined as a geographically contiguous set of artefact types that may occur in differing combinations in different functional contexts and that together form the surviving material expression of a distinctive way of life sufficiently comprehensive to permit its bearers to perpetuate themselves and their behavioural patterns over successive generations (Trigger 1978:76).

By the turn of the century, the use of the concept of culture in archaeology marked the beginning of the culture-historic approach in prehistoric studies. Archaeological components containing identical and similar artifacts were grouped together to form a culture which was viewed as being only material remains and built up from artifact types (Trigger 1978:76,100, 1989:161). It was Childe who first systematically used the concept of culture as the basic unit forming the temporal and spatial ordering of archaeological data. He defined cultures as archaeological units which "contain types of remains...constantly recurring together...." Childe's cultures were based on a small number of diagnostic artifact types and were used to trace relationships between neighbouring cultures and to establish chronologies (Childe 1925, 1929, Trigger 1978:84, 1980:40, 1989:168-171). Since then, the concept of archaeological culture has been widely accepted and used in Europe and most parts of the world until recently.

The concept of culture in Western archaeology has undergone significant change during the 20th century. In his later works, Childe looked on culture as part of the ecosystem adjusting to environment (Childe 1942, 1944, 1956; see Trigger 1978:85, 1989:172). Childe's functional view of archaeological culture has been developed and elaborated since then. W.W. Taylor (1948) introduced into archaeology a functional view of culture. He distinguished between culture as a system of ideas and the artifacts derived from this system. Thus artifacts were seen as the products of culture rather than culture itself (Trigger 1978:104, 1989:277).

The Neo-evolutionist and processual approach, which developed in American archaeology during the 1960s, advocated a new concept of archaeological culture. The Neo-evolutionists treated progress as a characteristic of culture in general and ignored the influence of environments and of one culture upon another. White (1975) defined culture as an elaborate thermodynamic system composed of techno-economic, social, and ideological components. Following White in viewing cultures as adaptive systems, Binford (1972) defined culture as humanity's extrasomatic means of adaptation which was composed of three interrelated sybsystems: technology, social organization, and ideology (Trigger 1989:290-1, 296-8).

Trigger (1978:105) has predicted that "the concept of the archaeological culture has played, and will continue to play, an important role in the structuring and interpretation of archaeological data." Although the concept of culture has changed significantly from its earliest formulations, the definition of archaeological culture offered by Trigger (1978:76, see above) can be effectively employed in microblade analysis to view cultures as a geographically contiguous set of artifact types.

This notion of culture, commonly used in microblade research, has changed little from the early formulations of the concept of culture. It has long been utilised as a term referring either to whole microblade discoveries in a broad region or to a specific complex and assemblage. In China and Japan, archaeological remains containing microblades have been sometimes lumped into broad categories, such as "Microlithic Culture," with little temporal or spatial differentiation (An 1978; Aso 1965; Pei 1954; Sundai Shigaku 1979). These microblade discoveries are thought to be a homogeneous cultural entity and derived from a common ancestry. Sometimes, the term has also been used to refer to a specific microblade complex or assemblage thought to be temporally and spatially discrete, such as Nelson's "Shabarakh-usu Culture" (1926a), Mochanov's "Dyuktai Culture" (1978, 1980), and Wang's "Xiachuan Culture" (Wang *et al.* 1978). The term is often confused to certain extent with "tradition" and "complex" which are discussed below.

In this study, the term *culture* will be avoided owing to its ambiguous, multi-levelled definition. Archaeological units discussed in this study, such as the Dyuktai Culture, will follow Mochanov's definition, which is based on a group of distinctive artifact types.

b. Tradition

The term *tradition* has widespread application in archaeology and implies a degree of cultural continuity ranging from a long-lasting artifact type to a whole cultural sequence (Bray and Trump 1982; Champion 1980:133; Fagan 1978:381). Having discussed different connotations of the concept of tradition defined and used by American archaeologists, Willey and Phillips (1958:37-38) propose to define a tradition based on single technologies or other unified systems rather than on whole cultures. They argue that such a limitation makes tradition a more useful tool in their investigation of cultural stability. The definition of tradition given by Willey and Phillips is as follows:

> An archaeological tradition is a (primarily) temporal continuity represented by persistent configurations in single technologies or other systems of related forms (1958:37).

In microblade research, two concepts, cultural and technological traditions, can be distinguished. In terms of the cultural level, a tradition, has been thought to be a whole homogeneous culture with a common ancestry and considerable temporal duration. The "Microblade Tradition" employed by An (1978), Jia (1978), Hayashi (1968:155), Oda and Keally (1979:6), Smith (1974, 1982), and Tang and Gai (1986), can be included in this category. A tradition usually comprises a number of temporal and regional phases or subtraditions which are distinguishable based either on typological differences of specific artifacts or on the presence and absence of diagnostic types (Oda and Keally 1979:6; Tang and Gai 1982:342).

Jia regarded microblades found in East Asia and North America as a single tradition which he did not subdivide. Hayashi (1968) divided the Japanese microblade tradition into three periods. The first period is represented by the Yadegawa-Yasumiba industry in the southwest and the Sokkatsu-Araya industry in the north. The second period involves very complicated regional phases. The most distinctive representatives are the Fukui industry in Kyushu and the Yubetsu industry in Hokkaido. The third period is restricted to Hokkaido and associated with a corresponding expansion of pottery and tanged points in the rest of the archipelago. The microblade tradition is thought by Oda and Keally (1979) to be Phase III of the Japanese Paleolithic. No temporal and regional subtraditions are distinguished although conical and wedge-shaped cores are thought to be two separate industries. Smith's NANAMT is divided into five subtraditions which are entirely based on their geographic distribution with little attention paid to techno-typological considerations (1974, 1982). Tang and Gai's discussion on microblade tradition is influenced by Tang's Japanese training, and the concept of phases or subtraditions is obviously derived from Oda and Keally's discussion (1979). They established three Upper Paleolithic phases in North China and assigned microblade development to Phase IIb, Phase IIc, and Phase III (Tang and Gai 1986:350-360).

Microblade traditions in North America such as Irving's Arctic Small Tool Tradition, Anderson's American Paleo-Arctic Tradition, MacNeish's Northwest Microblade Tradition, and Sanger's Plateau Microblade Tradition, which are all defined according to types and techniques, can be assigned to the technological tradition category. Discussing microblade traditions in North America, Irving defined tradition as

> ...an aggregate of type complexes which, by virtue of their sharing distinctive artifact types and other distinctive features such as styles of decoration and geographic distributions, give the appearance of having been derived from a common predecessor (1962:55).

Irving and Anderson claimed that a microblade tradition may contain more than one cultural complex, such as the Denbigh Complex in Irving's Arctic Small Tool Tradition and the Akmak and Kobuk complexes in Anderson's American Paleo-Arctic Tradition (Anderson 1968:27,28; Irving 1962:55). An (1968) regarded a microblade tradition as a manufacturing technology characterized by some diagnostic artifacts such as microblades and associated cores. Unfortunately, An overlooked broad technical variations within a microblade tradition. Sanger shared certain similarities with An's viewpoint. He emphasized that a microblade tradition can refer to either clusters of many techniques or a single manufacturing technique. A technological tradition should be designed in a trinomial system of geographical locality, technique, and artifact class. He used these criteria to define the "Plateau Microblade Tradition" (1969:191-192). Mochanov (1978, 1986) divided Paleolithic finds in Siberia into two traditions, Malta-Afontova and Dyuktai. In his 1986 article, Mochanov substituted the "Dyuktai Tradition" for the "Dyuktai Culture" without explanation. There seems no fundamental difference between the Dyuktai Tradition and the Dyuktai Culture which are both based on the presence of bifacial workmanship, a continuing emphasis on wedge-shaped technology, and casual reliance on a variety of pebble tools. Mochanov (1986:717) suggested two variants for the Dyuktai Tradition: one with bifaces and wedge-shaped cores the other with bifaces but lacking wedge-shaped cores.

Although it is impossible to unify the concept of microblade tradition as defined by different archaeologists, these microblade traditions will be used in this study as analytic and comparative units according to techno-typological attributes of microblade cores.

c. **Complex**

Complex is defined by Irving (1962) as a smaller unit with less time depth than a tradition. He stated that complexes are "aggregates of types found to recur in a reasonably consistent pattern in several sites of about the same age. 'Complex' has much in common with 'tradition', but it lacks great time depth" (1962:55).

Many archaeologists base complexes either on diagnostic tool types or on cultural traits in a given industry or on a group of similar assemblages in a given region. Giddings (1951:191-195, 1960:125) named the Denbigh Complex based on a pebble and flint assemblage found in a thin stratum at Cape Denbigh. Later, another assemblage found on the Endicott Mountains of the Brooks Range, as well as those found at localities NK 1 and 2 on the Noatak drainage of Alaska, were grouped into the Complex (Irving 1951; Anderson 1972). Anderson's Akmak and Kobuk Complexes are based on two lithic assemblages unearthed from Band 8 and below it at Onion Portage. The tool components of these two complexes look very similar, except for the presence of bifaces in the Akmak Complex (1968:29-30). Hayashi (1968:156) named the Fukui Complex which is characterized by pottery and wedge-shaped cores. In contrast, West's "Denali Complex" first referred to a cluster of core and blade assemblages found at the Tangle Lake sites and two sites on the Teklanika River in Mount Mckinley National Park. A series of assemblages such as those found at the Campus and Donnelly Ridge sites, were then assigned to the Complex. The Denali Complex is based on a number of highly distinctive traits, including wedge-shaped microblade cores, Donnelly burins, boulder-chip scrapers, and bifacial multiple knives on flakes (West 1967, 1975, 1980).

The notion of complex used in this study will follow Irving's definition. This archaeological unit is used to group microblade assemblages which occur in a given region and probably belong to the same age, although chronometric dates for certain assemblages are not always available.

d. **Industry**

Koldehoff (1987:153) claims that there are two usages, traditional and technological, of the term *industry* in archaeology. Traditionally, industry has been defined as a collection of tools made from one type of raw material and recovered from the same stratum or context (Braidwood 1957:58; Coles and Higgs 1975:67; Oakley 1972:33-34). Technologically, industry refers to "a manufacturing or productive enterprise focusing on a raw material and involving certain common means of processing that material" (Sheets 1975:372). Irving gave a more detailed definition as follows:

> Industry is understood to mean a specialized manufacturing technique together with implement types and other diagnostic traits associated it. It may have considerable time depth. Grouping parts of two collections in one industry implies historical connection of some sort between them (1962:55).

Most industries defined in microblade analyses are based on technological attributes. This is an archaeological unit commonly used by Japanese archaeologists to define assemblages containing diagnostic types of microblade cores or techniques. For example, Hayashi defined the Yadegawa-Yasumiba Industry which is characterized by conical and prismatic cores, and the Araya-Sakkotsu Industry characterized by Araya burins and Yubetsu cores. He also assigned the name Momijiyama Industry to a delicate conical core assemblage in Hokkaido (1968:151,156). Similarly, Oda (1969:40) proposed that the preceramic culture in the Japanese islands consists of two lithic categories: the backed blade industries and the microblade industries.

Although the term *industry* is not used in this study, the definitions offered by Irving and Sheets are preferred.

e. Summary

All four of the archaeological terms discussed above have been used by archaeologists in microblade studies. Generally, the definitions of these units are extremely ambiguous and far from consistent. For example, we cannot see clear-cut boundaries between microblade culture and microblade tradition, or between Anderson's American Paleo-Arctic Tradition and West's Denali Complex. Nelson's Shabarakh-usu Culture, Wang's Xiachuan Culture, Giddings' Denbigh Complex, and Anderson's Akmak and Kobuk Complexes look more like industries, and some industries defined by Japanese archaeologists are more like complexes or traditions. Hayashi's Japanese Microblade Tradition and the Yubetsu Tradition are obviously two different notions (1968:155,156), while Hayashi's (1968) Japanese Microblade Tradition and Oda and Keally's (1979) and Oda's (1969) "microblade industries" refer to the same thing. It is difficult to understand the boundary between the Yubetsu Industry, the Yubetsu technique, and the Yubetsu Tradition, and there is also no obvious difference between the Dyuktai Culture and the Dyuktai Tradition.

The terminological problems encountered by archaeologists stem from changes in our understanding of the past. Many terms are employed provisionally in the course of archaeological study and are modified or abandoned as knowledge improves. The study of microblade technology is still in its earliest stages and these problems are to be expected until more data are available and further analyses are conducted. Aside from operationalizing relevant terms in the preceding discussion, sorting out problems of nomenclature shall not be a concern of this study.

B. OTHER ISSUES RELATED TO MICROBLADE RESEARCH

This section will discuss several issues related to microblade research. First, although the overall chronological sequence of microblades from East Asia and North America supports a migration and diffusion interpretation, the lack of tight stratigraphic and dating control makes it difficult to establish firm temporal relationships between sites on a more than local basis. Second, although the occurrence of microblades in diverse environments would support migration and diffusion, very few sites have yielded palynological or faunal evidence. Third, it is argued that it is irrelevant to use the function of microblades to account for migration and diffusion. Fourth, raw materials and their occurrence are crucial to technology and mobility. However, a complete lack of information concerning lithic sources and their distribution makes it impossible to use raw materials to interpret migration and diffusion. The discussion of these issues indicates that conventional comparative techno-typology is still the useful approach for the analysis and the explanation of cultural relationship in microblade research.

1. Stratigraphic and Chronological Data

Stratigraphy and chronology are essential for archaeological research, but many microblade assemblages recovered over the past sixty years either lack stratigraphic information or are poorly dated. The stratigraphic and chronological information pertaining to microblade assemblages in these regions are summarized below.

a. **China**

Microblades have a broad distribution in China, however, to date their spatial and temporal sequences have not been firmly established. Several Upper Paleolithic and Mesolithic microblade assemblages have yielded both stratigraphic and chronological information. Microblade assemblages from Chaishi, Xiachuan, Xueguan, and Hutouliang were unearthed from sediments at various depths of the second terrace of the Fuyuhe, the Xingshuihe and the Sangganhe. At many localities of Xiachuan, abundant lithic remains were exposed on the surface due to heavy erosion. Chashi has yielded two radiocarbon dates. One of 40,000 B.P. from charcoal is thought to be incorrect. The other, of 24,450±800 B.C. (ZK 653-1), which is thought to represent the age of the assemblage, was obtained from shell (Wang 1986), a notoriously inaccurate dating material. Nine radiocarbon dates from Xiachuan gave a time range of about 10,000 years. Since the dating samples were collected during the second excavation and their provenances are still unavailable, no detailed comment can be made until the excavation report is published (Institute of Archaeology 1983). Xueguan and Hutouliang provided single radiocarbon date. The provenances of these sample were not reported (Gai and Wei 1977; Gai 1985; Wang et al. 1983).

The Daxingtun assemblage at Angangxi was unearthed from the first terrace (Stratum 1) about 0.4-2.5 m below the surface. Animal bones collected from Stratum 1 gave a single date of 11,800±150 B.P. (PV-369) (Huang *et al.* 1984; Ho and Jiang 1991).

Only one of six localities at Layihai has been excavated. A microblade assemblage was unearthed from a sandy loess layer in the second terrace. The assemblage was thought to be Mesolithic, based on a single relatively recent date and on the absence of Neolithic remains (Gai and Wang 1983).

There are several sites in North China assigned to the late Pleistocene but lacking chronometric determination. These include Shibazhan in Heilongjiang Province, Dabushu in Jilin Province, Youfang, Donghuishan, Huanghua in Hebei Province, and Lingjing in Henan Province.

Five localities at Shibazhan are located on the second terrace along the Humahe. No faunal remains have been found at the site (Wen 1986; Ho and Jiang 1991). The Dabushu assemblage was discovered in a brownish paleosol layer about 3 m below the surface. The site was thought to be an *in situ* deposit on the second terrace of Lake Dabushu (Dong 1989). The Yufang assemblage was unearthed from a loess deposit about 6-10 m thick which was overlain by 0.3 m of cultivated soil (Xie and Cheng 1989). The Donghuishan assemblage was found in a greyish sandy layer on the second terrace, and 4 m below the surface (Institute of Cultural Relics of Hebei 1989). The microblade remains at Huanghua were reported to have been found *in situ* but their stratigraphic context is unknown due to the inaccessibility of older sediments below the groundwater level (An 1989). The stratification at Lingjing was destroyed during construction (Zhou 1974). One wedge-shaped core was found about 8 m below the surface at Guxiangtun, but the stratigraphy and chronology are still problematic (Teilhard de Chardin 1939; Lu 1986).

Microblades of more recent periods are widespread in three provinces of Northeast China and the provinces of Inner Mongolia, Xinjiang, Hebei, Shaanxi, Shanxi as well as in southern and southwestern China, such as Sichuan, Tibet, Yuannan and Guangdong provinces. The majority of these discoveries have yielded no chronometric dates.

Abundant Neolithic microblades from the three provinces of Northeast China have been reported to be derived from a distinctive black soil deposit. This deposit called "Tantu Black Soil" was formed during the middle Holocene, about between 7570 and 4820 years ago, and represents moist and warm climatic conditions accompanied by dense vegetation (Sung *et al.* 1981; Huang *et al.* 1984). This sediment is widespread in the Songhuajiang-Liaohe Plain that extends across most of the three provinces. Microblade assemblages from Angangxi in Heilongjiang Province and Beizhifu, Jielaxi. Hongqinaobao in Jilin Province were all embedded in this deposit. This black soil layer is either situated at the surface or overlain by a yellowish sandy layer of varying thickness (Liang 1959, Gai 1977; Huang *et al.* 1984).

The stratigraphic placement of microblades differs tremendously from place to place in Inner Mongolia. The microblade remains at Hailar, in the eastern part of the province, were either embedded in a brownish soil layer about 0.6 m thick or exposed on the surface of a sand deposit where the brownish soil was blown unearthed from a loess deposit about 6-10 m thick which was overlain by 0.3 m of cultivated soil (Xie and Cheng 1989). The Donghuishan assemblage was found in a greyish sandy layer on the second terrace, and 4 m below the surface (Institute of Cultural Relics of Hebei 1989). The microblade remains at Huanghua were reported to have been found *in situ* but their stratigraphic context is unknown due to the inaccessibility of older sediments below the groundwater level (An 1989). The stratification at Lingjing was destroyed during construction (Zhou 1974). One wedge-shaped core was found about 8 m below the surface at Guxiangtun, but the stratigraphy and chronology are still problematic (Teilhard de Chardin 1939; Lu 1986).

Microblades of more recent periods are widespread in three provinces of Northeast China and the provinces of Inner Mongolia, Xinjiang, Hebei, Shaanxi, Shanxi as well as in southern and southwestern China, such as Sichuan, Tibet, Yuannan and Guangdong provinces. The majority of these discoveries have yielded no chronometric dates.

Abundant Neolithic microblades from the three provinces of Northeast China have been reported to be derived from a distinctive black soil deposit. This deposit called "Tantu Black Soil" was formed during the middle Holocene, about between 7570 and 4820 years ago, and represents moist and warm climatic conditions accompanied by dense vegetation (Sung *et al.* 1981; Huang *et al.* 1984). This sediment is widespread in the Songhuajiang-Liaohe Plain that extends across most of the three provinces. Microblade assemblages from Angangxi in Heilongjiang Province and Beizhifu, Jielaxi, Hongqinaobao in Jilin Province were all embedded in this deposit. This black soil layer is either situated at the surface or overlain by a yellowish sandy layer of varying thickness (Liang 1959, Gai 1977; Huang *et al.* 1984).

The stratigraphic placement of microblades differs tremendously from place to place in Inner Mongolia. The microblade remains at Hailar, in the eastern part of the province, were either embedded in a brownish soil layer about 0.6 m thick or exposed on the surface of a sand deposit where the brownish soil was blown away (An 1978). At Haolebanor in New Balhu Left Banner, about 150 km to the southwest of Hailar, a microblade assemblage was found in a layer of black soil about 1 m thick which was overlain by either a permanent or shifting sand layer. At the village of Ershijiazhi near Huhhot, the microblade remains, pottery, and hearths were discovered in a surface loess layer about 1-1.5 m thick (Wang 1963). Similar conditions were encountered at the sites near both the village of Wayao and Xini County in the Yikeshao Leager, in the middle part of Inner Mongolia. Microblade remains were exposed either on the surface or embedded in hearths (Wang 1963; Gai 1983). The microblade remains from the village of Dayifaquan in the Chahal Right Banner, in the middle part of Inner Mongolia, were found from both surface and a brownish fine sand layer about 1 m thick (Inner Mongolia Museum 1975). No chronometric dates have been obtained from any of these sites.

At Fuhegoumen, the Balin Left Banner in the southeastern part of Inner Mongolia, a large collection containing microblade remains, pottery, polished stone tools and bone tools was unearthed from 37 dwelling deposits and 12 hearths in the surficial layer. A single radiocarbon date gave an age of 2785$\pm$110 B.C. (ZK-188) (Xu 1964; An 1981).

The Sven Hedin Expedition has catalogued a total of 327 sites in Inner Mongolia. Little stratigraphic information is available for these sites. The majority of cultural remains was in surface collections (Maringer 1950).

The microblade assemblages from Shayuan, Yaozhitou and Gaoshanzheng in Shaanxi and Shanxi Provinces are all surface collections (An and Wu 1957; Chen and Ding 1984; Chen *et al.* 1985).

Microblades from southern provinces such as Sichuan, Tibet, Yunnan, and Guangdong are mainly surface collections as well. Only Xiqiaoshan in the Guangdong Province yielded chronometric information.

A large quantity of microblade remains at Zhongzhipu in Sichuan Province was either collected from surface or unearthed from the plough zone about 30-60 cm in depth (Wang 1991). In Tibet, only a few microblade remains from Nielamu were discovered from *in situ* deposits (An *et al.* 1982; Dai 1972; Qiu 1958). The Heihe locality and 18 localities at Shenja and Shuanghu were all open air surface sites. Microblade remains at Yuanmou in Yunnan Province were surface collected (Zhc · and Zhang 1980). In Guangdong Province, microblade remains and heavy-duty stone tools occur all over the hill of the Xiqiaoshan site. Radiocarbon dates range between 6000 and 4500 B.P., but their provenances are not clear (Huang *et al.* 1982).

In the eastern provinces of Shangdong and Jiangsu, microblades are most surface occurrences. At Fenghuangling, Heilongtan, Zhaike, and Junan in Shandong Province, microblades have been collected either on the surface or in the uppermost layer which was often disturbed by cultivation (Xu 1984; Xu and Xu 1986; Yuan *et al.* 1989; Kong 1990). In the mountainous region of Malingshan, Jiangsu Province, microblades are either exposed on the bedrock or found in very thin colluvial sediment on the slopes (Ge and Lin 1985; Zhang 1985). No chronometric information is available from sites in these two provinces.

b. **Outer Mongolia**

In Outer Mongolia, detailed stratigraphic and chronological data pertaining to microblade development are not yet available. The Andrews Expedition in the late 1920s led to the discovery of 180 Stone Age sites. Most were surface collections from the desert and steppe, except Shabarakh-usu which was reported to be a stratified site. American and Soviet archaeologists have held different views about the age of the lower level at that site (Chard 1961; Maringer 1963; Nelson 1926a,b).

A stratified site at Moil'tyn-Am on the Orkhon River was reported ranging from the Upper Paleolithic to early Neolithic. Four cultural levels were identified in a 1-1.5 m deposit. The microblades from the upper level were assigned to the Mesolithic. A number of sites comparable to Moil'tyn-Am were reported along the Orkhon River valley and in the Ulan-Bator region. In addition, many sites assigned to the terminal Upper Paleolithic or Mesolithic were found on river terraces south of Sukhe-Bator (Chard 1962:12, 1964:10-12).

Microblade assemblages assigned to the Neolithic were associated with pottery and ground stone tools. These assemblages were usually contained in the remains of dwellings or hearths. At the site in the Dalan-Dzadgada region near Shabar-us, artifacts and hearths were exposed on the surface where the top sandy layer has been deflated. At the site in the Pestroi valley, not far from Tugriken-Shiret, wind-eroded hearths were surrounded by concentrations of microblades and other artifacts. Numerous Neolithic sites found in the Tuqriken-Shiret district were thought to be contemporaneous with the Shabarakh-usu site, but their stratigraphic contexts are unknown (Chard 1962:12, 1964:10-13, 1974:82).

Owing to the inaccessibility of recent information, this description of the Outer Mongolian sequence must be considered extremely tentative. Based on the available data, few microblade assemblages have been dated by chronometric methods. The chronological sequence has been established on the basis of either typological comparisons or the presence and absence of Neolithic or metal artifacts (Chard 1971; Maringer 1963).

c. **Japan**

As Serizawa and Ikawa (1960:34) have noted, precise stratigraphic information on many microblade sites has not always been available. This situation seems to have undergone no significant change according to Oda and Keally's 1979 report. The chronological sequence in Kyushu is better understood than before owing to the discovery of two stratified cave sites at Fukui and Senpukuji. Since these loam deposits comprise mainly volcanic ash, few organic materials survive in archaeological sites to provide radiocarbon dating samples.

Fukui and Senpukuji are two important cave sites containing both stratigraphic and chronometric information. At Fukui, a 5.5 m thick deposit was divided into 15 natural layers. Regrettably, seven radiocarbon dates from the cultural layers contradict their stratigraphic sequence (Morlan 1967b; Aikens and

Higuchi 1982). The 2 m thick deposit at Senpukuji was divided into 40 natural layers or 12 cultural horizons (Tang 1985:255). According to Aikens and Higuchi (1982:104), however, the same deposit was divided into 13 natural layers. The cultural layers containing the earliest pottery and microblade remains were dated by both radiocarbon and thermoluminescence methods (Ichikawa and Nagatomo 1978:174; Ikawa-Smith 1978, 1980, 1986; Tang 1985:256).

The microblade assemblage from Yadegawa was embedded in the uppermost part of the loam deposit (Serizawa and Ikawa 1960:34). A similar assemblage from Yasumiba was also found in the upper part of a brownish volcanic loam which was overlain by a surface soil about 2 m thick. Two dating results based on both radiocarbon and obsidian hydration methods are available (Aikens and Higuchi 1982:69). The Yadegawa-Yashumiba industries are comparable to the industry in Fukui layers 4 (Hayashi 1968:152; Morlan 1976b:186).

Microblade assemblages similar to the Yadegawa-Yasumiba industries were reported to be widespread from Kanto to Kyushu in southwestern Japan. They were derived from either buried or surficial sites. The study of these sites is complicated by their short term occupation (Oda and Keally 1979:11).

In Hokkaido, Chubu, and Tohoku, microblades spanned a longer duration than those in southwestern Japan, but the established sequence is not without its critics (Oda and Keally 1979:11). The Shirataki site is the most productive and best studied site in northern Hokkaido (Serizawa and Ikawa 1960; Morlan 1967a). The preceramic localities occur mostly on the third, fourth, and fifth terraces. Microblade remains were found in the sediments varying from 0.2 to 2 m below the surface. Except Locality 31, most localities were thought to be *in situ* deposits. The Shirataki site has also yielded a series of obsidian hydration measurements. Three radiocarbon dates from Locality 31 are in good agreement with one another. Unfortunately, they may not be contemporaneous with the cultural remains due to secondary deposition (Chin-Yee 1980; Morlan 1967a, 1967b). In addition, some sites in Hokkaido such as Sakkotsu in Mombetsu County and Okedo in Tokoro

County, yielded both stratigraphic information and hydration measurements, but some site such as Towarubetsu at Yakumo Town, Oshorokko in Mombetsu County, and Tachikawa in Isoya County yielded only hydration measurements but no stratigraphic information. There are several undated sites in Hokkaido, such as Toyoda in Tokoro County, Tarukishi in Suttsu County, and Togeshita in Abuta County. Microblade remains were either found in sediments (Tarukishi) or collected from the surface (Togeshita) (Morlan 1967a).

The microblade assemblage at Araya in northern Honshu was contained in a 1 m sandy loam mantled by humus. There are two radiocarbon dates, but one is considered out of context (Aikens and Higuchi 1982; Ikawa-Smith 1978; Serisawa and Ikawa 1960).

d. **Eastern Siberia**

The chronology and stratigraphy of microblade assemblages in eastern Siberia are better established than those in China, Outer Mongolia, and Japan, although the credibility of some early sites on the Aldan has been questioned.

In the region of the upper Angara and the upper Lena, the sites assigned to the Upper Paleolithic offered only stratigraphic information. Five strata at Makarovo I ranged from the Bronze to Mesolithic Ages, but no chronometric dates are available (Powers 1973:41). At Verkholenskaya Gora, microblades in the middle layer were assigned to the Mesolithic (Chard 1971:6). The stratigraphy at Krasnyi lar were described differently by Abramova and Chard. Seven cultural layers were described by Chard (1971:6), with microblades occurring in layers 6 and 7. In contrast, nine natural levels and three cultural layers were reported by Abramova, with microblades occurring in the second layer (Abramova 1965:122-127).

In the Aldan region, a series of microblade sites yielding both stratigraphy and chronology have been reported. The Dyuktai Cave is a well stratified site. Regrettably, the descriptions provided by different authors are not consistent. Powers (1973:47-52) reported that Mochanov divided the deposit into 14 cultural layers, layers 3-14 belong to the Upper Paleolithic. Michael (1984:5-6) stated, however, that nine strata were identified, and strata 5-9 were Upper Paleolithic. In contrast, Tseitlin's statement differs from both of the above authors. He noted that Mochanov distinguished 12 cultural levels which can be grouped into three layers and that all Upper Paleolithic finds were concentrated in Layer 3. Six radiocarbon dates have been reported from this layer (Tseitlin 1979:222-223). Geologically, the Dyuktai Cave is situated on the second terrace of the Aldan River. Verkhne-Troitskaya, on the same terrace, was thought to be slightly earlier than the Dyuktai Cave, but its geological context is unclear (Mochanov 1978:55; Michael 1985:16-17; Tseitlin 1979:230). Ezhantsy, Ust'Mil, and Ikhine, assigned by Mochanov (1978) to the proto-Dyuktai industry, are all situated on the third terrace of the Aldan. Lithic remains and animal bones were obtained either from the surface or from varying depths in sandy and loam deposits. Radiocarbon testing provided dates ranging from 35,000 to 24,000 B.P. (Hopkins 1985; Mochanov 1978, 1980, 1986; Tseitlin 1979). Sporadic collections, reversed dating sequences, and supposed cryoturbation at Ezhantsy, Ust'Mil, and Ikhine led some scholars to suspect that they might have suffered postdepositional modification (Ackerman 1985; Hopkins 1985; Yi and Clark 1985). In the Aldan region, several microblade sites assigned to the "Holocene Upper Paleolithic" or the Mesolithic were grouped in the "Sumnagin Culture." Bel'kachi and Sumnagin I are two multi-layered sites situated on the first terrace of the Aldan. Fifteen of 23 cultural layers at Bel'kachi were identified to be the "Sumnagin Culture." Sixteen of 27 radiocarbon dates gave the "Sumnagin Culture" a time range between 8500 and 6000 B.P. Mochanov correlated the microblade assemblage from Layer 15 at Sumnagin I with Layer 8 at Bel'kachi. Three radiocarbon dates were obtained from the Sumnagin I (Mochanov and Fedoseeva 1986; Powers 1973:60,68; Tseitlin 1979:221).

Ustinovka and Osipovka are two multi-layered sites in the Amur and Maritime region. The microblade assemblage at Ustinovka came from the lower cultural horizon. Its age was estimated on the basis of typological comparisons (Powers 1973:33-35; Michael 1984:48).

In the Northeast region, the Ushki Lake sites have been well studied stratigraphically and chronometrically. Located in the deposits of a 4 m terrace, eight cultural layers were grouped in two major cultural units. The lower four layers belong to the Upper Paleolithic. A series of radiocarbon dates were obtained from Layers 5, 6, and 7. In addition, many surface collections assigned to the Upper Paleolithic or the "Dyuktai Culture" were reported. They are Maiorych on the Kolyma River, and Kurupka I, Ul'khum, Chaatamye, and Kymynanonvyvaam in the extreme east of the Chukchi Peninsula (Powers 1973:76,77; Michael 1985:21; Dikov 1987:4).

e. **North America**

Dixon (1985:47) has pointed out that the cultural chronology in central interior Alaska is characterized, with a few exceptions, by a lack of naturally stratified sites and is mainly based on widely scattered sites and site components. This comment is also applicable to most regions where microblade sites are found throughout northwestern North America. Many microblade assemblages of presumed early age are either surface occurrences or embedded in the layer nearest the surface, with the exception of several stratified sites such as Healy Lake, Dry Creek, Onion Portage, GHB 2, Ugashik Narrows, and Bluefish Caves.

Five components were identified at Healy Lake. Microblades were produced from four successive components which are covered by the sod on the top. Unfortunately, the chronometric data of these components have not been yet reported (Cook 1989; Dixon 1985:49).

Dry Creek is one of the best stratified sites in Alaska, but postdepositional modification was identified there. Four archaeological components were identified from a profile about 2 m thick. A microblade assemblage was embedded in a loess layer about 1.3-1.6 m below the surface. Eighteen radiocarbon dates were obtained from the site, but three of them are considered questionable (Powers and Hamilton 1978; Powers and Hoffecker 1989; Thorson and Hamilton 1977).

Anderson established an eight-band stratigraphic sequence at Onion Portage based on information from scattered localities. The Akmak Complex assigned by Anderson to the lowest layer under Band 8 was in fact recovered from an ancient surface 30-50 cm below the modern surface (Anderson 1968:28, 1970:13).

At GHB 2, six soil zones and three cultural components were identified in Terrace III. The lower components containing microblades were uncovered within soil zones IV and V. A chronological sequence was firmly established by a series of radiocarbon dates (Ackerman *et al.* 1979:198,200).

The Ugashik Narrows archaeological stratum is located at the base of a loess-like soil about 1-1.5 m below the surface. A series of radiocarbon dates is available (Dumond *et al.* 1976:21; Henn 1978:36).

The Bluefish Caves are thought to be the earliest microblade site so far found in North America. A total of seven units was distinguished from 2 m of deposit in Cave I. One microblade was reported to be out of context but assigned by Cinq-Mars to Unit VI. One wedge-shaped core and microblades were unearthed from the lower part of the loess in Cave II. A mammoth scapula near the microblades gave a date of 20,000 B.P. (Cinq-Mars 1982:7,8,22; Morlan and Cinq-Mars 1982:368; Morlan 1987:286,287).

Many assemblages assigned to the American Paleo-Arctic Tradition were derived from either shallowly buried or surface sites. The assemblage at the Campus site was recovered from a muck layer (Nelson 1937:268). Observations made in 1966 confirm the lack of obvious stratigraphy noted in the 1930s, although the assemblage is ascertained to be derived from undisturbed context (Mobley 1991:9,15). In the Tangle Lake region, three horizons, A1, A2, and B, were reported. Microblades were found from A2 and B, but below the A1 of the buried soil. It is unclear whether this context is applicable for all twelve sites. No chronometric determinations are available (West 1975:77; 1980:166, 1986). At the

Donnelly Ridge site, most artifacts were found on the gravel surface and in blowouts or in the top 2-3 cm of soil. No stratigraphy was observed (West 1967:363,365). Eleven localities at the Yunalik site in the arctic coastal plain and 17 prehistoric small sites in northern Alaska are all shallow surficial expressions (Gal 1982; Geriarch 1982).

In the Northwest Coast, many microblade assemblages were uncovered from stratified shell midden sites such as Whalen, Argyle Lagoon, Cadboro, Montague Harbour, and Namu. Microblades were derived either from uppermost sediments (Whalen) or from a few metres below the surface (Namu). The stratigraphy at Namu was firmly dated by a series of radiocarbon determinations (Carlson 1960, 1979; Sanger 1968a). Lawn Point and Kasta on the Queen Charlotte Islands are two stratified localities. Microblades were uncovered from lower cultural components about 2 m below the surface. Several radiocarbon dates were obtained from Lawn Point (Fladmark 1986a).

On the Columbia Plateau, Sanger reported a cluster of microblade sites at the Lochnore-Nesikep Locality and recognized up to seven components at many sites. Unfortunately, no detailed stratigraphic and chronometric data are available (Sanger 1970a:1). Drynoch Slide, Natalkuz, Marron, Ryegrass, and Windy Springs were reported to be the stratified sites, but cultural contexts were uncertain. Drynoch Slide yielded a single radiocarbon date, but there is no chronometric data for others (Sanger 1968a).

In the Northwest Territories, the assemblages at Pointed Mountain, Great Bear Lake, and Site 42 on the Mackenzie River were found by MacNeish to be located within the humus or just under it. A series of radiocarbon dates are available for the Pointed Mountain assemblage (MacNeish 1953, 1954, 1955; Morrison 1987).

In Alberta, two microblade collections were obtained from a blowout on the High River and unearthed from levels from 15 to 60 cm below the surface at the Bezya site (Le Blanc and Ives 1986; Sanger 1968). In addition, Ice Mountain and

Batza Tena are two obsidian quarry sites without reported stratigraphy or chronology (Clark 1972; Smith 1971; Fladmark 1985).

A few sites assigned to the Denbigh Flint Complex of the Arctic Small Tool Tradition were found in Alaska. Microblades were found from a sandy loam about 50 cm below the surface at Iyatayet of Cape Denbigh, from six occupation levels and six shallow house floors at Onion Portage, and from the surface alongside the Anaktuvuk River. In addition, similar assemblages were also found in the coastal region around Hotham Inlet, on the Kobuk and Noatak Rivers, and in the Brooks Range (Anderson 1970:9,10; 1972:75,76; Giddings 1951:193; Irving 1951:52). Five radiocarbon dates were obtained for the Iyatayet assemblage. The earliest dates of about 5000 B.P. were thought by Giddings to represent the age of the complex but were thought by McGhee to be problematic because none of the Arctic Small Tool Tradition variants known from Alaska can be dated earlier than 4000 B.P. with certainty (McGhee 1974:127).

f. **Summary**

Stratigraphy and chronology are important for tracing cultural change and development, and for accounting for migration and diffusion. Judging from the above, three major chronological problems affect the presently available microblade data:

1. With few exceptions, most microblade assemblages are from components derived from a single stratum or from the surface. Interregional or intraregional analysis is largely based on widely scattered sites. Such analysis is further impaired by a lack of chronometric determinations. Stratigraphic analysis has been primarily used to assess *in situ* deposits, and intrusion of more recent remains rather than to establish spatial correlations.
2. Although the chronological sequence as a whole is consistent with a trend of either migration or diffusion of microblade technology from East Asia to northwestern North America, the basic problem is the difficulty in firmly

establishing a temporal relationship between local sites. Some sites, such as Hutouliang and Layihai in North China, consist of more than one locality but yield only one single date. Some sites, such as Fukui Cave in Japan and Ust'Mil in eastern Siberia, yield dating series incongruous with the stratigraphy. While others, such as the Campus site, Donnelly Ridge, and Denbigh yielded radiocarbon dates which are difficult to interpret.

3. Several multi-stratified sites such as Fukui Cave, Senpukuji Cave, Dyuktai Cave, Ushki Lake, Bel'kachi, Bluefish Caves, Dry Creek, and Namu yielded both stratigraphic and chronological data. These sites are significant in establishing both interregional and intraregional cultural relationships. Such sites, however, are too few in number to be correlated temporally and spatially. In addition, microblade samples from some sites such as Dyuktai Cave, Bluefish Caves, and Namu are too small to permit a detailed comparison with other assemblages.

2. Paleoenvironments

Andrefsky (1987) has suggested that similarity in artifacts may be the result of environmental similarity, because similar artifacts could be needed to exploit similar environmental resources. Although detailed information on late Pleistocene and early Holocene environments is still not available for many regions, it is highly likely that the paleo-environmental conditions where microblade-using groups lived were extremely diverse.

Faunal and palynological data provide evidence of environmental and climatic conditions which may in turn be indicators of subsistence patterns. Unfortunately, few microblade sites in East Asia and North America have yielded these data. A brief description is given below.

a. **China**

Our understanding of late Pleistocene and early Holocene paleoenvironments in China is mainly based on sedimentological and paleobiological studies. The data from microblades sites alone are too meagre to reconstruct climatic change and paleoenvironmental diversity during this period.

In North China, the late Pleistocene is also called the "Phase of Malan Loess" after a widespread greyish-yellow loess deposit. According to interpretations of loess deposits profiles at Luochuan in Shaanxi Province, the climate in North China was primarily warm and moist during the early period of the late Pleistocene between 40,000-35,000 and 25,000 years ago, but became arid and cool between 25,000 and 10,000 years ago. During the warm and moist period, precipitation was high. Lakes increased in number, expanded, and were widely distributed in the provinces of Inner Mongolia, Xinjiang, Qinghai and Tibet. The desert shrank and loess accumulation decelerated. The vegetation was characterized by grassland and mixed deciduous and coniferous forest. The contemporary mammalian fauna from the Shalawusu (Sjara-Osso-Gol) site consisted of many species adapted to a cold-arid climate and a few adapted to a warm-moist climate. Palynological research indicates that xylophyta and herbs were in the ratio of 56:43 (Huang 1989:221; Qi 1989:303-304).

The period between 25,000 and 10,000 B.P. witnessed an arid and cold climate and environment. Inland lakes shrank, desiccated, or disappeared. Loess accumulation accelerated. Grassland and forests in many regions were replaced by steppe and desert. Sand dunes enlarged and became more active. The average temperature in North China was about 7-9 degrees lower than at present. The fauna and pollen data from the Shiyu site in Shanxi Province and the Hutouliang site in Hebei Province suggested an arid grassland environment (Gai and Wei 1977:290-291; Jia *et al.* 1972:41-47; Huang 1989:221-222; Qi 1989:306). Olsen suggests that expansion of playa and semi-playa deposits in Xinjiang Province, southern and western Inner Mongolia reveals a continuous paleoclimatic change from the Upper Paleolithic to the Iron Age. Large numbers of stone age artifacts and microblades occur in desiccated playa or lacustrine sediments probably belonging to the early Holocene. He suggests that the extensive desert of northwestern China was a relatively recent phenomenon and might have been caused by complicated natural and man-made factors (1987:105,108).

Paleoenvironments during the late Pleistocene in South China are not yet as thoroughly understood as those in North China due to the complex topography and extreme environmental diversity of the south. The studies mainly depend on faunal data recovered from caves. The fauna in association with human remains found at Xizhu in Yunnan Province, at Liujiang, Tiandong, Tubo, and Duan in Guangxi Province, and at Tongzi in Guizhou Province all contain fossils of orangutan and gibbon, indicating a tropical forest environment. The fauna assemblages recovered from Dantu and Lishui in Jiangsu Province contain monkey (*Macaca speciosa*), brown bear (*Ursus arcos*), rhinoceros (*Dicerorhinus* sp.), and buffalo (*Bubalus cf. wansjocki*), suggesting a subtropical environment covered by forest and grassland. In the mountainous area of Sichuan Province, the fauna in association with human remains found at Luho are characterized by species living in cold and arid environment such as zokor, wild ass, and cattle (Han and Xu 1989:362-363).

The early and middle Holocene between 10,000 and 5000 B.P. was a period with warmer temperature and abundant moisture. Palynological studies indicated that climatic situations from Northeast China, the North China Plain, East China to Xinjiang and Tibet have shown a consistent pattern of vegetational and environmental changes involving the rise and decline of forests and fluctuations in their composition (Chang 1986:72,74; Qi 1989:312). A profile about 60 m thick at Zhalainor (Djalai-nor), near the city of Manzhouli (Manchuria) in Inner Mongolia revealed a drastic climatic change from the late Pleistocene to the middle Holocene. The two lowest layers (5 and 6), which dated to about 33,760 B.P., indicated an arid and cold climate. Spruce was common in these two layers. Layer 3, ranging between 11,460 and 7070 B.P., showed a climatic amelioration towards warm and moist conditions. Birch, pine, lamb's-quarters, wormwood, and herbs became the dominant vegetation. The composition of the Zhalainor fauna revealed a transition from members dominated by the "woolly rhinoceros and mammoth fauna" to those of the Holocene fauna. Microblades, pottery, various bone tools, and human remains were found in this layer (Shi 1978; Qi 1989:308).

Both faunal and palynological evidence is not always available from microblade sites. Sporadic information obtained from these sites provides a picture generally corresponding to the paleoenvironmental situation described above.

A very few fragmentary mammalian fossils belonging to deer and wild cattle were found at Xiachuan. Xueguan and Hutouliang contained relatively abundant animal remains. The principal components included wild horse, wild ass, deer, wild cattle, boar, ostrich and various species of voles. The fauna reflected a semi-grassland and semi-desert condition (Gai and Wei 1974; Wang *et al.* 1978; Wang *et al.* 1983).

Both faunal and palynological studies at Daxingtun indicated a arid and cold steppe environment when the upper Paleolithic microblade-using occupants lived at the site. Faunal remains included wild horse, wild ass, bison, wild cattle, and various voles. Pollen spectra from the occupation layer included: sage (*Artemisia*), lamb's quarters (*Chenopodiaceae*), scandent hop (*Humulus*), grass (*Gramineae*), composite (*Compositae*), and birch (*Betulaceae*).

The paleoenvironment changed drastically during the early and middle Holocene in Northeast China. When the Angangxi microblade-using groups lived in the same area during the middle Holocene, the climatic conditions were much warmer and more mild (Huang *et al.* 1984; Sun 1981).

Although the Layihai assemblage was dated to the middle Holocene, the climatic and environmental conditions still seem arid and cool which contrasts sharply to the areas of the Central Plain. The mammalian fossils at Layihai included: goat (*Ovis* sp.), fox (*Vulpes vulpes*), marmot (*Marmota himalayana robusta*), sand rat (*Meriones* sp.), steppe hare (*Ochotona* sp.), and one big rib of horse or wild cattle (Gai and Wang 1983).

Guxiangtun in Heilongjiang Province yielded abundant faunal remains which were characterized by the typical late Pleistocene "woolly rhinoceros and mammoth fauna" in Northeast China (Qi 1989:308). The principal members of Guxiangtun fauna are: mammoth (*Mammuthus primigenius*), woolly rhinoceros (*Coelodonta antiquitatis*), horse (*Equus caballus*), wild horse (*Equus przewalskyi*), wild ass (*Equus hemionus*), mule (*Asinus* sp.), Ordos giant deer (*Magaloceros ordosianus*), bear (*Ursus spelaeus*), wolf (*Canis lupus*), tiger (*Panthera tigris*), red deer (*Cervus elaphus*), moose (*Alces alces*), wild buffalo (*Bubalus wansjocki*), wild cattle (*Bos primigenius*), bison (*Bison priscus*), hyena (*Crocuta ultima*), cat (*Felis catus*), roe deer (*Capreolus capreolus*), sika deer (*Cervus nippon hortulorum*), and different species of voles, etc. Unfortunately, their association with microblade remains is unknown (Lu 1986; Tokunaga and Naora 1936; Wei and Wen 1983).

The palynological analysis of a Neolithic microblade site at Dayifaquan Village, Cahar Right-Middle Banner, Inner Mongolia, indicates that environmental and climatic conditions in the middle Holocene provided a steppe and semi-desert vegetation (Zhou *et al.* 1975). The main pollen spectra includes: Ephedra (*Ephedre*), sage (*Artemisia*), lamb's-quarters (*Chaenopodiaceae*), and a small amount of pine, oak, and composite. This situation was very similar to that encountered at the Layihai site on the Qinghai Plateau.

As described earlier, microblade sites are found in the Himalayas, about 4300 m above sea level, to the eastern lowlands of China, only 55-60 m above sea level. They are also found on the Loess Plateau which runs along the Huanghe, and in steppe and desert areas of Xinjiang, Inner Mongolia, and Tibet. It is interesting to note that many sites were located in areas which are either now uninhabitable or supporting only low-density populations. Olsen (1987) has suggested that this might be the result of combined climatic deterioration and agrarian mismanagement in the historic period. Because of the extreme diversity and drastic change of paleoenvironments, during the late Pleistocene and the early and middle Holocene, it is unreasonable to presume that the spread of microblade technology was simply a response to environmental similarity.

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b. **Japan**

In Japan, very few faunal remains have been found at microblade sites. This is partly due to the fact that bone and antler rarely survive the high acidity of volcanic soils (Chard 1974; Ikawa-Smith 1982). However, some faunal assemblages slightly earlier than microblade industries may give some insight into the late Pleistocene fauna of Japan. The "Hanaizumi Fauna" of northern Honshu, dated about 20,000 B.P., contains: horse (*Equus caballus ferus*), wild ass (*Equus hemionus*), bison (*Bison priscus Bojan*), auroch (*Bos primigenius*), Ordos giant deer (*Sinomegacros ordosianus*), moose (*Alces kinryuensis*), and mastodon (*Paleoloxodon namadicus*). This fauna reveals an arid and cool grassland environment. In addition, mammoth has been recorded on Hokkaido (Ikawa-Smith 1976:79).

In addition to faunal evidence, palynological studies indicate a cool environment during the late Pleistocene. Except for northern Hokkaido and high mountains, the Japanese archipelago was forested during the glacial and late glacial periods. Hokkaido exhibited a sub-alpine coniferous forest containing spruce (*Picea*), pine (*Pinus*), fir (*Abies*), sage (*Artemisia*), hemlock (*Tsuga*) mixed with cool temperate broad leave trees such as beech (*Fagus*), oak (*Quercus*), blue beech (*Carpinus*), hazel (*Corylus*).

A tundra vegetation was also present. Birch (*Betula*) was dominant from the full glacial to the late glacial period. A decline of spruce, pine, fir, and hemlock indicates the beginning of a warmer climate about 10,000 years ago. At the end of the last glaciation, there was a rapid increase of deciduous broadleaf forest species, which replaced spruce and other conifer species in Hokkaido.

In northern Honshu, there was dense sub-alpine coniferous forest with a few broad leaf trees. In central Honshu, pine, fir, and hemlock were dominant genera between 13,000 and 12,000 years ago. Birch, hazel, and oak appeared suddenly about 12,000 years ago.

In southwestern Japan, sub-alpine coniferous trees such as spruce, fir, and hemlock were present but not in great frequency. They were mixed with temperate trees such as: oak (*Quercus*), beech (*Carpinus*), elm (*Ulmus*), alder (*Alnus*). Beech reached its maximum development about 10,000 B.P.

Drastic vegetational change occurred in the early Holocene due to climatic warming. Warm temperate evergreen forests were spreading in southernmost Japan. Mild climate allowed the growth of a broadleaf deciduous to mixed forest. The number of broadleaf deciduous trees decreased toward the central mountains and northern parts of the islands. In Hokkaido, however, some sub-alpine coniferous trees were still frequently present (Andrefsky 1987:38-40; Tsukada 1986:31-37; Yasuda 1978:162-165).

Yasuda points out that when microblade-using groups lived both in southwestern and northern Japan, there was a strong contrast in paleoenvironmental condition. From Hokkaido to central Honshu, the vegetation was dominated by sub-alpine coniferous forest mainly composed of spruce, fir, and hemlock. Southwestern Japan, on the other hand, was dominated by a mixed forest of sub-alpine conifers, mainly spruce, and temperate deciduous broad leaved trees, such as oak, beech, elm, hazel, and birch (1978:170).

Chin-Yee also notes that when the Yubetsu technique flourished in Hokkaido, southern Tohoku, and central Honshu, the paleoenvironments varied in these regions. Northeastern Hokkaido was essentially park land with birch (*Betula*), while southern Tohoku was subalpine forest mixed with cool temperate trees such as: beech (*Fagus*), oak (*Quercus*), blue beech (*Carpinus*), hazel (*Corylus*), and birch (*Betula*). In central Honshu, hemlock (*Tsuga*) was dominant in the pollen profiles (1980:103-104).

c. **Eastern Siberia**

Our knowledge of climate history and vegetation patterns in this region is still fragmentary. During the late Pleistocene or the Sartan glacial period which commenced some 22,000 B.P. and terminated about 10,500 B.P., eastern Siberia experienced considerable aridity and a markedly continental climate (Powers 1973:13).

The faunal species in the late Pleistocene were predominantly large herbivores. Among these, reindeer were relatively abundant, and wild horses and wild cattle also occur in archaeological contexts. Mammoth and woolly rhinoceros appear to have been fairly abundant as well (Klein 1971). The principal species included: mammoth (*Mammuthus primigenius*), woolly rhinoceros (*Coelodonia antiquitatis*), wild horse (*Equus przewalskii*), wild ass (*Equus hemionus*), steppe bison (*Bison priscus*), musk ox (*Ovibos moschatus*), moose (*Alces alces*), snow sheep (*Ovis nivicola*), wolf (*Canis lupus*), arctic fox (*Alopex lagopus*), pika (*Ochotona pusilla*), lemmings (*Lemmus sibiricus*), hare (*Lepus* sp.), and various kinds of vole (Mochanov 1978; Powers 1973). According to the vertical distribution of fauna in the Dyuktai Cave, animal bones were concentrated in Layers V to XI. Mammoth was the most common species. Arctic fox, hare, and grey vole were relatively abundant but far less than mammoth. The remains of 31 other species, including horse, moose, reindeer, bison, and musk ox, were extremely few in number (Powers 1973:51). Although Mochanov (1986:702) claimed that the people of Dyuktai Culture were hunters of mammoths, woolly rhinoceros, bison, horse, oxen, and other big game, Morlan (1987:297) has pointed out that "we have no idea how they were hunted, how exploitation of seasonal resources was scheduled, or how food was stored for the winter."

The vegetation during the late Pleistocene in eastern Siberia was characterized by either dry tundra or periglacial steppe. A small remnant of larch-pine forest and scattered stands of birch and larch were confined along the major river valleys. A long tongue of steppe extended from southwest Siberia eastward between the cental Siberian Plateau and Lake Baikal as far as Yakutsk on the Middle Lena. The Cis-Baikal region contained a widespread tundra with scrub birch. The western Trans-Baikal appears to have been more arid. Vegetation was composed mainly of sage (*Artemisia*), lamb's-quarters (*chenopodes*), and ephedra (*Ephedra*). The mountains of southern Siberia were covered with a montane dark coniferous forest with pine and larch. In the highland of eastern Siberia, there was montane larch forest with some pine and birch. The upper reaches of the

Indigirka and Kolyma Rivers and a large area of Kamchatka and the entire coast of arctic Siberia were covered with fern, moss, and tundra with scattered stands of shrub birch. The interior seems to have been relatively dry, creating a stony tundra in some places (Giterman *et al.* 1982; Hopkins 1979; Klein 1971; Powers 1973; Savvinova 1986). The transition from the last glacial epoch to the Holocene started about 10,000 years ago. Vegetation during the beginning of the Holocene was marked by the spread of sparse pine and larch forests and shrub alders. At the same time, dwarf cedar, birch, and willow also started to flourish. The climatic optimum was established about 8500-8000 years ago (Lozhkin 1986; Savvinova 1986).

Pollen studies of some microblade sites provide us with an insight into the climate and environmental condition in eastern Siberia. At Ust'Mil II, the Karginsk warm interval about 30,000 B.P. reveals coniferous forest of pine, spruce, and larch. The Sartan stage between 22,000 and 10,800 B.P. witnessed a taiga vegetation with the reduction of arboreal species such as pine, spruce, and tamarack. Shrub tundra dominated by birch (*Betula*) was in existence at 12,000 B.P. (West 1981:15)

At Ikhine I, the pollen spectra from the upper 80 cm of Layer B indicate the domination of taiga characterized by pine. Underlying Layer B are two other zones; immediately below, one that may be characterized as "open tundra", and beneath that, another taiga series. A small number of cultural remains were found in Layer B (Mochanov 1978:56; West 1981:51-52).

At Ezhantsy two zones are indicated, taiga and underlying open tundra. The latter is characterized by a cold, open, woodless landscape. The cultural remains were found in the lowest parts of Terrace III (Mochanov 1978:56; West 1981:52).

As some authors suspected that geological agencies might have caused disturbances at Ust'Mil, Ikhine, and Ezhantsy (Ackerman 1985, Hopkins 1985, Yi and Clark 1985), the pollen data from these sites may or may not be relevant to the cultural remains.

Belkachi I revealed increasing warmth. The vegetation was represented by forest tundra between 9000 to 6000 B.P.

The pollen records at Ushki Lake are among the most complete for eastern Siberia. The base of the sequence, about 15,000 B.P., is characterized by a xeric or stony tundra landscape with scattered shrubs of alder and birch. After 10,300 B.P., birch became dominant and the vegetation is called a shrub moss tundra. In the Chukochi Peninsula, there was a brief interstadial warm episode between 12,000 to 11,000 B.P. characterized by steppe tundra (West 1981:52).

d. **Northwestern North America**

The paleoenvironment of the late Pleistocene and the early Holocene of eastern Beringia has been extensively studied. Powers and others reported that the Tanana Lowland in interior Alaska supported a steppe-tundra environment between 17,000 and 14,000 years ago. Pollen spectra contained: high percentages of grass (*Gramineae*), sage (*Artemisia*), sedge (*Cyperaceae*), willow (*Salix*), and small percentages of spruce (*Picea*), birch (*Betula*), and alder (*Alnus*).

Between 14,000 and 10,000 B.P., eastern Beringia underwent a major climatic and vegetational change. The steppe-tundra vegetation was rapidly replaced by a shrub tundra which was composed of shrub birch, willow, sedge, grasses, and heaths with an increase in the abundance of dwarf birch and widespread peat accumulation. Trees were present along river valleys and would have represented a relatively favourable environment, providing shelter for animals (Ager 1982; Andrefsky 1987; Giterman *et al.* 1982; Griffin 1979; Hopkins 1982; Janossy 1986; Powers *et al.* 1989; Schweger 1982).

Pollen studies from archaeological sites in Alaska and Yukon Territory reveal that the vegetation during the interval between 14,000 and 8000 B.P. was characterized by shrub tundra, steppe tundra, birch-shrub tundra, and sedge-moss tundra (West 1981:36). At approximately 11,000 to 10,000 B.P., the time when wedge-shaped microblade cores were used, the climate and environment of Beringia was much like that of the region today. Ager (1975:85) and Thorson and Hamilton (1977:175) have suggested that the environment near Dry Creek about 11,000 to 8500 B.P. was windswept and rather barren under late glacial conditions. The area was probably an arctic steppe biome sparsely vegetated by grasses and herbs. Pollen diagrams obtained from Bluefish Caves indicate that the vegetation was a treeless herbaceous-tundra which was followed by a marked rise in birch (*Betula*), and then by the appearance of spruce (*Picea*) (Morlan and Cinq-Mars 1982:367-368). Pollen spectra from Bluefish Caves correspond to the palynological evidence elsewhere in eastern Beringia indicating that much of the area lacked forest during the interval about between 24,000 and 14,000 B.P. Birch increased from about 14,000 to 10,000 B.P. Spruce invaded central Alaska shortly after 10,000 years ago (Griffin 1979:31; Matthews 1982:149).

Late Pleistocene and early Holocene megafauna recovered from eastern Beringia are similar to those in eastern Siberia. The principal components of what Russian paleontologists called the "mammoth fauna" or "Upper Paleolithic fauna" occur at site after site eastward from western Europe through the Ukraine and Siberia to Alaska and the Yukon. Harington (1980, see Grayson 1988:112) mentioned that of 22 species of late Pleistocene mammals, excluding human beings, known in northeast Siberia, 21 are also found in Alaska. The exception was the woolly rhinoceros, whose absence from North America is still a puzzle (Giterman *et al.* 1982:73; Grayson 1988:112; Matthews 1982:139; Sher 1982:523). The mammalian fauna near Fairbanks was dominated by mammoth, horse, steppe bison, and caribou. Although many megafauna remains have been reported in eastern Beringia, most microblade sites of the area do not contain any animal remains except the Campus site, Dry Creek and Bluefish Caves. Most of the faunal material from the Campus site consist of small burned and calcined bone fragments which are considered to be culturally produced by burning. The fauna contains: bear (*Ursus* sp), beaver (*Castor canadensis*), hare (*Lepus americanus*), wolf (*Canis* sp), Arctic ground squirrel (*Citellus parryi*), and bison (*Bison priscus*) (Mobley 1991:71).

Poorly preserved faunal remains at Component II of Dry Creek included Dall sheep (*Ovis dalli*) and bison (Powers and Hamilton 1978). Bluefish Caves yielded a well preserved faunal assemblage (Cinq-Mars 1979:26,27; Morlan and Cinq-Mars 1982:368). Radiocarbon dates from various faunal localities in central Alaska reveal that much of the steppe-tundra mammal community was still present but gradually declining during the period between 14,000 and 10,000 years ago (Powers *et al.* 1989).

e. **Summary and Discussion**

According to both faunal and palynological evidence available at present for East Asia and North America, it is clearly evident that microblade technology was employed by people living in diverse environmental conditions. During the late Pleistocene, with a few exceptions, climatic conditions in most parts of North China, Outer Mongolia, eastern Siberia, Japan, and northwestern North America were arid and cold. Paleoenvironments in these regions were characterized by coniferous forest, dry grassland, steppe-tundra, taiga, and moss-tundra. The climate appears not to have ameliorated until the early Holocene. It can be suggested that when microblades flourished in these regions during the late Pleistocene, few plant food resources were suitable for human consumption, and microblades might represent a technology adapted to the exploitation of faunal resources, which were usually available year round and easy to locate, procure, and process. Such a generalized culture could have helped these people explore an unknown territory without modifying their technology or life style.

Kelly and Todd (1988:233) state that drastic climatic and environmental change during the period between the late Pleistocene and early Holocene might have had a great impact on the density of local game populations. Decline or extinction of local fauna would produce periodic stress on hunting groups who had only two options to cope with it: either switch to different resources in the same territory or move to new territories. In many circumstances, migration is thought to have been the easiest choice.

Both options for coping with the stress of changing food resources are observable from archaeological evidence. For example, the microblades from the Fuhegoumen site in Inner Mongolia were found in association with hand-made grit-tempered pottery, and a large number and variety of bone fishing tools. Remains of dwellings indicate a sedentary settlement pattern. Unique forms and designs of pottery, distinctive forms and manufacturing techniques of stone and bone tools may have reflected reorganization and specialization of subsistence pattern which differed significantly from other assemblages in the same area (Inner Mongolian Team 1964:5). Microblade assemblages found in the Angangxi area during the late Pleistocene (the Daxingtun site) and middle Holocene (the Angangxi site) belong to people living in different environments (Huang *et al.* 1984; Liang 1957). Microblades found in the midden sites along the Northwest Coast in North America suggest a local maritime adaptation (Carlson 1960, 1979; Sanger 1968a). To many microblade-using groups in East Asia and northwestern North America, high mobility strategies may be assumed as means of coping with periodic resources stress. It is reasonable to suggest that the movement of microblades from Northeast Asia to North America was closely linked to a strong dependence on faunal resources and the frequent shifting of hunting territories under harsh environmental conditions.

3. Functions of Microblades

One thorny issue in searching for homology is the question of how microblades were used. Functional interpretations rely on an understanding of activities and subsistence patterns tied closely to ecological and environmental conditions. If we know the activities in which microblades were involved, the factors governing their migration or diffusion can be better understood. Powers and Hoffecker (1989:273) point out, however, that despite the growing number of microblade sites discovered, remarkably few have been analyzed for their subsistence strategies.

Microblades, like microliths, have been traditionally viewed as being related to hunting activities (An 1978:307; Clarke 1976:452; Dumond 1978; Fladmark 1986b; Jia 1978:140; Myers 1989:80; Pei 1954:38). Although the use of microblades as insets into laterally slotted hafts is documented by finds from the North Chinese Neolithic, eastern Siberia, and Alaska (Chard 1974; Jia 1978; Larsen 1968; Mochanov and Fedoseeva 1986; Outwater 1957; Wyatt 1970), there is little evidence of microblade utilization derived from East Asian Upper Paleolithic assemblages. In addition to use as insets, microblades in more recent periods were manufactured for use as various small tools, such as arrowheads, scrapers, drills, and burins (Chard 1974; Gai 1977, 1983; Inner Mongolian Team 1964). In North America, evidence shows that microblades were inset on the end of hafts probably used for artistic carving (Carlson 1987; Wyatt 1970). Microblades in Northwest Coast are assumed to have been fish-knives (Fladmark 1986b:48).

John Clark mentions that ready-made blades are functionally highly flexible. Unmodified blades serve well as scraping and cutting tools, while modified ones can be used as drills, gravers, burins, or other special purpose tools (1987:268,269). David Clarke states that equating microliths with a meat diet may be a stereotype and misleading. In addition to being employed for hunting and meat processing, European microliths may have been also used in composite tools for various activities such as fishing, fowling, plant-gathering, harvesting, slicing, grating, plant-fibre processing for lines, snares, nets, and traps, or used as shell openers, bow-drill points, and awls (1976:452). Odell argues, however, that Clarke's interpretation might be speculative. His own use-wear studies indicate that the microliths from the Mesolithic settlement of Bergumermeer appear to have been used mainly for hafting on arrow shafts or butchering. Only limited evidence showed that they might have been used for cutting, slicing, and sawing (1981:329,330). Myers claimed that microliths in the context of the British mainland were the components of projectile technology. A number of discoveries have been made where microliths were found still embedded in animal bones. In addition, there are a number of cases in which the original composite microlithic tools have been found, such as well-preserved arrows with microliths. There are no cases indicative of their use for vegetable processing or reaping (1989:80). Hayden (1989:13) postulates that hafted blades with the working edge at their distal ends could be resharpened over and over again like sharpening a pencil. Hofman (1987:91) suggests that blades from Middle Woodland Hopewellian assemblages in the eastern United States might be used as funeral offerings, status markers, and units of exchange. In Mesoamerican civilization, prismatic blades might serve as an important metaphor of sociopolitical relationship (Clark 1987:281).

Ethnoarchaeological observation reveals that most flaked stone tools are multi-functional. Tools used by aborigines and their functions postulated by archaeologists are not always consistent (Odell 1981; White and Thomas 1972). Based on both archaeological and ethnographic data in general, it is reasonable to suggest that the function of microblades could have been more variable than we had previously thought. The data available at present are still not enough to solve this problem.

Paleoenvironmental contexts do not support a single functional interpretation either. Chin-Yee states that a technology adaptable to varying environments will obviously have higher possibility of widespread usage. She argues that if the tool itself is multi-functional, the possibility of its adoption by a hunter-gatherer group on the move is much greater (1980:100).

It seems hopeless at present to discuss migration and diffusion in terms of functional similarities or variations, since it requires an intimate knowledge of microblades and the context in which they operated. It is also impossible to use function to measure cultural relationships between assemblages without taking into consideration such varied factors as the active modes of microblades, the role they played, and the ends they met.

4. Raw Material Variation

Collins has stated that raw material variation, mode of occurrence, and means of acquisition determine the qualities of the resulting product group (1975:20). Analysis of material variation and spatial distribution will be helpful in assessing such important issues as technological tradition, and migration or diffusion.

Goodman (1944:416) pointed out that "the choice of certain material may be purely a matter of tradition." This statement is partly correct because the selection of a desirable raw material is crucial for distinct techniques or for producing specific tool types. Therefore, a study of technology is not complete without knowing the properties of the raw materials and their influences (Crabtree 1967; Goodman 1944; Straus 1980; Torrence 1989). On the other hand, inaccessibility of raw material may play a great role in technological change, since technology will be adjusted to fit the specific constraint of a particular situation. Bordes (1971:212) states that raw materials will influence the technique more than the typology of the finished stone tools. Patterson and Sollberger (1976:40) have also mentioned that the type of raw materials can greatly affect the quality of finished tools, even more than the limitation in size of raw materials. In North America, evidence indicates that change in technological tradition might have been the result of change of lithic quality during the Paleo-Indian stage (Hayden 1981:520). In his research of blade technology in a Middle Woodland Hopewellian assemblage, Hofman (1987:98) notes that blades made from different raw materials may exhibit variation resulting from technological differences imposed by the raw materials, rather than being the result of purposeful design. According to these statements, it is reasonable to suggest that technological stability may have a close connection with the accessibility of suitable raw materials as well as the stability of subsistence pattern and mobility, and that technological change could be caused by change of raw materials or subsistence pattern.

In terms of the relationship to the environment, Hayden regards lithic raw materials as similar to plant food resources (1989:8). Suitable raw materials for a distinctive technology or for a specific task are not ubiquitous in the environment. The procurement of desirable raw materials is not a big problem for highly mobile groups but will greatly influence less mobile groups. To those less mobile groups who lived in an area lacking suitable materials, long distance transportation and exchange of good quality materials may be inevitable if they want to keep using sophisticated lithic technology. Other adjustments may include the procurement of local materials of poorer quality, and economizing on the consumption of desirable materials. The specific roles of different raw materials should be reflected in assemblages in terms of discard rates and artifact use-life (Jeske 1989).

Raw material variation of microblades in East Asia and northwestern North America as a whole reveals fairly homogeneous selections. Several high quality materials such as flint, chert, obsidian, compact quartzite, and hard shale which can be worked in the same manner (Bordes 1971) were widely used in microblade manufacture. Although only limited information is available about lithic sources in East Asia and northwestern North America, the stability of raw material selections in most assemblages generally reflect both technological stability and high mobility.

Basalt and obsidian were materials commonly used in microblade manufacture in many assemblages of the Columbia Plateau and the Northwest Coast. The high discard rate of basalt cores and almost total consumption of obsidian cores by the bipolar technique (Carlson 1979; Sanger 1968a) may indicate both local procurement of basalt and distant transportation of obsidian. Conversely, consistent use of flint and chert in some sedentary sites such as Fuhegoumen in Inner Mongolia and Ushki Lake in eastern Siberia suggests the presence of exchange or distant transportation of high quality materials if these materials are not accessible nearby.

Analysis of the relationship between raw material variation and technology is one of the themes of this study. Unfortunately, it is still impossible to discuss the issue of procurement and mobility in many cases, since we have little information about the distribution of raw materials in given regions, and cannot assign raw materials in given assemblages to their specific sources.

C. CONCEPT AND ANALYSIS

1. Type and Style

This section discusses the concepts of type and style, two different but closely connected terms in lithic analysis. As discussed earlier in this Chapter, both morphological and technological approaches have been widely used by many Asian and North American archaeologists in their microblade research. Some of them have contributed significantly and provided a systematic framework to such research (Ambiru 1979; An 1978; Anderson 1970a; Gai 1984; Hayashi 1968; Jia 1978; Kobayashi 1970; Mochanov 1978, 1980, 1986; Morlan 1967a, 1970, 1978; Nelson 1937; Powers 1973; Powers *et al.* 1983; Sanger 1968a, 1968b, 1970a, 1970b; Smith 1971, 1974; Tsurumaru 1979).

Typological classification has been used as an analytic tool in archaeology to identify differences and similarities among phenomena (Hill and Evans 1972). Typology is also used to compare artifacts and assemblages found in different places, and is considered a specific language used by archaeologists to communicate their research results. Methodologically, typological classification in general is an arbitrary and empirical process. Criticizing the ambiguity of such approach, Odell (1981:319) has pointed out that "one can classify lithic material according to technique of manufacture, morphology, or function", and Dunnell (1978:192) has stated that "identical terms are given different meanings by different authors; different authors use different terms to mean the same thing." Therefore, a standardized terminology based on common criteria for classifying and describing lithic materials is helpful and necessary.

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Although over the past sixty years, East Asian and North American archaeologists have reached similar conclusions with respect to microblade research, they have tended to focus on data found in their own regions. Consequently, their methodologies, classifications, and terminologies are not always consistent with each other. Fortunately, these differences are not serious enough to impede comparisons.

In studies of lithic materials, there are different ways of establishing a typological classification. One can classify implements according to either their functions, their morphologies, or manufacturing techniques (Cahen and Van Noten 1971; Jelinek 1976). Meltzer (1981:313) mentions that many lithic typologies are morphological in character and derivation. Such typologies are often extended to explain human activities or cultural relationships. He also notes that tool morphology is determined by technology which in turn is determined by tool function (1981:313,315). Therefore, we may be certain that morphology, technology, and function are three closely connected aspects of a stone artifact.

The classification which I would like to employ is based on core morphology and technology. My analytic strategy follows Rouse's analytic classification which "is done by forming successive series of classes, focusing on different features of the artifacts. Each class is characterized by one or more attributes which indicate a procedure to which the artisan conformed" (Rouse 1960:317).

My strategy uses two steps to classify microblade cores. The first step is to classify type according to the core morphology. Although *type* is thought to be a term without a single definition accepted generally by typologists (Cahen and Van Noten 1971), it is referred by Hill and Evans (1972:233) to "a group that has been formed on the basis of a consistent patterning of attributes of the materials or events." As far as stone artifacts are concerned, every morphological variable has an equal potential for either a functional or a stylistic interpretation. If such variable has no apparent functional correlates, it can be assigned to stylistic factors which are thought to be culture-historically significant (Jelinek 1976:20; Sackett 1973:324, 1982:63). With respect to microblade cores, each core type is distinguishable according to morphologically common attributes. Some types are then subdivided on the basis of manufacturing techniques. Functionally, these core forms were designed and prepared to produce microblades. Since the end products of different core types--microblades--are basically the same except for differences in size, these varied forms and techniques are stylistically significant and have to be viewed as representing different options chosen by the artisans to pursue the same goal. Specific temporal and spatial occurrence suggests that these cores types are the products of socially conditioned choice made by artisans and the formal similarity among these cores possesses a high diagnostic value in identifying their ethnic relatedness.

The typological terms of various microblade cores are derived from the existing literature. It should be noted, however, that similar terms used by different writers do not always have identical meanings, and sometimes different terms refer to the same thing. For example, wedge-shaped and boat-shaped cores often refer to a similar core type, and conical cores are sometimes called cylindrical or prismatic cores. Therefore, before using these typological terms, precise definitions have to be made.

Shape is the first impression archaeologists encounter when they begin examining microblade core collections. In lithic analysis, morphology of stone tools has long been used as a basis for either indirectly inferring functions or directly defining cultural boundaries. Meltzer has commented that this approach may lose attendant information pertaining to the variability of the object's attributes, and overlook the fact that shape is a continuous variable whose distribution can show a wide range of variation (1981:315). From this perspective, the morphological approach is obviously insufficient without taking further analytic steps into consideration. Thus, at the second level of the classification, I divide some of the core types, especially the wedge-shaped cores, into subtypes by technique.

As mentioned earlier, many archaeologists consider that wedge-shaped core typology based on morphology is not sufficient to compare specimens found in different regions. In the other words, morphologically similar wedge-shaped cores could be produced using different techniques. Thus, examination and comparison of the dynamics of the manufacturing process are thought to be a fundamental step in core classification. As Sackett (1989:51) asserts in his discussion of burin typology:

> The term "typology" is no longer restricted to its literal meaning of categorizing lithic artifacts into discrete type classes. Today it refers to investigating their morphology, or formal variation in more comprehensive terms, placing at least as much emphasis upon the need to understand the dynamics that lie behind their patterning as upon the task of ordering it in terms of artifact classifications.

A techno-typological approach which combines core morphology and the dynamics of manufacture will be the major analytic strategy in this study of microblade cores.

In order to use the core typology to trace cultural relationships, it is necessary to give a brief review of a frequently discussed and controversial concept, *style*, which is thought to embody symbolic meanings of ethnic groups. The concept of style defined by Wobst (1977:321) is: "formal variability that is related to the participation of artifacts in the processes of information exchange." Close (1989:4) gives a similar definition as follows: "style is formal variation in artifacts that transmits information about social identity." Sackett (1982:63) states that stylistic analysis "concerns the manner in which morphological, or *formal*, variations among artifacts reflects culture-historically significant units of ethnic tradition."

The definitions of *type* and *style* show certain correlation between these two concepts. Based on Hill and Evans' definition, a type is thought to be a *classified* category in which artifacts with distinctively similar characteristics are grouped together. In this sense, a type is a division or a component unit of assemblages identified and defined by archaeologists. In terms of Wobst and Close's definition, a style is thought to be inherent in materials (Conkey 1990:10) or an *intrinsic* category in which distinctively formal characteristics are shared by artifacts or assemblages through time and space. Thus, style may or may not be necessarily identified c employed by archaeologists in their classification, although the definition of artifact types are often based on styles. If stylistic attributes of artifacts are used as the criteria in typological classification, the type of artifacts or assemblages can be seen as a manifestation of the style.

According to Conkey, style may be viewed as a conceptual process or a cultural code that produces variability in material culture and is related to the social context of manufacture and use. Such a conceptual process exhibits some degree of standardization which implies characteristics of social groups and information transmission and exchange. Thus, style has been implicitly used by many archaeologists as an indicator of social boundaries among prehistoric cultures (1978:67,70,71, 1990:11).

Stylistic similarity is thought by many archaeologists to be a homologous similarity, and the result of cultural contact or common decent (Conkey 1990:15; Dunnell 1978:199; Meltzer 1981:318; Sackett 1977:371). Explaining the correlation between style and social identity or ethnicity, Sackett states that there ordinarily exists a broad spectrum of options in material cultures and a given artisan uses only a few options from this spectrum which are largely dictated by craft traditions within social groups (1982:73, 1985:277, 1990:33). He further notes:

> Since material culture is largely the product of learned behaviours that are socially transmitted, there exists a strong and direct correlation between the specific choice a society makes and its specific position in the stream of culture history.
>
> The degree of similarity in choices observable in the design and manufacture of craft products should constitute a reasonably direct measure of the social interaction of the people who made and used them (Sackett 1982:73,74).

In lithic analysis and comparison, a given tool type can be based only on either stylistic or functional attributes at a given time (Jelinek 1976:20; Sackett 1973:324). Although microblade cores in general have functions in microblade manufacture, typological classification based on shapes and techniques can be seen as only stylistically relevant. Diverse choices of core shapes and techniques are largely dictated by technological traditions and do not have detectable selective value. Since style is thought to be selected in a cultural system and is thought in general to be nonfunctional, it is reasonable to conclude that stylistic similarity is the evidence of ethnic relatedness or cultural relationship (Close 1989:7; Meltzer 1981:314; Sackett 1982:74, 1990:33; Trigger 1968:34).

With the challenges of the "New Archaeology" to the culture-historical approach, a concept of culture-as-adaptive-systems has strongly influenced the use of style in archaeological interpretation. Conkey (1990:9) argues that according to the adaptive-systems approach, stylistic patterns can be treated as "coded information about variability in and the functioning of past cultural systems." She further assumes that stylistic variation can be considered as if it were a language, and that if material culture traits are treated as products of cultural systems, artifact style is referable to the "social context of manufacture and use" of an item (Binford 1965:208).

Sackett pointed out that unlike other artifacts such as decorated pottery, which usually exhibits a high and unambiguous diagnostic value of ethnicity, lithic style is usually subdued and mainly expressed in terms of the choice of raw materials, the knapping techniques to produce preforms, and alternative modes of secondary retouch (1985, 1990). As far as microblades are concerned, manufacture and use of this unique stone tool could be seen as culturally conditioned activities. First, cultural invention is thought to be a random phenomenon (Dunnell 1978:197). Owing to a broad spectrum of alternative options, tasks can be fulfilled by various approaches without using microblades. Second, microblades represent a highly characteristic lithic technology and is peculiar to a specific time and space. Distinct choices of core shapes and techniques in microblade production tend to be quite specific within a given group at a given time and are largely dictated by the technological tradition. Neither core shapes nor techniques are crucial for the purpose of microblade production. Whichever core shapes or platform patterns were selected or employed, all end products -- microblades -- are generally the same. The complexity of microblade manufacture might represent different approaches to reach similar end products and might be the result of technological elaboration developed within the cultural system rather than being independent of such system. Similar choices made by unrelated groups are thought to be as remote as the number of potential options is great (Sackett 1990:33). In this sense, the selection of given core shapes and platform patterns can be seen as expression of concepts shared by artisans in socially related or transmitted groups to reach the same goal. Therefore, core types, preform and platform patterns can be seen as a relevant measurement to trace the relationship between ethnically related groups.

Based on the preceding argument that stylistic similarity reflects information exchange and social interaction, the techno-typological analysis and comparison of microblade cores can be reasonably employed to trace cultural relationship through time and space.

2. Morphological Classification

In my previous studies, I identified and classified six major microblade core types by examining microblade industries discovered in North China, northeast Asia and North America (Chen 1983, 1984). These types are the wedge-shaped, conical, boat-shaped, cylindrical, semi-conical, and funnel-shaped cores. I still think that most microblade cores found in East Asia and North America can be classified using these categories, although irregular forms and forms which fall between these categories can also be distinguished. The following is a detailed description of these six major core types.

a. **Wedge-shaped Core**

This core type is the first to be identified and has been the most extensively studied. There are several alternative names given to these cores (Gobi cores, Campus type cores, celt-shaped cores, boat-shaped cores, tongue-shaped cores, fan-shaped core, etc)., but wedge-shaped is the one most widely accepted and used by archaeologists. The wedge-shaped core is a broad typological category which refers to the product of different manufacturing processes or techniques, that result in cores that are morphologically similar. Hayashi (1968), Morlan (1970), Sanger (1968a), and Mobley (1991) have provided detailed morphological descriptions of these cores. Here, I quote Morlan's definition as an example.

> Such cores have elongate platforms, but the fluting chord is in the short axis of the platform and the flutes are marginally distributed. The broad faces of the specimens are irregularly flaked, and the margin opposite the fluted surface may form either a wedge or a flat surface of some kind (Morlan 1970:18).

According to Morlan, four main "elements" of wedge-shaped cores are:

(1) Face element: the two main faces of the core are either flaked from one or more of their margins or they may be cortical surfaces or unretouched flaking surfaces;
(2) Platform element: this forms one margin of the face elements. It is a flat juncture between the faces which may be formed by blows delivered from any direction on the platform plane. It may also include an angular juncture of the faces which is distal to the platform itself with respect to the flute element;
(3) Flute element: this is a second relatively flat juncture of the faces and occurs adjacent to the platform element. This element is formed by microblade removal from the fluting arc which forms the juncture between the platform element and the flute element. The flute element may also include a angular or flat juncture of the face distal to the flutes themselves;
(4) Wedge element: usually an angular juncture of the faces in typical wedge-shaped cores but may be a flat, flaked or cortical surface in some specimens. The wedge element forms the third margin of the face elements and extends from the distal end of the fluted element to the distal end of the platform element. The wedge can be described in terms of one or more segments (Morlan 1970:18,19).

It should be noted that the description of wedge-shaped cores given by Morlan is based mainly on specimens found in North America and Japan. An additional form of wedge-shaped core which is overlooked by Morlan contains elongate fluted and wedge elements and a short platform element which I have called narrow-bodied wedge-shaped cores (Chen 1983).

In addition, several specific wedge-shaped cores have been distinguished and defined in terms of preform and platform techniques. These core types and techniques will be discussed in detail below.

b. **Conical Core**

This type of microblade core normally has a circular or oval platform with flutes formed on part or all of the core body. In some, the core body tapers sharply downward to form a point. Thus, this type of core is also called a pencil-shaped core (Jia 1978). In other specimens, the body runs parallel to the long axis and then tapers to a point near the distal end. These are sometimes called prismatic cores (Chard 1962).

c. **Boat-shaped Core**

This name has sometimes been used as an alternate name for wedge-shaped cores. I propose to restrict the term boat-shaped cores to those have a broad body and an untrimmed platform. The two faces of the core are formed by blows struck on the platform, which consists of a cleavage plane or a single flake scar. Thus, wedge-shaped and boat-shaped cores are technologically different. The faces of the wedge-shaped core are formed mainly by flake scars that originate the margins. Morlan (1967a:173) named the manufacturing process for boat-shaped cores "the Horoka technique."

d. **Cylindrical Core**

Maringer (1950) and Morlan (1970) place "cylindrical" and "conical" cores in the same category. In my classification, however, I propose to use the term cylindrical core to define a core type which has a platform on each end and which have removed microblades alternatively from end to end. This may represent the attempt to rejuvenate a platform on the distal end after the failure of the original platform. However, many preforms of cylindrical cores from Inner Mongolia exhibit a prepared platform on each end, indicating they are a distinct core type.

e. Semiconical Core

This core type is called tabular in North America. Morlan has described them as follows:

> Tabular cores have elongate platforms on which the long axis parallels the fluting chord. The fluting chord is a straight line or plane which lies between the ends of a restricted fluting arc. In tabular cores the flutes may be said to be facially distributed in the sense that they occupy a broad face of the specimen. Adjacent smaller faces are irregularly flaked as is the broad face opposite the fluted surface (Morlan 1970:18).

f. Funnel-shaped Core

This type of cores has a wide round platform which is sometimes trimmed and sometimes untrimmed. The diameter of the platform is always larger than the height in their initial stage of microblade reduction. The manufacturing process is similar to conical cores, but they have much broader platforms than conical ones. Microblades have been removed from around the perimeter of the platform. The bottom or distal end of the core is an intact small flat plane or an obtuse point.

The percentages of different core types within an assemblage will be calculated in my research. As argued above, the preferences for making particular core types may be determined by the socio-cultural context of the artisans. Thus, a statistical analysis of core type frequencies may help identify the traditional method of microblade technology shared by culturally related artisans.

3. Technological Classification

In my research, I will use the technological approach as a second step in classifying core types according to their manufacturing patterns. Several diagnostic attributes directly relevant to core manufacture will be selected for detailed statistic analysis. These attributes include the following.

a. **Raw Materials**

As discussed before, raw material variation may provide important information on technology, tradition, and mobility, although raw materials may also be related to such factors as tool size and manufacturing expediency (Straus 1980:71).

b. **Preforms of Microblade Cores**

Blank shaping and preform preparation is the first step of microblade manufacture and is directly related to the removal process. It constitutes an important element of morphological classification.

c. **Platform Preparation**

The platform is one of the most important aspects of core technology and is directly related to microblade reduction.

In wedge-shaped cores the patterns of platform preparation are the most important criteria for distinguishing different core types or techniques. A series of different platform patterns can be identified.

(1) The platform consists of a weathered plane or single flake scar. These wedge-shaped cores have little platform preparation. A natural surface or flake scar was used directly as a striking platform without trimming.

(2) The platform is prepared transversely to form a plane. When the face elements and wedge element of a core are formed, the platform is flaked from one face to the other in order to shape a flat striking platform. These platforms are either level or bevelled.

(3) The platform is formed by a unique platform technique. The majority of the core preform is a biface. Long ski-like flakes are detached from one lateral edge of the biface to shape a long smooth platform.

(4) The platform consists of tiny multiple facets which were trimmed in the course of microblade production. The core preform is usually a biface. A small plane is prepared at one end of the biface and used

to remove microblades. When this platform is exhausted, successive preparation is done to create a new one.

(5) The platform is prepared longitudinally or around the perimeter. This kind of platform preparation is very common in narrow bodied wedge-shaped cores and was done to produce a flat plane or to adjust edge angles.

In conical and cylindrical cores, two kinds of platforms can be identified.

(1) The platform consists of a weathered plane or a single flake scar.

(2) The platform is prepared around the perimeter to produce a flat plane or to adjust the edge angles.

Boat-shaped and funnel-shaped cores, with a few exceptions, have platforms consisting of a weathered plane, a cleavage surface, or a single flake scar.

In semiconical cores, two kinds of platforms can be identified.

(1) A bevelled or level platform consisting of a flake scar which is formed by a single blow struck from the front to the back.

(2) A bevelled or level platform is prepared by multiple flaking from the front to the back or around the edge of the platform.

d. **Rejuvenation Patterns**

Rejuvenation patterns are another important process in core technology. They are a major characteristic of the platform.

In wedge-shaped cores, three rejuvenation patterns can be identified:

(1) The platform is rejuvenated by multiple, longitudinal blows.

(2) The platform is rejuvenated by the removal of a tablet.

(3) The platform is rejuvenated by the removal of a whole section of the platform.

In conical and cylindrical cores, two kinds of rejuvenation patterns can be identified:

(1) The platform is rejuvenated by multiple blows delivered around the perimeter.

(2) The platform is rejuvenated by the removal of a whole section of the platform.

In semiconical or tabular cores, the platforms were mainly trimmed from the front to the back to adjust the edge angle.

With a few exceptions, most boat-shaped and funnel-shaped cores were never rejuvenated.

e. **The Platform Edge Angles**

Platform edge angle plays an important role in reflecting the technical skill of microblade makers, although microblade cores studied here are all discarded ones, and the measurements derived from these cores no longer represent the effective ranges of edge angle in microblade detachment. Various kinds of factors could influence the abandonment of cores, and the abandonment of cores was not always due to the failure of its edge angle. For instance, access to raw materials must have been an important consideration before a core was discarded. As noted on many specimens, step fractures on the fluted surface may have made microblade removal impossible, despite the fact that the edge angle was still effective. Materials of poor quality usually do not produce microblades if the edge angle is large. Furthermore, different techniques may have different ranges of effective edge angle. Generally speaking, the more obtuse an edge angle, the more difficult it is for a flake or blade to be removed. Whatever the case, a discarded core represents the last stage of microblade detachment. Most measurements of edge angles may reflect the ultimate control capability of a artisan in microblade production. To a certain extent it reflects the artisan's skill, even though the abandonment of the core may be caused by other factors.

In my research, each specimen was measured. The technique for the measurement of edge angle is a goniometer which is similar to a protractor with the addition of a movable arm hinged at the vertex. A core platform edge is placed between the protractor and the movable arm, and the angle is then recorded (Burgess and Kvamme 1978; Dibble and Bernard 1980).

Microblade cores, especially wedge-shaped cores, sometimes contain two types of edge angle which resemble the two kinds of edge angles defined by R. Tringham *et al.* (1974). One is called the *spine-plane angle*. This is measured from the platform to the fluted surface. The other is called the *edge angle* which is defined as "the angle to the plane at which a microflake is detached" (Tringham *et al.* 1974:179; Burgess and Kvamme 1978). This kind of edge angle on microblade cores is measured from the partly rejuvenated platform to the fluted surface. For example, if a tiny tablet is removed from a wedge-shaped core to adjust the edge angle, two edge angles can be measured one from the original and another from the rejuvenated platforms to the fluted surface. The core edge angle measurement will be taken at a precise point along the edge where the axes of the platform and fluted surface converge.

In this study, if a wedge-shaped core has two types of edge angle, both spine-plane angle and edge angle are measured. Wedge-shape and boat-shaped cores containing two fluted surfaces yield two measurements. If a conical or cylindrical core had varied ranges of edge angle, the two extreme measurements are taken. Cylindrical cores usually require two measurements.

In some cases, concave and convex platform and fluted surfaces could cause edge angle measurements to be inaccurate. This problem is reduced by using a retractable arm placed within the concave surface or close to the edge angle.

For convenience of comparison of core edge angles in different assemblages, I divide edge angle variation into two large groups. One is the edge angles of 89 degrees or less. The other is 90 degrees and larger. The percentages of these two groups may reflect differences in core technology between different assemblages, or the degree to which cores were used before they were discarded.

f. **The Core Dimensions**

In lithic analysis, the size and quality of raw materials may have a direct effect on the form of the finished product (Jelinek 1976:24). In addition to flaking techniques, core dimensions may be also related to such factors as raw material, flaking characteristics, and the function and utilization of the microblades. The dimensions may even reflect cultural traditions. In this study, I propose to use a "dimensional index" to express core sizes. The dimensional indices of wedge-shaped, boat-shaped, and semiconical cores are the sum of three measurements, the maximum length, width, and height of a core. For conical, cylindrical, and funnel-shaped cores, the indices are the sum of three attribute measurements, two diameters of the platform and the height of the core body. The two diameters refer to the longest and shortest measurements of the platform (if the platform is circular, the two diameters are the same). Based on my overall examinations of microblade cores, I have arbitrarily divided core dimensions into two groups: large and small cores. Large cores are those yielding indexes larger than 7 cm, and small cores yielding indexes less than 8 cm. The percentages of these two groups are used in inter-assemblage comparisons.

D. ANALYSIS AND COMPARISON

A series of microblade core collections from North China, Japan, eastern Siberia, and North America are selected, analyzed, and compared according to their regional chronological sequences. The microblade assemblages from North China which yield large samples of cores are analyzed separately. Microblade cores found in Inner Mongolia in association with pottery and ground stone tools are grouped into a single complex owing to their uncertain contexts. The wedge-shaped cores found in the "Dyuktai Culture" in eastern Siberia are treated as a single unit. Microblade cores in northwestern North America are analyzed according to tradition. Wedge-shaped cores found from Hokkaido and northern

Honshu are treated as a complex. Those from the Fukui Cave site are analyzed as an assemblage.

1. Analytical Procedure

The analytic process of each collection includes:

a. Site descriptions of microblade assemblage, complex, and tradition.

b. Descriptions of raw materials on which the microblade cores were made.

c. Descriptions and calculations of core type percentages from each assemblage, complex, and tradition.

d. Descriptions of preform, platform and rejuvenation patterns of microblade cores. At this time, core techniques are identified.

e. Measurements of platform edge angles.

f. Measurements of core dimensions.

This is followed by a discussion of the results of the analysis. Given the information provided above, I attempt to delineate techno-typological development of microblade cores in North China, Japan, eastern Siberia and North America. Then, similarities and differences of microblade cores are compared among those collections. Finally, these data are synthesized to provide an overview of the cultural relationship between East Asia and North America.

2. Data

The following summarizes the collections analyzed in this study. Types and numbers of microblade cores introduced are listed in Table 2.

a. North China

The core analysis is organized according to chronological order. Xiachuan and Xueguan are two assemblages dated to the Upper Pleistocene and yield considerable samples. They are analyzed as two separated units. The specimens were examined and measured at the Provincial Institute of Archaeology in Shanxi.

Hutouliang and Jiqitan are grouped into the Yangyuan Complex which is slightly more recent than Xiachuan and Xueguan. The specimens were examined and measured in the Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences in Beijing and the Provincial Institute of Cultural Relics in Hebei.

The Hailar assemblage is named for the materials found at Songshan which is thought to be Mesolithic. Measurements of the specimens from Songshan are taken from An's 1978 publication.

Microblade cores found in many localities in Inner Mongolia are tentatively dated to more recent periods, although their chronometric ages are unknown. These microblade remains are usually associated with pottery and ground stone tools, or even iron items. They are grouped into a general complex called "the Complex Associated with Pottery and Ground Stone Tools." The microblade cores analyzed in this study include the specimens examined in the Museum of Inner Mongolia and in the Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences. These have been recovered from more than dozen sites over the last forty years. The materials from Maringer's 1950 publication are used for typological percentage comparisons.

b. **North America**

North American microblade cores are analyzed in terms of both individual assemblage and tradition. In addition to first hand examination and measurement of specimens at Simon Fraser University, the University of Washington State, the University of Oregon, and the University of Alaska Museum, this analysis includes data from published sources. The materials described here include the assemblages from the Campus site, Dry Creek Healy Lake Ugashik Narrows, Donnelly Ridge, Noatak Drainage sites, Akmak, Tangle Lakes sites, GH 2, and small sites in northern Alaska which belong to the American Paleo-Arctic Tradition;

the assemblages from Namu, Queen Charlotte Islands Heceta Island, San Juan Islands, and Cadboro Bay which were discovered along the Northwest Coast; the assemblages from Ryegrass Coulee, Drynoch Slide, Marron Lake, Central British Columbia, Windy Springs, and Lochnore-Nesikep Locality which belong to the Plateau Microblade Tradition; the assemblages from the Denbigh Flint Complex, Onion Portage, and Cape Krusenstern which belong to the Arctic Small Tool Tradition; and two assemblages from Ice Mountain (Edziza) and Bezya.

c. **Eastern Siberia**

A general review of microblade development is made based on the publications which are available in English. The microblade cores used for comparison include only those from the Dyuktai Culture sites. Wedge-shaped cores are analyzed and measured from illustrations.

d. **Japan**

A general review of microblade development is conducted on the basis of English and a few Japanese publications. The comparison of microblade cores focuses on the assemblages from the Fukui Cave in the southwest and the complex from Hokkaido and northern Honshu.

Table 2. Microblade Cores Used For Analysis

Location	Wedge	Conical	Boat-shaped	Cylindrical	Semi-conical	Funnel-shaped	Total
North China							
Xiachuan	19	110	29	10	54	24	243
measured*	19	67	29	1	24	5	145
Xueguan	19	5	52	-	10	-	86
measured*	19	4	12	-	4	-	39
Yangyuan	266	-	-	-	-	-	266
measured*	64	-	-	-	-	-	64
Hailar	15	5	-	-	-	-	20
Inner Mongolia	58	43	-	8	24	1	134
Maringer's**	660	454	-	333	-	6	1453
North America							
American Paleo-Arctic Tradition	122	-	-	-	-	-	122
Northwest Coast	-	-	-	-	-	-	65
Plateau***	-	-	-	-	-	-	45
Arctic Small Tool Tradition	-	-	-	-	-	-	6
Ice Mountain	19	-	-	-	-	-	19
Bezya	5	-	-	-	-	-	5
Eastern Siberia							
Dyuktai	46	-	-	-	-	-	46
Japan							
Fukui Cave	14	-	-	-	-	-	14
Hokkaido	40	-	-	-	-	-	40
Total (measured)							764

* some cores were missing or unavailable for measurement
** core types are based on illustration and no measurements
*** cores were measured by Sanger (1970a)

CHAPTER IV. - ANALYSIS AND COMPARISON OF MICROBLADE CORES FROM NORTH CHINA

In this chapter, the analysis and comparison of microblade cores from North China are discussed in chronological sequence. According to the radiocarbon results, the Xiachuan assemblage represents a relatively early stage of microblade development. The Xueguan assemblage and the Yangyuan Complex which consists of the Hutouliang and Jiqitan assemblages are slightly more recent than Xiachuan. The Hailar assemblage and the assemblages associated with pottery and polished stone tools mainly found in Inner Mongolia were assigned by Chinese archaeologists and Maringer (1950) to the Mesolithic or more recent periods. Although pottery and polished stone tools appeared in the late Pleistocene in some regions of the World such as Japan (Ikawa-Smith 1986), widespread microblade assemblages in association with heavy-duty ground stone tools and pottery in eastern Inner Mongolia, Jilin, and western Heilongjiang provinces were assigned to the late Neolithic or even the early Chalcolithic periods on the basis of the presence of distinctive geometric designs on the pottery (Gai 1977; Institute of Archaeology 1964). According to Maringer's (1950:197-199) examination, some plain potsherds found in association with microblade remains were identified as the fragments of Li-tripods which characterized the North Chinese late Neolithic as well as of the Bronze age. Some painted potsherds were assigned to the Yangshao Culture.

A. THE XIACHUAN ASSEMBLAGE

1. Site Description

The Xiachuan site is located in the eastern part of the Zhongtiao Mountains, southern Shanxi Province (Wang, Wang and Chen 1978). The site is named after Xiachuan, a small village where the strata are relatively well preserved and lithic remains are abundant. The Xiachuan basin, where the village is located, measures about 4.5 km from north to south and 2 km from east to west and is surrounded by mountains. Sixteen localities were noted in an area of about 20 x 30 km which covered three counties. All of these localities, which range in elevation from 900 to 2100 m above sea level, yielded similar cultural materials.

At Xiachuan, the deposits of the Upper Pleistocene are well preserved, measuring a maximum of about 30 m in thickness at some localities. Five natural horizons from top to bottom are presented in Table 3.

Table 3. Stratigraphy of the Xiachuan Basin

Horizon	Sediments	Thickness (m)	Lithics & Fauna
1	greyish brown sandy clay (upper cultural layer)	1-1.5	microblades, cores, stone tools, charcoal, and animal bones
2	brownish sandy clay	1.3	----
3	reddish sandy clay (lower cultural layer)	5-10	flake tools, no microblades
4	greyish yellow and greyish black clay	5	—
5	gravel	20	—

Organic samples obtained from Fuyuhe, Xiachuan village, Shunwangping, and Shaziyan during the 1976-1978 excavations yielded eleven radiocarbon results (see Table 4) (Institute of Archaeology 1983:18-19).

Fuyuhe is the locality about 0.5 km northwest of the Xiachuan village. Shunwangping is located about 4 km southwest of the Xiachuan village. The location of Shanziyan is unavailable from the reports, but it is located at the Qinshui county.

Table 4. Radiocarbon Dates for the Xiachuan Site

Lab No.	Material	Date	Location
ZK-638	charcoal	36,200+3500/-2500 B.P.	Fuyuhe
ZK-417	charcoal	23,900±1000 B.P.	Xiachuan
ZK-384	charcoal	21,700±1000 B.P.	Xiachuan
ZK-393	charcoal	20,700±600 B.P.	Xiachuan
ZK-634	charcoal	19,600±600 B.P.	Shunwangping
ZK-497	peat	18,500±480 B.P.	Shanziyan
ZK-494	mud	18,375±480 B.P.	Shanziyan
ZK-385	charcoal	16,400±900 B.P.	Xiachuan
ZK-762	charcoal	13,900±300 B.P.	Shunwangping
ZK-634	charcoal	2830±100 B.P.	Shunwangping
ZK-493	charcoal	1380±80 B.P.	Shanziyan

It should be noted that ZK-638 was obtained from the lower cultural layer at Fuyuhe which contained no microblade remains. The very young ages of ZK-493 and ZK-634 are puzzling because the charcoal samples were said to be associated with Upper Paleolithic remains.

Among the four radiocarbon dates from the village of Xiachuan, ZK-384 and ZK-385 were reported to be in association with microblades. ZK-393 and ZK-417 were obtained from the same cultural layer, but no associated cultural finds were mentioned.

At present, the association of radiocarbon dates with artifacts is unclear for several reasons: first, archaeological data were obtained during the first excavation (Wang *et al.* 1978), while the dating samples were collected during the second excavation; second, the localities and stratigraphic divisions during the first and second excavations are not consistent; third, the report on the second excavation is still unavailable.

2. Description of Raw Materials

The raw materials employed to make stone artifacts include chert of different colours, crystal, vein quartz, sandstone, and quartzite. The majority of microblade remains and small tools such as end scrapers, burins, and perforators were made on black, green, and grey chert. Only one conical core and two funnel-shaped cores were made on vein quartz. Microblades were mostly made on black chert, while most heavy-duty tools were made on sandstone and quartzite.

3. Core Type Description and Frequency Distribution

Six types are distinguished on the basis of core morphology.

a. Wedge-shaped Cores

These were mainly made on flakes. They have a unifacially or bifacially worked keel, one platform, and a fluted face. Two subtypes, broad-bodied and narrow-bodied cores, are identified (Fig.9:1-3).

b. Conical Cores

These were made on small chunks with fluted scars covering either part or all of the body. Two kinds of platforms are identified: a cleavage plane or a single flake scar, and a plane trimmed by flaking. It should be mentioned that many cores are not always typically conical in shape owing to the rough appearance of the preform (Fig.9:4-8).

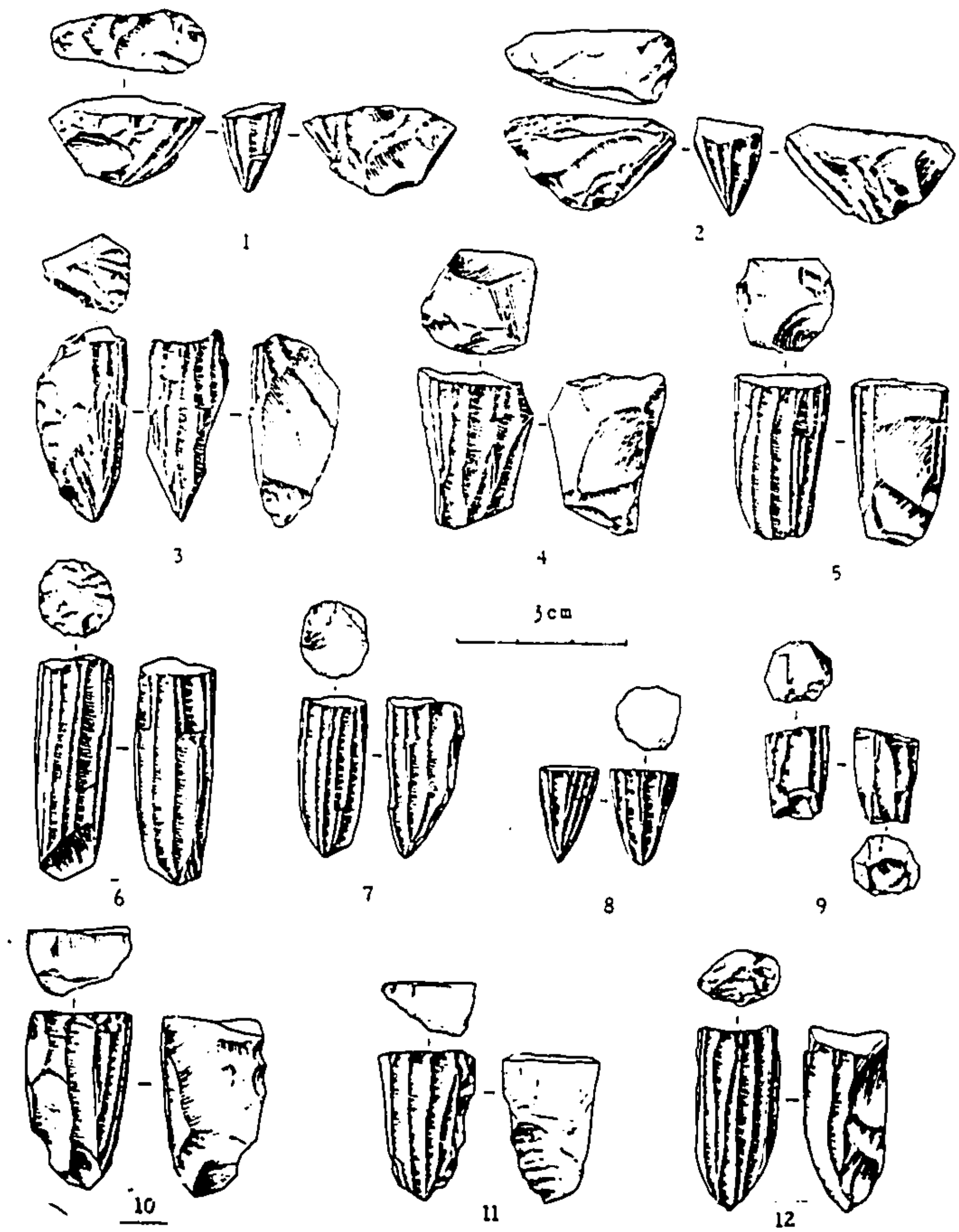


Figure 9: Microblade Cores from the Xiachuan Site (by courtesy of Provincial Institute of Archaeology in Shanxi)

c. **Boat-shaped Cores**

These were made on chunks or thick flakes and have a wide body. The platform consists of a cleavage plane or a single flake scar. The body was prepared mainly from the platform and lacked an intentionally prepared keel (Fig.10:1-4).

d. **Semiconical Cores**

These were made on small flakes and had a bevelled platform of either a single flake scar or trimmed. One or both sides were worked transversely to control the width of the body. The back consisted of either a cleavage plane or a single flake scar. Microblade detachment was focused on a wide surface in front of the body (Fig.9:10-12).

e. **Cylindrical Cores**

These resemble the conical core. The difference is that they have one platform on each end (Fig.9:9).

f. **Funnel-shaped Cores**

This kind of core has a rough appearance with a discoid platform and a short body (Fig.10:5,6).

A total of 243 microblade cores (219 from the first excavation and 24 from the field survey conducted by myself in 1981) are reported. The percentages of the six core types described above are as follows:

Table 5. Frequency Distribution of Xiachuan Core Types

Type	wedge	conical	boat	cylind	semi	funnel	total
#	19	110	26	10	54	24	243
%	8	45	11	4	22	10	

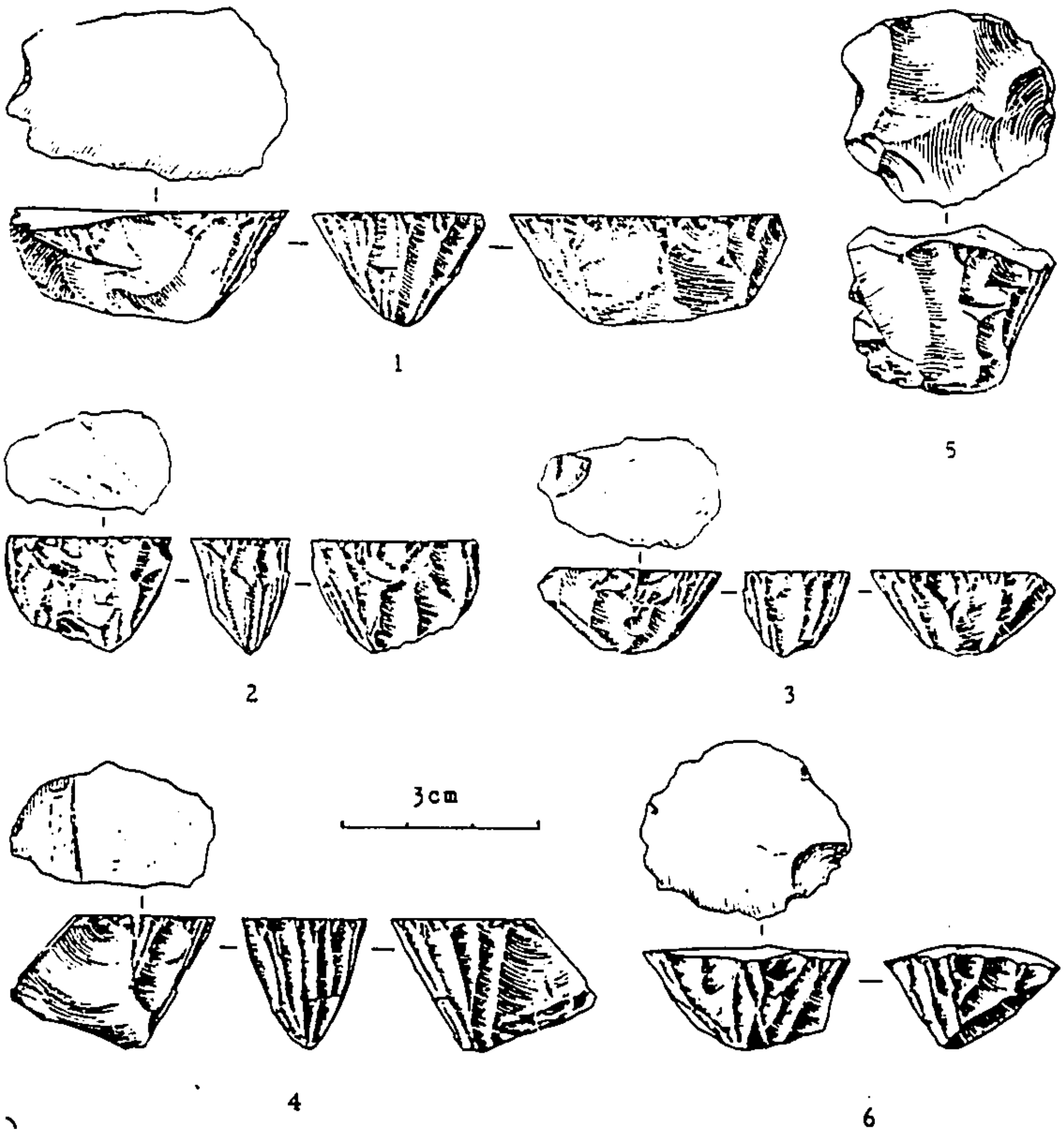


Figure 10: Microblade Cores from the Xiachuan Site (by courtesy of Provincial Institute of Archaeology in Shanxi)

Conical cores are the dominant type in the Xiachuan assemblage. Wedge-shaped cores are relatively low in frequency in comparison with most other microblade cores.

4. Preform, Platform, and Rejuvenation Pattern

a. **Wedge-shaped Cores**

Two processes of core preparation were used on both broad and narrow bodied cores. The first process began with platform formation. The platform usually consisted of a single flake scar or a cleavage plane. The body was then bifacially or unifacially worked to shape a keel. Trimming was often used to adjust the edge angle.

This process was somewhat similar to that for boat-shaped cores, however, there are several differences: first, the body was mainly shaped from the keel rather than from the platform; second, the platform is much more narrow than that of boat-shaped cores; and third, the platform was usually trimmed to adjust the edge angle.

The second process was one in which the body was formed first. Cores were bifacially or unifacially prepared, then transversal or longitudinal blows were made on the top to produce either a bevelled or a level platform. Finally, longitudinal trimming was conducted to adjust the edge angle.

b. **Conical Cores**

These were made mainly on small chunks. Most specimens contained an irregular shape. Nevertheless, some are very delicate. The preparation process is as follows:

(1) The platform was formed first. It consisted of a single flake scar, a cleavage or flaked plane.

(2) A series of blows were made from the platform to shape the body. Some specimens were retouched laterally to make the body more narrow.

(3) Two kinds of platforms were distinguished. The first was a single flake scar or a natural plane without trimming. The second was slightly trimmed near the edge or around the perimeter.

c. **Cylindrical Cores**

The preform and platform preparation for these cores were basically the same as those of conical cores with the exception of the production of another striking platform at the distal end.

d. **Semiconical Cores**

Two manufacturing processes have been identified for these cores:

(1) The platform was formed first. It consisted of a single flake scar without trimming. The back of the body was either a natural plane or flake scars. Some specimens were retouched laterally to shape the body contour.

(2) The body contour was formed first. Then the platform was retouched around the working edge to form a more or less bevelled platform.

e. **Boat-shaped Cores**

The platform of these cores was always prepared first and consisted of a wide natural surface or a single flake scar. Then, a series of blows were made from the platform to shape the body. The back of the core was usually left intact.

f. **Funnel-shaped Cores**

Like boat-shaped cores, the platform of these was always formed first and consisted of a natural plane or a single flake scar. Then, a series of blows were made around the perimeter of the platform to shape a discoid form. Very few specimens exhibit a retouched platform.

5. Edge Angle Variation

Due to inappropriate storage, some specimens were missing when I examined the collection at the Provincial Institute of Archaeology in Shanxi. As mentioned previously, some microblade cores can yield more than one measurement. For example, if a wedge-shaped core has two fluted faces, it will yield two measurements. A cylindrical core has one platform on each end, and yields two measurements. If a conical or a funnel-shaped core has a wide range of edge angles around its perimeter, two maximum measurements were selected. Therefore, except for wedge-shaped cores, 67 conical cores yielded 90 measurements, 29 boat-shaped cores yielded 31 measurements, one cylindrical core yielded two measurements, 24 semiconical cores yielded 28 measurements, and five funnel-shaped cores yielded nine measurements, respectively.

Most microblade cores from the Xiachuan assemblage have the edge angles less than 90 degrees, except for the 15% of conical cores which yielded measurements of 90 degrees or larger.

Table 6. Edge Angle Variation for Xiachuan Cores

Angle	50-59	60-69	70-79	80-89	90-99	100-110	total
Wedge							
#	2	6	6	5			19
%	10	32	32	26			
Conical							
#	1	9	27	39	11	3	90
%	1	10	30	43	12	3	
Boat							
#	6	10	6	8	1		31
%	19	32	19	26	3		
Cylindrical							
#	1	1					2
%	50	50					
Semiconical							
#	2	4	9	11	2		24
%	7	14	32	39	7		
Funnel							
#	1	4	4				9
%	11	44	44				

6. Core Dimensions

In this study, the total length of three measurements is employed as an index of core sizes. These three elements are the height of the body, the length and width of the platform. For conical, cylindrical, and funnel-shaped cores, the length and width of the platform is expressed both by the longest and the shortest measurements, respectively. For convenience, round number are used. For instance, numbers ranging between 3.5 cm to 4.4 cm are rounded to 4 cm.

As mentioned in Chapter Three, core dimensions are arbitrarily divided into two categories for convenience of comparison. One is large cores which yielded indices larger than 7 cm. The other is small cores which are 7 cm or less.

Table 7. Dimensions for Xiachuan Cores

index(cm)	4	5	6	7	8	9	Total
Wedge							
#		2	6	5	4	2	19
%		10	32	26	21	10	
Conical							
#	6	25	22	11	2	1	67
%	9	37	33	16	3	2	
Boat							
#	7	7	7	4	2	2	29
%	24	24	24	14	7	7	
Cylindrical							
#	1						1
Semiconical							
#	1	7	13	3			24
%	4	29	54	13			
Funnel							
#					3	2	5
%					60	40	

It is evident that the microblade cores from the Xiachuan assemblage are relatively small. Only two (10%) wedge-shaped, three (5%) conical, four (14%) boat-shaped, and all five funnel-shaped cores (100%) fall into the large category. Funnel-shaped cores seem to be a unique core type in terms of the size index.

B. THE XUEGUAN ASSEMBLAGE

1. Site Description

The Xueguan site is situated on the western bank of the Xingshuihe, a tributary of the Huanghe, about 1 km to the west of the village of Xueguan, Puxian County, Shanxi Province. This area is part of Luliang Mountain, more than 1500 m above sea level (Wang, Ding and Tao 1982).

Geomorphological study indicated that four terraces occur along the eastern bank of the Xingshuihe. The alluvial sediments of the first and second terraces are about 4-6 and 10-13 m above the river bed, respectively. They were both assigned to the Holocene by the presence of Neolithic discoveries. Terrace III, about 20 m thick, has greyish yellow loess on the top and gravel of the late Pleistocene at the bottom and overlies Triassic sandy shale. Terrace IV is about 100 m thick, consisting of a reddish loess on the top and a gravel underneath. It was estimated to belong to the middle Pleistocene by lithostratigraphy. Microblade remains and lithic artifacts were found in a colluvial, loess-like deposit on the western bank. The deposit, about 14.8 m thick, was correlated to the third terrace on the eastern bank. The stratigraphy was described from top to bottom as follows.

Table 8. Stratigraphy at the Xueguan Site

Horizon	Sediment	Thickness (m)	Lithics & Fauna
1	surface soil	0.2	----
2	greyish yellow soil interbedded gravel	5.9	microblades, cores, flake tools, fauna
3	reddish-brown and yellow soil	7.2	----
	--------------- unconformity -----------------		
4	sandy Triassic purple shale bedrock		

2. Description of Raw Materials

The raw materials include chert, quartzite, hornfels, and diabase obtained from the gravel layers of Terraces III and IV. Microblades are made mainly on chert, hornfels, and diabase.

3. Core Type Description and Frequency Distribution

Four core types were identified: wedge-shaped, conical, boat-shaped, and semi-conical cores.

a. **Wedge-shaped Cores**

These were bifacially worked to form the keel. Most specimens are broad bodied, with the exception of a few containing a platform shorter than the fluted face. Some specimens have double fluted faces (Figs.11 and 12:1-6).

b. **Conical Cores**

Only a few rough conical cores were found at Xueguan. The platforms of some specimens consisted of cleavage planes. From their rough appearance it seems the conical technique was not well developed (Fig.12:7,8,11).

c. **Boat-shaped Cores**

Most of these cores are small in size with one notable exception (Fig.10:2). They are characterized by broad, untrimmed platforms. Some specimens have double fluted faces on both ends (Fig.13).

d. **Semiconical Cores**

Although few in number, the preform preparation and microblade detachments of these cores are sophisticated. The exhausted specimens have a thin body with a bevelled and untrimmed platform. The back surface is a natural plane (Fig.12:9,10).

Boat-shaped and wedge-shaped cores are the two most common types in the Xueguan assemblage. Together they account for 83% of the total.

Figure 11: Wedge-shaped Cores from the Xueguan Site (by courtesy of Wang Xiangqian)

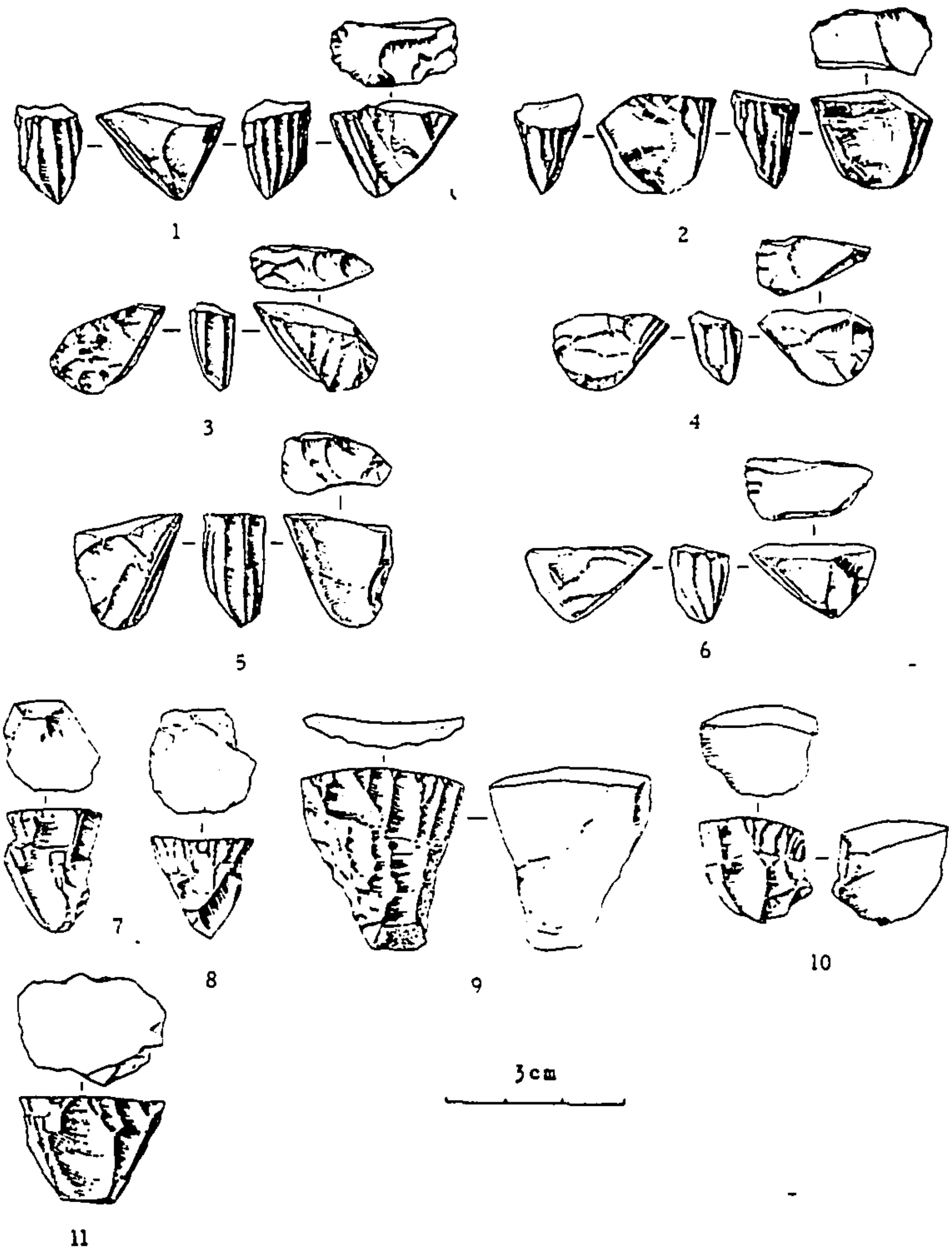


Figure 12: Microblade Cores from the Xueguan Site (by courtesy of Wang Xiangqian)

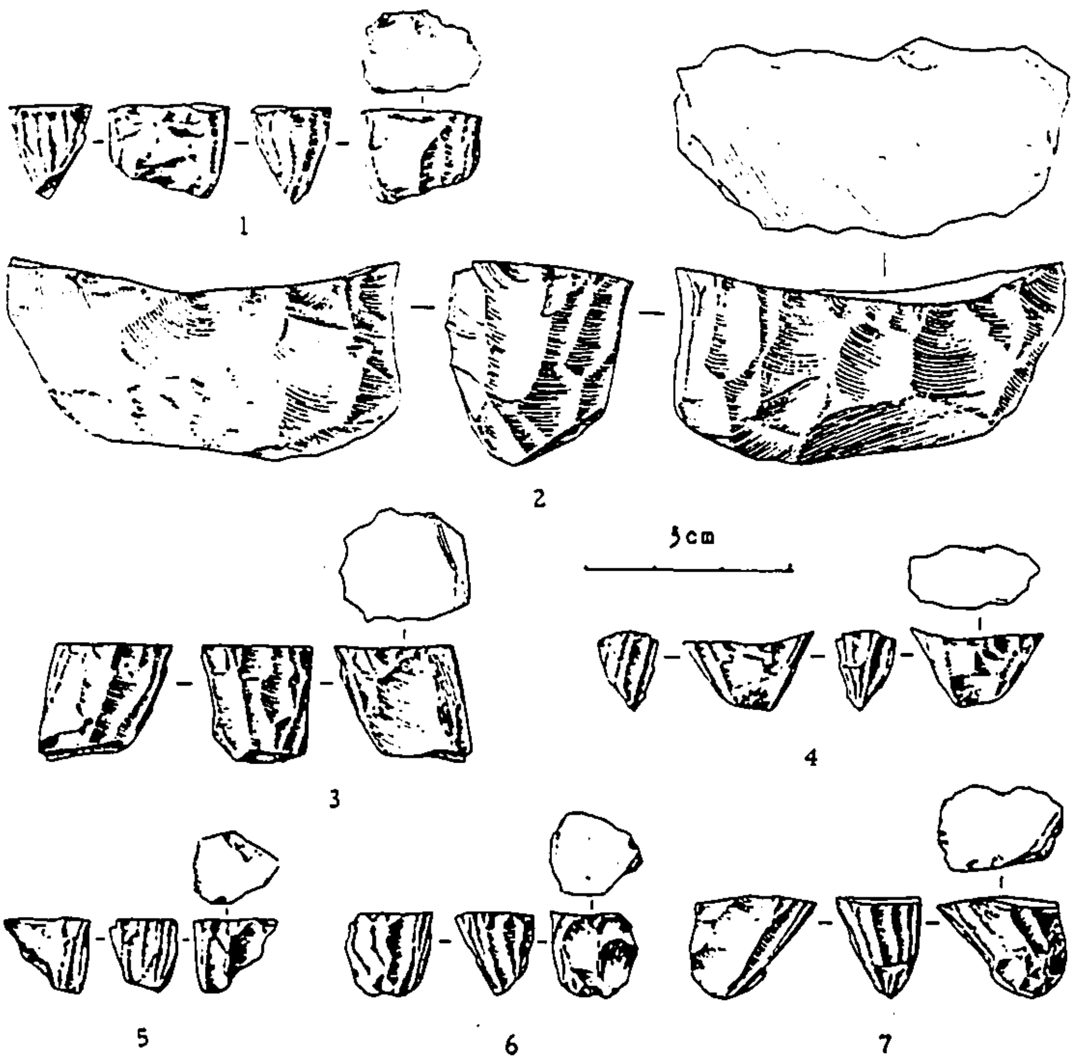


Figure 13: Boat-shaped Cores from the Xueguan Site (by courtesy of Wang Xiangqian)

Table 9. Frequency Distribution of Xueguan Core Types

Type	Wedge	Conical	Boat	Semi	Total
#	19	5	52	10	86
%	22	6	61	12	

4. Preform, Platform, and Rejuvenation Pattern

a. **Wedge-shaped Cores**

Two preparation processes have been identified. In the first, the platform was formed first and consisted of a natural plane or a single flake scar either untrimmed or trimmed to adjust the edge angle. The body was bifacially worked to form the keei (Fig.11:4,8; Fig.12:1,2,6). In the second, the body was formed first and bifacially retouched before transverse or longitudinal blows were executed on the top to shape a bevelled or level platform. Longitudinal trimming was then conducted to adjust the edge angle (Fig.11:1-3,5-7; Fig.12:3,5).

These two processes are identical to those at Xiachuan. Most wedge-shaped cores at Xueguan were bifacially prepared. Some specimens had double fluted faces (Fig.11:3 and Fig.12:1,2).

b. **Conical Cores**

The platform of these cores was always formed first and consisted of a natural plane or a single flake scar. No trimming was used to adjust the edge angle. The body was roughly shaped, ieaving an extremely crude appearance (Fig.12:7,8,11).

c. **Boat-shaped Cores**

The platform of these cores was always formed first. It consisted of a natural plane or a single flake scar without trimming. A series of blows were delivered from the platform to shape the body. Some specimens have double fluted faces (Fig.13).

d. **Semiconical Cores**

The platform was formed first and consisted of a single flake scar without trimming. No special preparation was used to shape the body. The backs were either a natural plane, a single flake scar, or cortical (Fig.12:9,10).

5. Edge Angle Variation

Some specimens had been misplaced when I examined the collection at the Institute of Archaeology in Shanxi Province. Of the available samples of Xiachuan cores, 19 wedge-shaped cores yielded 22 measurements, 13 boat-shaped cores 15 measurements, and 4 conical cores 7 measurements.

Measurements reveal that most microblade cores from the Xueguan assemblage have edge angles of less than 90 degrees with the exception that 5% of the wedge-shaped cores and 14% of the boat-shaped cores yielded edge angles exceeding 90 degrees.

Table 10. Edge Angle Variations for Xueguan Cores

Angle	<49	50-59	60-69	70-79	80-89	90-99	>100	total
Wedge								
#	1	2	6	7	5	1		22
%	5	9	27	32	23	5		
Conical								
#		1	1	4	1			7
%		14	14	57	14			
Boat								
#	1	2	3	3	4	1	1	15
%	7	13	20	20	27	7	7	
Semiconical								
#			2	1	1			4

6. Core Dimensions

A total of 19 wedge-shaped, four conical, 13 boat-shaped, and four semiconical cores were measured.

Table 11. Dimensions for Xueguan Cores

Index(cm)	3	4	5	6	7	9	11	Total
Wedge								
#		1	10	4	2	1	1	19
%		5	53	21	11	5	5	
Conical								
#			3	1				4
%			75	25				
Boat								
#	2	5	4	1			1	13
%	15	38	31	8			8	
Semiconical								
#		1	2		1			4
%		25	50		25			

Most microblade cores from Xueguan are small in size. Only two (10%) wedge-shaped and one (8%) boat-shaped cores are large (Fig.11:8, Fig.13:2).

C. THE YANGYUAN COMPLEX

The Yangyuan Complex consists of two assemblages: Hutouliang and Jiqitan. The excavation report on the Jiqitan site is still unavailable. Owing to their geographical proximity, identical lithostratigraphy, and similar diagnostic attributes of lithic artifacts, they are treated here as a single complex.

1. Site Description

The best representative of the Yangyuan Complex is the Hutouliang site (Gai and Wei 1977). At Hutouliang Village, four terraces along the Shangganhe were identified. Terrace I, 5-8 m above the river bed, consisted of sandy loess and interbedded gravel. Terrace II, 20-30 m above the river bed, consisted of sandy loess and lenticular intercalations of sand and gravel. Terrace III, 50-60 m above the river bed, consisted of greyish yellow fluvial-lacustrine deposits. Terrace IV, 77-82 m above the river bed, consisted of deposits similar to those of Terrace III.

More than 4000 stone artifacts, including abundant microblade remains, and late Pleistocene faunal remains were excavated from the lower part of the sandy loess deposit in Terrace II.

Locality 73101 yielded large amounts of debitage, burnt animal bone, and broken ostrich shells in association with three hearths suggesting that this might be both a habitation camp and workshop. Locality 65040, containing only ten stone tools and no debitage, was thought to have been a hunting site. Locality 65039, which yielded mainly projectile points and scrapers, was believed to be a butchering and meat processing site, and Locality 72117, which yielded a large quantity of cores, blanks, and stone chips, probably was a chipping station or workshop (Gai and Wei 1977).

A recently excavated locality, called Jiqitan, has yielded many microblade remains and other stone tools from the lower part of the second terrace on the Shangganhe not far from Hutouliang. Through the courtesy of Xie Fei at the Provincial Institute of Cultural Relics in Hebei, I examined part of a microblade core assemblage from Jiqitan. Microblade cores from these two assemblages are discussed here together.

2. Description of Raw Materials

The raw materials at Hutouliang and Jiqitan are quartzite, chert, and rhyolite. Quartzite is the dominant material used to produce microblades and other artifacts. There is an outcrop of quartzite located on a mountain called Nanshan about 10 km northeast of Hutouliang. This quartzite is hard, brittle, and brightly coloured including yellow, purple and pink varieties.

3. Core Type Description and Frequency Distribution

All microblade cores of the Yangyuan complex are wedge-shaped. I examined and measured 34 and 30 wedge-shaped cores from Hutouliang and Jiqitan respectively (Fig.14).

4. Preform, Platform, and Rejuvenation Patterns

Wedge-shaped cores from the Yangyuan Complex represented the whole sequence of preparation and microblade production, from preforms to fully exhausted specimens.

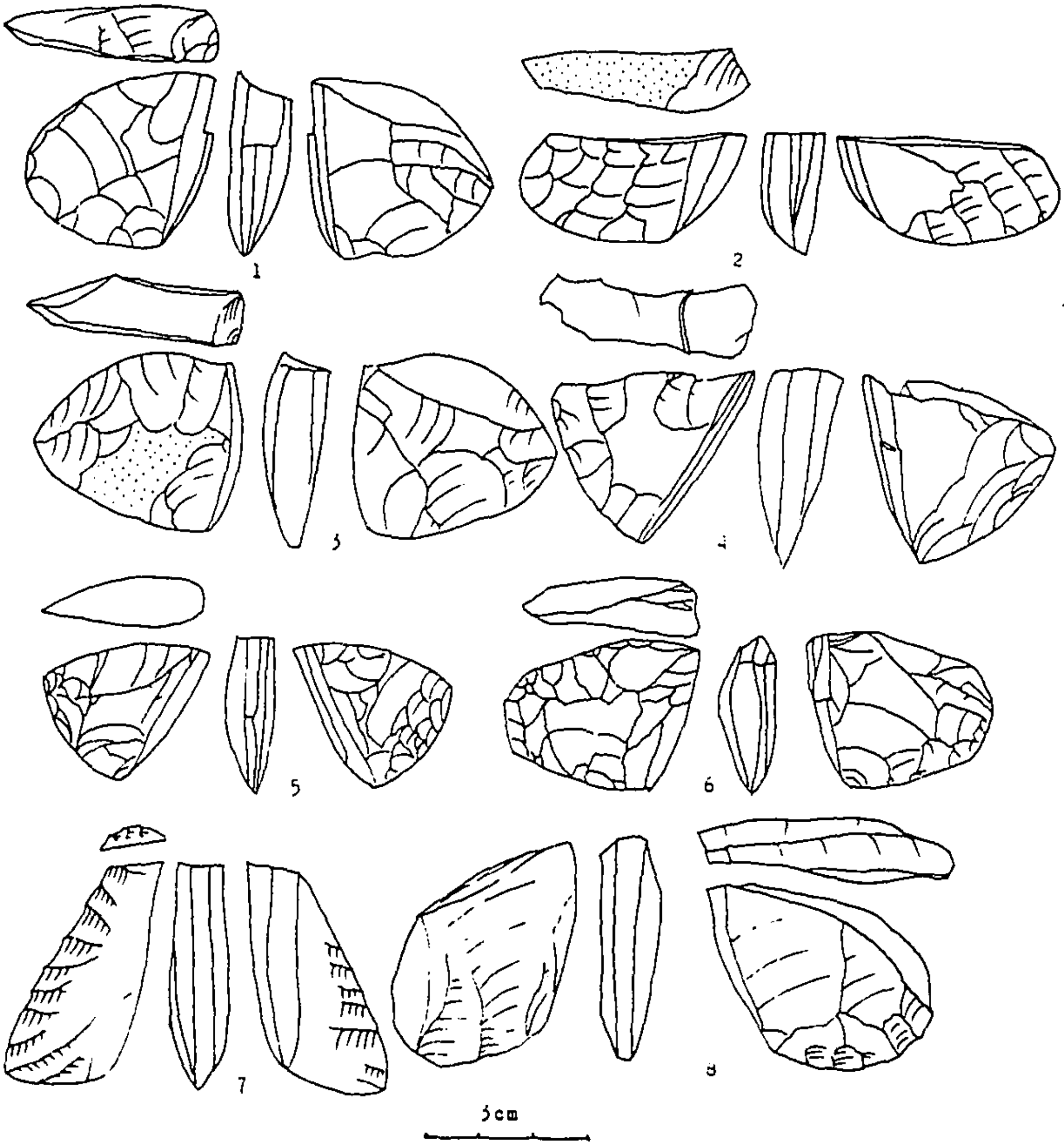


Figure 14: Wedge-shaped Cores from the Yangyuan Complex (by courtesy of Wei Qi and Xie Fei and from Tang and Gai 1986)

a. **Preform Preparation**

Two manufacturing processes of core preparation were recognized. In the first, the platform, consisting of a natural surface of the raw material, was formed first. The body was bifacially worked to form a keel. Only three specimens were worked using this process, accounting for only 6% of the total sample (Fig.14:2,4). In the second, the body was formed first. These were worked bifacially or unifacially to form a keel (Fig.14:1,3,5-8).

One prominent feature is that most cores were bifacially prepared. Only 10 (19%) specimens were prepared unifacially.

b. **Platform Preparation and Rejuvenation**

Platforms showed different patterns of preparation and rejuvenation as follows.

(1) The platform consisted of a cleavage surface, a single flake scar, or a cortex. A total of six specimens exhibit this pattern. Three were preforms. The rest had an effective platform trimmed longitudinally to adjust the edge angle (Fig.14:2). Some specimens have had a tablet removed to rejuvenate the platform (Fig.14:4).

(2) The platform was first transversely retouched to form a level or bevelled plane. Then longitudinal flaking was done to trim or rejuvenate the edge angle (Fig.14:1,3). Twenty of the microblade cores were of this pattern.

(3) The platform consisted of a smooth plane passing across the entire body. Some platforms were formed by removing several ski-like spalls from the top of the biface. Some were formed with a single longitudinal blow. Eighteen specimens had this kind of platform (Fig.14:5).

(4) The platform consisted of a burin-like multi-facetted face passing across the entire body, and resembling a fluted face. This kind of platform might be a variant of pattern three. Four cores were exhibited this pattern (Fig.14:8).

(5) The platform consisted of a tiny facet. Small spalls were taken from the top of the preform to form a narrow platform. The preforms of these cores

were all bifaces. This platform was successively trimmed in the course of microblade production. Two specimens of this sort were identified (Fig.14:6,7).

5. Edge Angle Variations

With the exceptions of eight preforms, the edge angles of 55 out of 64 specimens were measured.

Table 12. Edge Angle Variations for Yangyuan Complex Cores

Angle	47	50-59	60-69	70-79	80-89	90-92	Total
#	1	5	13	14	18	4	55
%	2	9	24	25	33	7	

The measurements show that 93% of the specimens had edge angles less than 90 degrees.

6. Core Dimensions

Core size indices range between 13 and 4 cm. Twenty six (41%) out of 64 are of the large category. Specimens with size indices of 13, 12, and 11 cm were all preforms.

Table 13. Dimensions for Yangyuan Complex Cores

Index(cm)	4	5	6	7	8	9	10	11	12	13	Total
#	1	6	15	16	10	7	6	1	1	1	64
%	2	9	23	25	15	11	9	2	2	2	

D. THE HAILAR ASSEMBLAGE

1. Site Description

The Songshan site is located in the city of Hailar, Inner Mongolia. Hailar lies on the first terrace of the Yiminhe, about 3-4 km wide and 0.5-2 m above the river bed. Songshan is a large sand dune located on the west of the city. Geological evidence indicates that the sediment around Songshan is a huge sand deposit at least 10 m deep. Heavy winds have disturbed this sand deposit and blown out many sand depressions. The cultural materials discussed here were collected from 16 localities which were all natural sand depressions from 1 to 10 m deep. Stratigraphy at Locality 6 consists of four layers. The top layer is a brownish loam about 0.6 m thick. The lower three layers consist of different coloured sands. According to An's observations, all lithic artifacts were derived from the top layer. No cultural remains were found in the sand layers.

The lithic inventory includes microblade cores, microblades, scrapers of various forms, end scrapers, burins, bifacial projectile points, one chopper, adzes, and debitage. Three of the 16 localities yielded a total of 97 potsherds and even a few iron items. The potsherds are identified as belonging to the Han (206 B.C.-A.D. 220) and the Liao (A.D. 916-1125) dynasties and were considered to be the result of mixing from more recent occupations. No radiocarbon dates are available. The microblades and other lithic materials were thought to belong to the Mesolithic by An (1978) who considered the potsherds and iron items to be much younger than the lithic artifacts.

2. Raw Materials of the Lithic Assemblage

Lithic raw materials at Songshan included flint or chert, jasper, chalcedony, and tuff. Most cores retained some cortex, and were probably made on pebbles.

3. Core Type Description and Frequency Distribution

Only 15 wedge-shaped (Fig.15:1-12) and five conical cores (Fig.15:13) have been identified. The frequency of the former is 75% and 25% for the latter.

a. **Wedge-shaped Cores**

These were subdivided into two subtypes: broad-bodied and narrow-bodied forms.

b. **Conical Cores**

These are very rough in appearance and have an irregular fluted surface with cortex remaining on part.

4. Preform, Platform, and Rejuvenation Patterns

The body of all wedge-shaped cores was prepared first. Flat cobbles were chipped bifacially to form a keel. Cortex was left intact on one or both sides.

Broad-bodied and narrow-bodied wedge-shaped cores showed an entirely different platform preparation. Broad-bodied cores have a smooth platform formed by removing one or more ski spalls (Fig.15:1,2). Narrow-bodied cores are usually tongue-shaped and the platform was prepared using multiple flaking from different directions (Fig.15:3,6-12).

Fourteen tablets of platform rejuvenation were reported. Most belong to wedge-shaped and a few to conical cores.

5. Edge Angle Variations

Fifteen wedge-shaped and three conical cores were measured from illustrations. One wedge-shaped core is a preform, yielding no edge angles, and another one has double fluted surfaces. Therefore, 15 measurements of wedge-

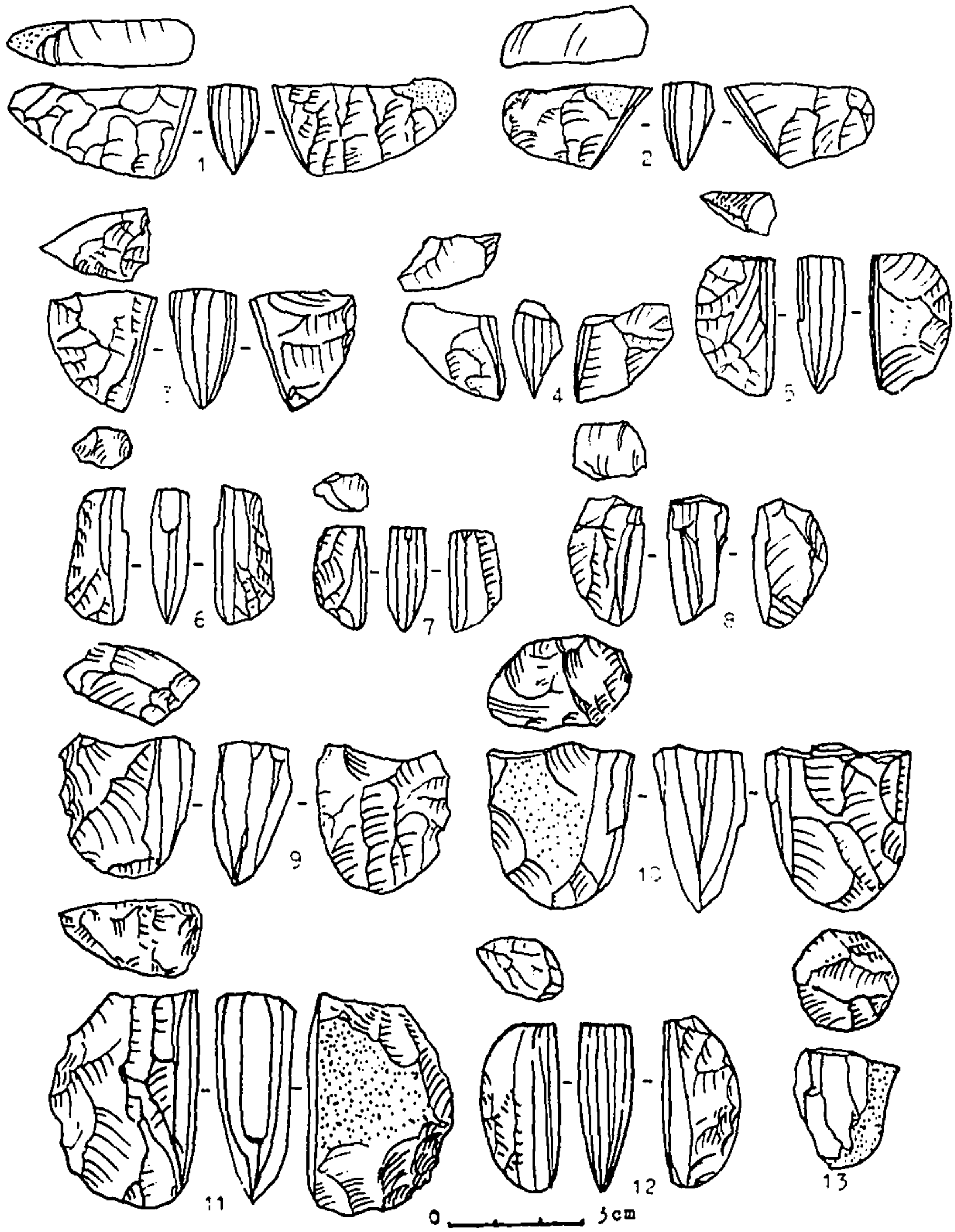


Figure 15: Microblade Cores from Hailar (after An Zhimin 1978)

shaped and three of conical cores were possible.

The edge angles of wedge-shaped cores range between 95 and 55 degrees with the exception of one specimen having an edge angle of 115 degrees, probably due to failure of platform rejuvenation. It is noteworthy that edge angles exceeding 90 degrees mainly belong to narrow-bodied cores. Some are exhausted specimens. Most broad-bodied cores exhibit an edge angles of less than 90 degrees.

Table 14. Edge Angle Variations for Hailar Cores

Angle	55	60-69	70-79	80-89	90-99	115	Total
Wedge							
#	1	2	2	3	6	1	15
%	7	13	13	20	40	7	
Conical							
#				3			3

6. Core Dimensions

Size indices showed that the large, wedge-shaped cores with indices of 10 to 8 cm make up 33% of the total sample. The small ones with indices of 7 to 5 cm comprise 67%. Two of the three conical cores are large.

Table 15. Dimensions for Hailar Cores

Index(cm)	5	6	7	8	9	10	Total
Wedge							
#	3	4	3	2	2	1	15
%	20	27	20	13	13	7	
Conical							
#		1		2			3

E. ASSEMBLAGES ASSOCIATED WITH POTTERY OR GROUND STONE TOOLS

1. Site Description

Microblade remains associated with pottery or ground stone tools have an extensive distribution throughout North China. In this study, the cores belonging to this category were mainly collected from Inner Mongolia. Some, however, come from northern parts of Shanxi and Hebei provinces. Almost all of the Inner Mongolian collections examined at the Inner Mongolian Museum were discovered between twenty and forty years ago. Many assemblages have no detailed contextual and chronological information. Some had even lost their provenance labels. In general, these remains were found either associated with pottery or ground stone tools. Most microblade remains of these assemblages occurred on the surface or were excavated from dwelling or open air camp sites. Sites were usually situated near dry lakes, river valleys, on sand dunes, or at the bottom of sand depressions. In some cases, they have been found with chipped stone tools, and with a few ground stone tools. In other cases, they were associated with a large number of heavy-duty ground stone tools or various bone tools such as needles, harpoons, and spears.

The sample of microblade cores varies from site to site. More than that, most microblade core assemblages have no provenance. Thus, it is necessary to lump these assemblages into a complex in order to use as much data as possible.

Microblade cores from more than a dozen sites in Inner Mongolia were studied. These sites were located at New Barhu Right Banner (a banner is equivalent to a county) and New Barhu Left Banner in the northeastern part of the region, Abaga Banner, Duolen and Dayao in the central part of the region, and Yingen at Alakshan Left Banner in the western part of Inner Mongolia.

The microblade remains collected by the Sino-Swedish Expedition Team under the leadership of Sven Hedin were derived from more than three hundred sites extending from the middle of Inner Mongolia to Xinjiang (Maringer described this region as extending from Manchuria to Xinjiang, because part of what was Northeast China at that time now belongs to the Inner Mongolian Autonomous Region). Four large geographic variants were proposed by Maringer as follows:

a. Steppe Facies. The steppe facies extend through the present steppe and part of the desert east of Khara dzagh.

b. Alakshan Desert Facies. These occur in the Ukh Tokhoi plateau and the northern desert.

c. Edsen-gol Facies. This is located along the Edsen-gol River.

d. Black Gobi Facies. This extends through the westernmost part of Inner Mongolia and resembles the Edsen-gol facies.

Maringer's description of microblade occurrences in Inner Mongolia is generally similar to those of Chinese archaeologists. Maringer (1950:167) notes that:

> Confronted with the fact that practically all the finds were picked up on the surface of the steppe or desert, where at least in some instances they might have been left in a mixed-up condition, we had no possibility of making a stratigraphically substantiated division of the abundant and varied finds into different chronologically determined layers. There only existed some hope of discerning different cultural horizons or stages by means of topological and technical difference, perhaps also of a different state of patination.

All archaeologists can appreciate this problem and understand the difficulty of working on materials from such a large area gathered by others over such a long temporal span. Context and systematic description are both lacking. For this reason, the only thing that can be done here is to treat the artifacts as one general complex.

2. Raw Materials of the Complex

The raw materials used to produce these microblades are quite distinctive. In the Chinese literature, these materials are briefly described as flint, agate, chalcedony, and jadeite, all rocks often display bright colours and a fine texture. A detailed description and discussion of the origin of these materials are described in Maringer's report.

> The raw materials used for the flaked and chipped artifacts generally belong to the series of later or Mesozoic-Tertiary volcanic rocks. They include white and reddish chalcedonies, salified sediments such as argillites, loams and schists, white, yellow, brown, red, bluish or black in colour, further quartz-porphyritic tufas. Those coloured siliceous rocks of volcanic origin constitute often a very flint-like material of the same dense and workable quality as marine flints. In some cases also salified wood, rock-crystals and feldspar were used. Different kinds of greenstone, schists, basalt sandstones and quartzites have often served for the production of large implements, above all axes and axe-like implements (Maringer 1950:168).

Maringer also noted that in his collections few artifacts were produced from pebbles or boulders. According to the reports of Chinese archaeologists and my examination, however, pebbles were indeed used to produce large stone tools and some microblade cores.

3. Core Type Description and Frequency Distribution

Inner Mongolian cores have been classified into five types: wedge-shaped, conical, cylindrical, semiconical, and funnel-shaped. No boat-shaped cores have been found either from the collections I examined nor in publications (Fig.16).

A total of 134 specimens were examined and measured. An additional 1453 specimens catalogued by Maringer (1950) are used here for quantitative comparisons. Maringer mentioned about 3000 microblade cores in his artifact lists, but many are described briefly as "small flint nucleus", or "small cores"

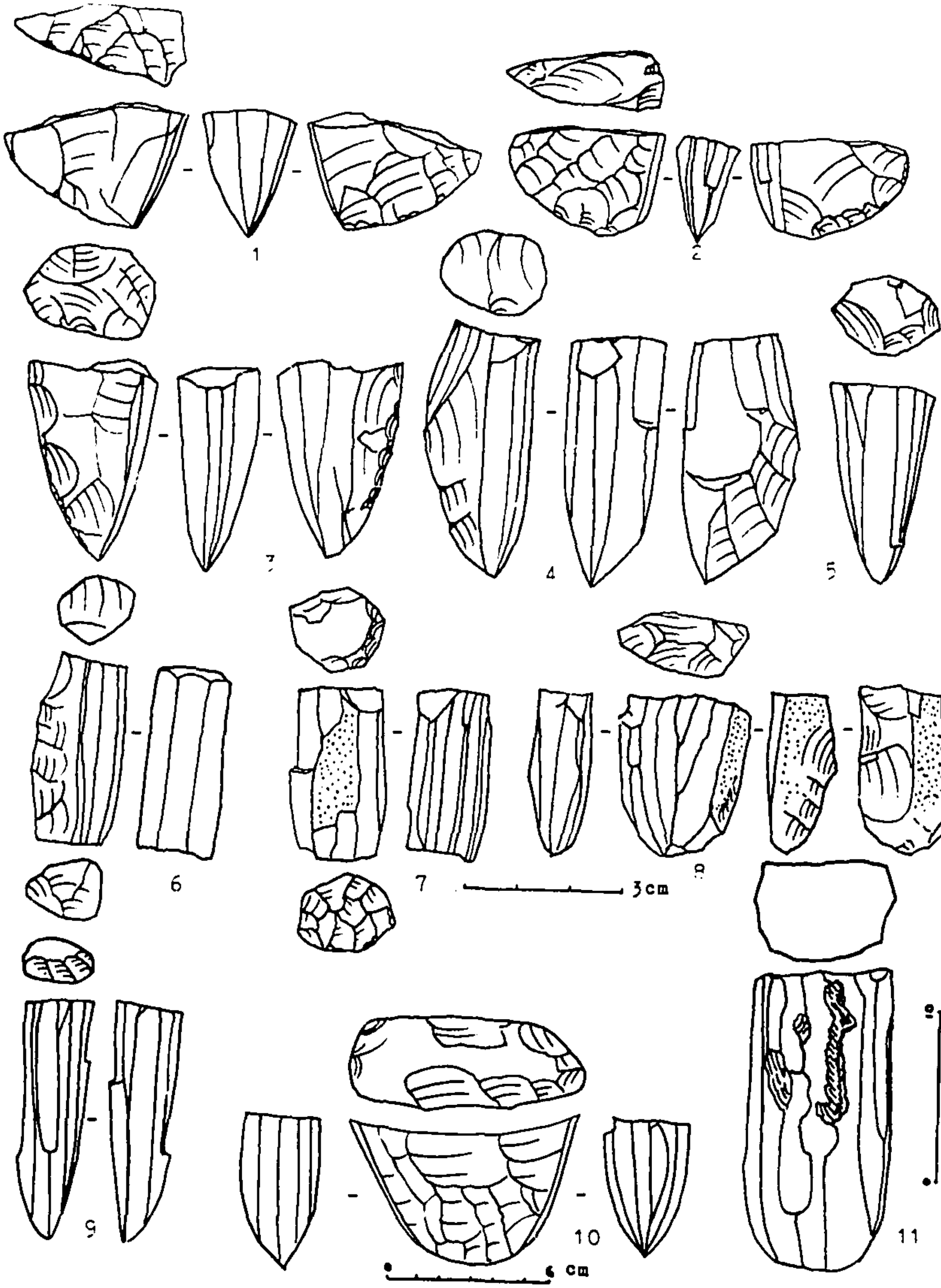


Figure 16: Microblade Cores from Inner Mongolia (by courtesy of the Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences and Inner Mongolia Museum)

(Maringer 1950:11,68). These specimens are ignored because of the uncertainty of their typological classification. Maringer's typology and classification are basically similar to mine, with the exception of semi-conical or tabular cores. These types were not recognized by Maringer. He did classify some semiconical cores. Upon closer inspection, these were probably exhausted narrow-bodied wedge-shaped cores with a conical appearance rather than conical cores as defined in my typology. To avoid confusion, I divided the quantitative analysis into two groups: one for the collection examined by myself, and the other for Maringer's collection. The following descriptions of core types are based on my examination.

a. **Wedge-shaped Cores**

Two subtypes have been distinguished: broad-bodied and narrow-bodied. Broad-bodied cores are usually identical to their Upper Paleolithic counterparts (Fig.16:1-2), containing a long platform, a long keel, and a relatively short fluted face. Some specimens, however, have a very distinctive appearance (Fig.16:10). They are quite large and have one fluted face on each end.

Narrow-bodied cores have a feature which is unique to this period. Some are bifacially worked to make a tongue-shaped preform. They were described by Maringer as "celt- or tongue-shaped nuclei" or "multifaceted and subspherical form" (1950:23,170). Microblades were removed from one or both ends. Some of the exhausted specimens look like a conical form but retain a keel if microblades were removed from one end (Fig.16:3,4). Others, if microblades were removed from both ends, may resemble a conical core.

b. **Conical Cores**

These reveal various stages of preparation and microblade production. Some exhausted specimens have a slender body like the point of a pencil (Fig.16:5,9). They were usually used until their platforms became a tiny plane and flute scars covered the entire body. Some specimens are quite large with sides parallel from the platform to the distal end. These are called prismatic cores by some authors (Fig.16:11). They are included here in conical form because they only have one platform. Maringer (1950:171) pointed out that conical and cylindrical cores outside Inner Mongolia "seldom appear in such perfection and at the same time in such large numbers," and "they were found in all stages of utilization and exceedingly often in an intact state."

c. **Cylindrical Cores**

These are numerous in comparison with previous periods. Some specimens are large and thick. Microblades were detached alternately from both ends, or first from one end and then from the other. This was done symmetrically following the edge all around the perimeter of the body (Fig.16:6,7).

d. **Semiconical and Semi-cylindrical Cores**

Some of these specimens have a flat body with some cortex on the back (Fig.16:8). They are not always tabular in the real sense. In many cases, these cores are roughly prepared to a preform with a flat surface either trimmed or untrimmed.

e. **Funnel-shaped Cores**

Only a few specimens are available either in the collections I examined or reported in the literature. One specimen from Zhalainor, northeastern Inner Mongolia, has a thick body and a broad natural platform. Maringer (1950:70) referred to several such specimens as "unusually broad conical" cores. A total of 134 cores which I examined and 1453 specimens described by Maringer are used for the following quantitative analysis.

Table 16. Type Percentages for Inner Mongolian Cores A

Type	Wedge	Conical	Cylind	Semi	Funnel	Total
Chen's						
#	58	43	8	24	1	134
%	43	32	6	18	1	
Maringer's						
#	660	454	333		6	1453
%	45	31	23		1	

According to this analysis, wedge-shaped cores account for a little less than one-half of the total, and both conical and cylindrical cores make up the other half.

Discussing the numerical occurrence of core types in the different parts of Inner Mongolia, Maringer mentioned that "in the eastern part, the cylindrical nuclei are very scarce, in most of the sites even absent" (Maringer 1950:174). The regional percentages of types, from my study of Maringer's collections, are presented in Table 17.

Table 17. Type Percentages for Inner Mongolian Cores B

Type	Wedge	Conical	Cylind	Funnel	Total
Steppe					
#	268	189	84	2	543
%	49	35	15	1	
Alakshan Desert					
#	335	171	202	4	721
%	47	24	28	1	
Edsen-gol and Black Gobi					
#	61	99	49		209
%	29	47	24		

If we group wedge-shaped cores under one category, and conical and cylindrical cores under another, it is obvious that the number of conical and cylindrical cores tends to increase from east (Steppe) to west (Edsen-gol and Black Gobi). In eastern Inner Mongolia, the percentages of these two groups are even. In the middle part of the region, the percentage of wedge-shaped cores decreases to 47%, and that of conical and cylindrical cores increases to 52%. In the western area, the percentage of wedge-shaped cores decreases to 29% and that of conical and cylindrical cores increases to 71%.

4. Preform, Platform, and Rejuvenation Patterns

Two major manufacturing processes were identified among all these types. In the first process, the striking platform was prepared first. As Maringer pointed out, the raw material, as a rule, occurred in the form of irregular angular blocks which sometimes already possessed a flat surface which could be used as a striking platform without much additional preparation. In the second process, the body was prepared first. In this case, platforms were worked either by a vigorous transverse blow or by multiple transverse blows or careful flaking. It is noteworthy that different core types share many similarities in platform preparation and rejuvenation.

a. **Wedge-shaped Cores**

Wedge-shaped cores showed high variability in preform preparation but less variability in platform preparation. An outstanding feature is a wide range of core sizes. Two groups of wedge-shaped cores have been identified.

(1) *Broad-bodied Cores*

Two kinds of cores have been distinguished in this group. First, cores which were made on relatively small flakes and bifacially or unifacially worked to form a keel. The platform was prepared by multiple flaking then longitudinal blows were delivered to adjust the edge angle. These specimens look similar to those found at Xiachuan and Xueguan (Fig.16:1,2).

Second, cores were bifacially worked to form either a rectangular or a triangular contour. Many specimens have double-fluted faces and a keel opposite or parallel to the platform. The platform is first transversely prepared then longitudinally trimmed to adjust the edge angle (Fig.16:10).

(2) *Narrow-bodied Cores*

Two kinds of cores have been distinguished in this group. First, cores were bifacially retouched to shape a rectangular contour with an oval cross section. The keel first runs parallel to the fluted face, then became a chisel-like edge which joins the fluted face at the distal end. The face from which microblades were removed was first transversely flaked to form two ridges at both corners of the body, then two ridge spalls and microblades were successively detached to form a fluted face. The platforms were produced either by a vigorous transverse blow or by several large transverse flakes followed by careful trimming. The platform was always shorter than the fluted face. When exhausted, these cores look conical in contour (Fig.16:3,4).

Second, cores were bifacially retouched to form tongue-shaped, celt-shaped, or subspherical forms exhibiting two or three thin lateral edges (keel). The platform was then trimmed from all directions. The microblades were removed symmetrically from both ends of the platform. With use, the core became more and more conical in shape, initially resembling a wedge, then tapering like an awl (Fig.16:3,4).

b. **Conical and Cylindrical Cores**

These two types had common manufacturing processes. Irregular or angular chunks or nodules were roughly worked to form a polyhedral prism, generally roundish in cross-section. If microblades were removed from only one end, a conical core was formed. If microblades were detached from both ends, a cylindrical core was formed. Platforms of these cores were mainly trimmed using multiple flaking, but a few specimens used a natural plane as the striking platform.

c. **Semiconical and Semicylindrical Cores**

The preform preparation of these cores is similar to that of conical and cylindrical cores. The body, however, is usually rectangular in shape and has a flat face on one side and a protruding face on the other. Microblades were removed from the protruding face. The characteristics of the platform are similar to those of conical and cylindrical cores.

d. **Funnel-shaped Cores**

A natural flat face on a chunk or nodule was used as the striking platform on these cores. The preform was prepared by multiple flaking from the platform to form a round and funnel-shaped contour.

Platform rejuvenation was only recognized on wedge-shaped, conical, cylindrical, semiconical and semicylindrical cores. When platform edge angles failed, careful, multiple flaking was conducted to renew the platform. Such rejuvenation often created one or more step fractures on the striking platform. Removal of the whole platform was recognized from many tablet fragments belonging to conical, cylindrical, or narrow-bodied wedge-shaped cores.

Rejuvenation of the fluted face was also identified in the collections. When the fluted face failed to produce microblades, a partial fluted face was sometimes taken off from one corner of the body to renew a ridge that acted as a guide to subsequent microblades. Maringer mentioned such artifacts being "fragments of small flint nuclei," "top fragments of nuclei," and "longitudinal fragments of nuclei" (Maringer 1950:21,25,74)

5. Edge Angle Variations

The edge angle analysis of this complex is based on my own examination and measurements of the collections. A total of 135 microblade cores were measured. Sixty wedge-shaped cores yielded 66 measurements, 44 conical cores yielded 53 measurements, 9 cylindrical cores yielded 15 measurements, and 22 semiconical and semicylindrical cores yielded 22 measurements.

Table 18. Edge Angle Variation for Inner Mongolian Cores

Angle	<59	60-69	70-79	80-89	90-99	>100	Total
Wedge							
#	1	5	6	21	22	11	66
%	1	8	9	32	33	17	
Conical							
#	1	1	3	15	24	9	53
%	2	2	6	28	45	17	
Cylind							
#		1		4	7	3	15
%		7		27	46	20	
Semi							
#		2	5	4	6	5	22
%		9	23	18	27	23	

Inner Mongolian cores showed relatively high frequencies (more than 50%) of obtuse edge angles (90 degrees or larger).

6. Core Dimensions

In addition to the 135 specimens measured by myself, 53 core measurements are possible from Maringer's (1950) illustrations. Therefore, the dimensions of a total of 188 microblade cores are presented in Table 19.

In this sample, percentages of large cores are relatively high. They account for 51% of wedge-shaped cores, 41% of conical, 62% of cylindrical, and 41% of semiconical and semicylindrical cores. All three funnel-shaped cores are large.

Table 19. Dimensions for Inner Mongolian Cores

Index(cm)	4	5	6	7	8	9	10	11	12	Total
Wedge										
#	2	6	19	9	15	6	6	4	7	74
%	3	8	26	12	20	8	8	5	10	
Conical										
#	3	7	15	11	8	12	3		2	61
%	5	11	25	18	13	20	5		3	
Cylind										
#	1	2	4	3	2	5	2	2	5	26
%	4	8	15	11	8	19	8	8	19	
Semi										
#	5	3	6	4	2	2			2	24
%	21	13	25	17	8	8			8	
Funnel										
#					2	1				3

F. DISCUSSION OF MICROBLADE CORES FROM NORTH CHINA

Using the analysis and comparison of 452 microblade cores from Xiachuan, Xueguan, Hutouliang, Jiqitan, Hailar, and the assemblages associated with pottery or ground stone tools, the following discussion covers techno-typological attributes of 452 microblade cores in terms of raw materials, core type percentages, preform, platform, and rejuvenation patterns, edge angle variation, and core dimensions. The developmental sequence of microblades from the Upper Paleolithic to the more recent periods in North China will then be traced.

1. Raw Materials

In the Xiachuan assemblage, different raw materials including chert, veined quartz, quartzite, crystal, and silicarenite, were chosen for tool manufacture. Microblades, however, were predominantly made on black, grey, brown and grey cherts. Only a few specimens were made on vein quartz (Wang *et al.* 1978). The most common material was black chert, which was quite homogeneous but usually contained cleavage planes.

The raw materials from Xueguan include chert, quartzite, and hornfels. Except for one made on hornfels, almost all microblade cores are made on black chert (Wang *et al.* 1982).

The raw materials of the Yangyuan Complex are mainly quartzite, with a few chert and rhyolite specimens (Gai and Wei 1977).

Raw materials at Hailar include chert, flint, jasper, chalcedony and tuff (An 1978). Given the presence of rolled cortex on the cores, they were probably obtained as pebbles.

Microblades associated with pottery or ground stone tools show various raw material selections. In Inner Mongolia, microblades were principally made on flint-like materials with various bright colours, including "white and reddish chalcedonies, silicified sediments such as argillites, loams and schists" (Maringer 1950:168).

2. Core Type Percentages

Six major core types were present at Xiachuan. The conical core was the most numerous type, accounting for 45% of the total. The second was the boat-shaped core, accounting for 26%. The third and forth were semiconical (22%) and funnel-shaped cores (10%). The wedge-shaped core was only the fifth (8%).

The boat-shaped and wedge-shaped cores were the two dominant types at Xueguan, while the wedge-shaped core was the only type present in the Yangyuan Complex.

The Hailar assemblage yielded mainly wedge-shaped cores. The percentages of microblade cores associated with pottery or ground stone tools differ from place to place. In general, wedge-shaped and conical cores were the two common types. The number of cylindrical cores increased significantly.

Therefore, the wedge-shaped, conical, and cylindrical cores were the three most common types during this period.

Based on different core percentages in these assemblages, I summarized the general trend of microblade typological changes as follows. First, in the Xiachuan assemblage, six core types were being used to produce microblades. The conical and boat-shaped cores are the two most common ones. The wedge-shaped core is very rare.

Second, the Xueguan assemblage and the Yangyuan Complex showed a general trend of typological diversification. The boat-shaped and wedge-shaped cores became the two most common types at Xueguan. The artisans of the Yangyuan Complex only made use of the wedge-shaped core. The degeneration and absence of conical cores may be significant in these industries, but new discoveries are needed to resolve this issue.

Third, the temporal occurrence of boat-shaped cores reveals that this might be an archaic type, or represent a relatively primitive core technology. At present, this type occurs only at Xiachuan and Xueguan.

Fourth, the wedge-shaped, conical and cylindrical cores were dominant types in the Hailar assemblage and the assemblages associated with pottery or ground stone tools.

3. Preform, Platform, and Rejuvenation Patterns

These variables are discussed in terms of different core types.

a. **Wedge-shaped cores**

A variety of manufacturing techniques were used in preform and platform preparation and there are some obvious temporal similarities and differences.

At the Xiachuan and Xueguan assemblages, wedge-shaped cores were made by a fairly simple and monotonous technique in terms of preform and platform preparation. Wang and I have defined a Xiachuan technique or the

Xiachuan core on the basis of the broad-bodied wedge-shaped cores (Chen and Wang 1989) (Fig.3:1).

In the Yangyuan Complex, several techniques were defined by Gai Pei (Gai 1984, Tang and Gai 1986) as the Yangyuan, Hutouliang, Hetao, and Shanggan techniques (Fig.3:2,3,4,5). According to Gai's definitions, the Hutouliang and Yangyuan techniques seem similar in preform and platform preparation. The only difference between these two techniques are the rejuvenation pattern. If the platform of a wedge-shaped core was rejuvenated by removing a tablet, it was called the Yangyuan technique. If it was rejuvenated by multiple trimming, it was called the Hutouliang technique.

At the Hailar assemblage, broad-bodied wedge-shaped cores were probably made by the Hetao technique. The technique used to produce narrow bodied ones is unique. I call it the Hailar technique:

(1) *The Hailar technique*

> A flat pebble or nodule was bifacially prepared to form a tongue-shaped or semi-lunar preform with a keel. The platform was prepared by multiple blows executed from various directions. Microblades were removed from one side only (Fig.17:1).

Some wedge-shaped cores in the assemblages associated with pottery or ground stone tools were made by quite different methods. The two defined here are Yingen and Zhalainor:

(2) *The Yingen technique*

> Chunks or nodules were bifacially prepared to form a thick and narrow rectangular preform. One side was bifacially prepared to make a keel which runs parallel to the long axis. The working face, on the opposite side, from which microblades were detached was transversely retouched to form two ridges. These two ridges also run parallel to the long axis and were used to guide the first two microblades. The platform was trimmed from various directions around the perimeter. When the core was exhausted it took on a conical form, but still retained a keel. Sometimes, such cores might totally change to the conical form when microblades were detached from the keel (Fig.17:2).

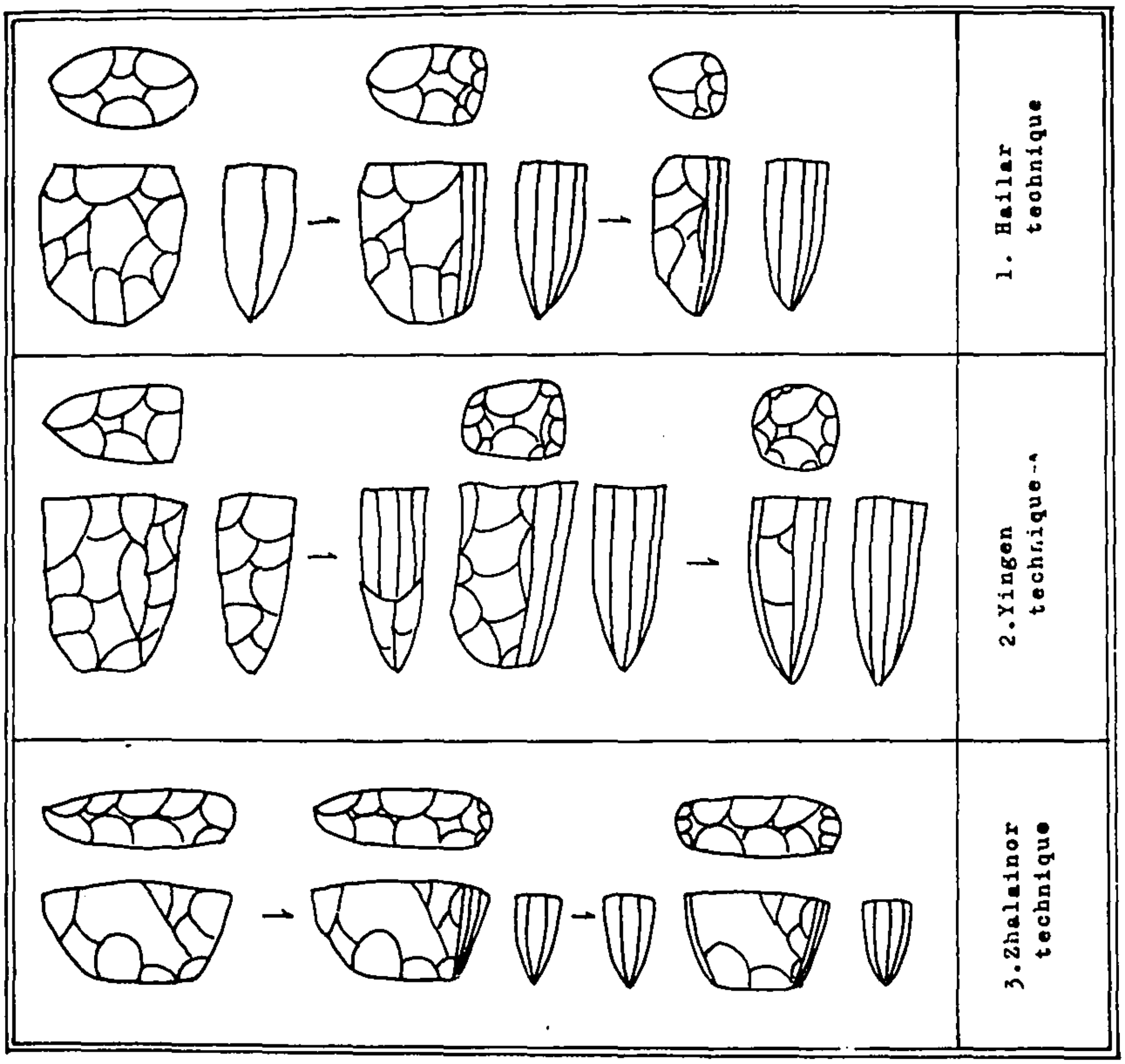


Figure 17: Wedge-shaped Core Techniques in Inner Mongolia

(3) *The Zhalainor technique*

> Chunks and nodules were bifacially prepared to form a broad, rectangular preform which had a keel at the bottom running parallel to the platform. Microblades were usually removed from one or both ends. The platform.was prepared using multiple flaking from various directions (Fig.17:3).

Wedge-shaped cores made by three different techniques are somewhat different in appearance, but they share some similarities in preform and platform preparation. For example, they were mostly bifacially prepared and had a platform always prepared from various directions.

As discussed above, the wedge-shaped core reveals a rather simple preform and platform preparation during a relatively early period represented by the Xiachuan and Xueguan assemblages. The core itself became more varied and sophisticated in manufacture in the slightly more recent period represented by the Yangyuan Complex. In the Hailar assemblage and the assemblages associated with pottery and ground stone tools, techniques used in the previous periods were still available, but many specimens indicate a simplification of platform preparation.

b. **Conical and Cylindrical Cores**

These two types were similar in preform and platform preparation, and are thus discussed together.

At the Xiachuan assemblage, chunks and flakes were used to produce microblades with limited preform or platform preparation. A natural ridge was used to guide subsequent microblade detachments. Most specimens contain a fluted face covering only part of the body owing to the lack of preform preparation. Platforms consist of flake scars or a natural plane.

These cores were either very few and rough in appearance in the Xueguan assemblage or totally absent in the Yangyuan Complex. It is still premature to explain this observation because of the limited amount of evidence.

Conical and cylindrical cores were dominant in many assemblages associated with pottery or ground stone tools. Their preforms were carefully prepared to assume a prismatic form with three or four ridges to guide microblade detachment, and a fluted face covering the whole slender body. Their platforms were either trimmed from various directions around the perimeter or were merely a natural plane.

c. **Boat-shaped Cores**

This core type was found only at the Xiachuan and Xueguan assemblages. Their diagnostic attributes are similar in these two assemblages. They are made on chunks or thick flakes, with a broad platform consisting of a single flake scar or a natural plane.

d. **Semiconical Cores**

This type mainly occurred in the Xiachuan and Xueguan assemblages and in the assemblages associated with pottery or ground stone tools. Preform preparation in different assemblages was fairly similar: a flake or flat chunk was slightly prepared along the side. The techniques of platform preparation, however, were different. In the Xiachuan and Xueguan assemblages, the platform was a bevelled face either trimmed from front to back or a single flake scar. In the assemblages associated with pottery or ground stone tools, some platform preparations show rather similar characteristics to those of wedge-shaped and conical cores. They have either a level plane trimmed from various directions around the perimeter of the platform or a bevelled plane flaked from front to back. The core size showed more variation in these assemblages.

e. **Funnel-shaped Cores**

At present, this type is only known from the Xiachuan assemblage and the assemblages associated with pottery or ground stone tools. Thick flakes, chunks, or nodules were used to make these cores. A natural plane or a single flake scar commonly served as the platform. They are very rough in appearance at Xiachuan and fairly delicate in the assemblages associated with pottery or ground stone tools. Because very few specimens were examined and analyzed, it is impossible to discuss their manufacturing process.

Several methods of rejuvenating wedge-shaped, conical, and cylindrical cores have been identified. Regular patterns cannot be discovered for other core types. in the Yangyuan Complex, the wedge-shaped core revealed diverse patterns of platform rejuvenation.

4. Edge Angle Variations

The edge angle variation differs from type to type. Generally, conical and cylindrical cores yielded edge angles more obtuse than those of wedge-shaped, boat-shaped, and funnel-shaped cores. The edge angle of narrow-bodied wedge-shaped cores is more obtuse than that of broad-bodied cores.

a. Wedge-shaped Cores

Wedge-shaped cores from Xiachuan yielded edge angles all less than 90 degrees.

The majority of Xueguan edge angles are less than 90 degrees with the exception of one specimen of 116 degrees which might have been caused by the failure of platform rejuvenation. In the Yangyuan Complex, the majority of edge angles is still less than 90 degrees.

Edge angles of 90 degrees or larger increased to 47% in the Hailar assemblage. For the assemblages associated with pottery or ground stone tools, the percentage of edge angles of 90 degrees or larger reached 51%. Edge angles witnessed a tremendous change in distribution in these assemblages.

b. **Conical Cores**

Conical cores mainly occurred in the Xiachuan assemblage and the assemblages associated with pottery and ground stone tools. The frequency of this core type at Xueguan and Hailar is too small to make any meaningful conclusions.

The majority of edge angles (62%) from Xiachuan are less than 90 degrees. In the assemblages associated with pottery or ground stone tools, edge angles of 90 degrees or larger account for 62%. Table 20 shows the change of conical core edge angles in these assemblages.

c. **Boat-shaped Cores**

This type only occurred at Xiachuan and Xueguan. The edge angle variations are very similar in these two assemblages, the majority are less than 90 degrees.

d. **Semiconical Cores**

This type mainly occurred in the Xiachuan and Xueguan assemblages and the assemblages associated with pottery or ground stone tools.

The majority of edge angles in the Xiachuan (93%) and Xueguan (100%) assemblages is less than 90 degrees. In the assemblages associated with pottery or ground stone tools, edge angles of 90 degrees or larger increase to 50%.

Analysis and comparison reveal that most cores from the Xiachuan and Xueguan assemblages and the Yangyuan Complex have an edge angle less than 90 degrees with the exception of a few specimens with failed platform rejuvenation. In the Hailar assemblage and the assemblages associated with pottery or ground stone tools, the percentages of edge angles larger than 90 degrees increased considerably. Table 20 shows changes in microblade core edge angles from the Early to Late Periods.

Table 20. Change of Microblade Core Edge Angles

%	Xiachuan	Xueguan	Yangyuan	Hailar	Inner Mongolia
Wedge					
90 or more		5	7	47	51
89 or less	100	95	93	53	49
Conical					
90 or more	15				62
89 or less	85				38
Boat					
90 or more	3	14			
89 or less	97	86			
Semiconical					
90 or more	7				50
89 or less	93	100			50

Figure 18 graphically illustrates the percentages of edge angle variation in different assemblages. It reveals that the edge angles of wedge-shaped cores are rather acute in the Xiachuan and Xueguan assemblages and the Yangyuan Complex and increase markedly in the Hailar assemblage and the assemblages associated with pottery or ground stone tools.

5. Core Dimensions

The following is a detailed comparison of core dimensions in different assemblages.

a. **Wedge-shaped Cores**

In the Xiachuan assemblage, wedge-shaped cores are small. Only two (11%) of the 19 specimens are large cores, one of which is a preform. In the Xueguan assemblage, wedge-shaped core sizes are similar to Xiachuan. Only two are large ones (11%), both of which are preforms. Large cores from the Yangyuan Complex amount to 41%. Large cores reach 33% in the Hailar assemblage, and

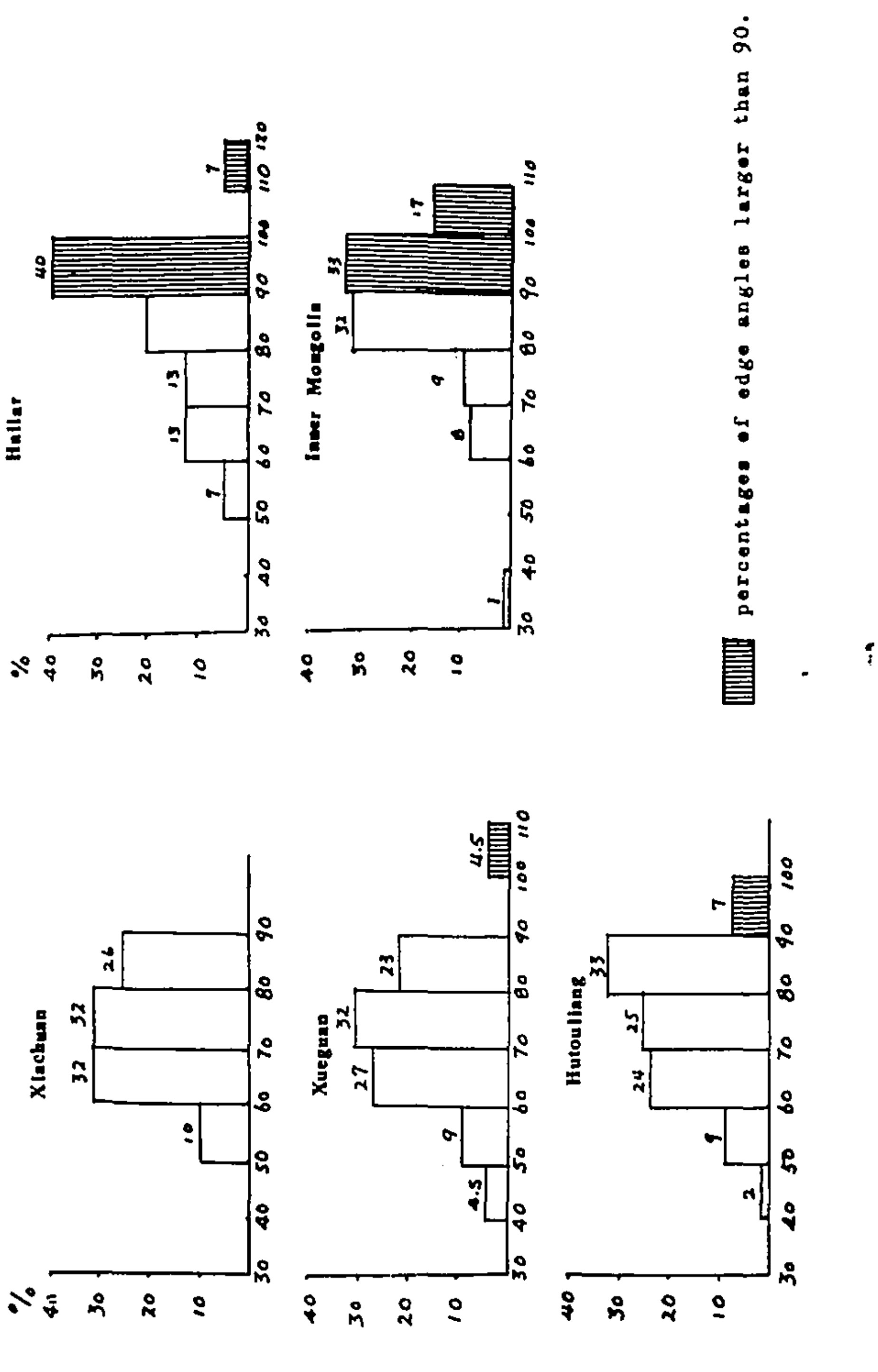


Figure 18: Comparison of Wedge-shaped Core Edge Angles in North China

51% in the assemblages associated with pottery and ground stone tools.

b. **Conical Cores**

In the Xiachuan assemblage, only three out of 67 (5%) are large cores. In the assemblages associated with pottery or ground stone tools, large cores reach 41%. The dimensions of conical cores increased markedly in these assemblages.

c. **Semiconical Cores**

These are all small in size at the Xiachuan and Xueguan assemblages. In the assemblages associated with pottery or ground stone tools, large specimens reach 41%.

d. **Cylindrical and Funnel-shaped Cores**

Owing to the small number of these two types, it is impossible to make meaningful comparisons between different assemblages. Only one cylindrical core yielded an index of 3 cm at Xiachuan. Many cylindrical cores in the assemblages associated with pottery or ground stone tools yielded indices between 15 and 4 cm. Large specimens account for 62%.

Four funnel-shaped cores from Xiachuan yielded two indices of 7 cm, one of 8 cm, and one of 9 cm. Three specimens in the assemblages associated with pottery or ground stone tools yielded two indexes of 9 cm, and one of 10 cm. Table 21 shows the change of core sizes in these assemblages.

Table 21. Dimensional Change of Microblade Cores

%	Xiachuan	Xueguan	Yangyuan	Hailar	Inner Mongolia
Wedge					
large	10	10	41	33	51
small	90	90	59	67	49
Conical					
large	5				41
small	95	100			59
Boat					
large	14	8			
small	86	92			
Semi					
large					41
small	100	100			59

Core dimensions revealed a marked difference between these assemblages. The overwhelming majority of the microblade cores from Xiachuan and Xueguan were small. Later on, large cores became more common. Table 21 shows dimensional change of microblade cores from these assemblages.

Figure 19 graphically compares microblade core dimensions from different assemblages from three periods.

6. Summary

The significance of the foregoing detailed attribute and statistical analyses of microblade technology in North China are summarized below.

a. Great similarity in raw material selection, microblade core morphology and technology, platform edge angle variation, and size strongly suggest that the Xiachuan and the Xueguan assemblages are closely related. Such close interrelationship is also strongly supported by their geographic proximity and chronological contemporary.

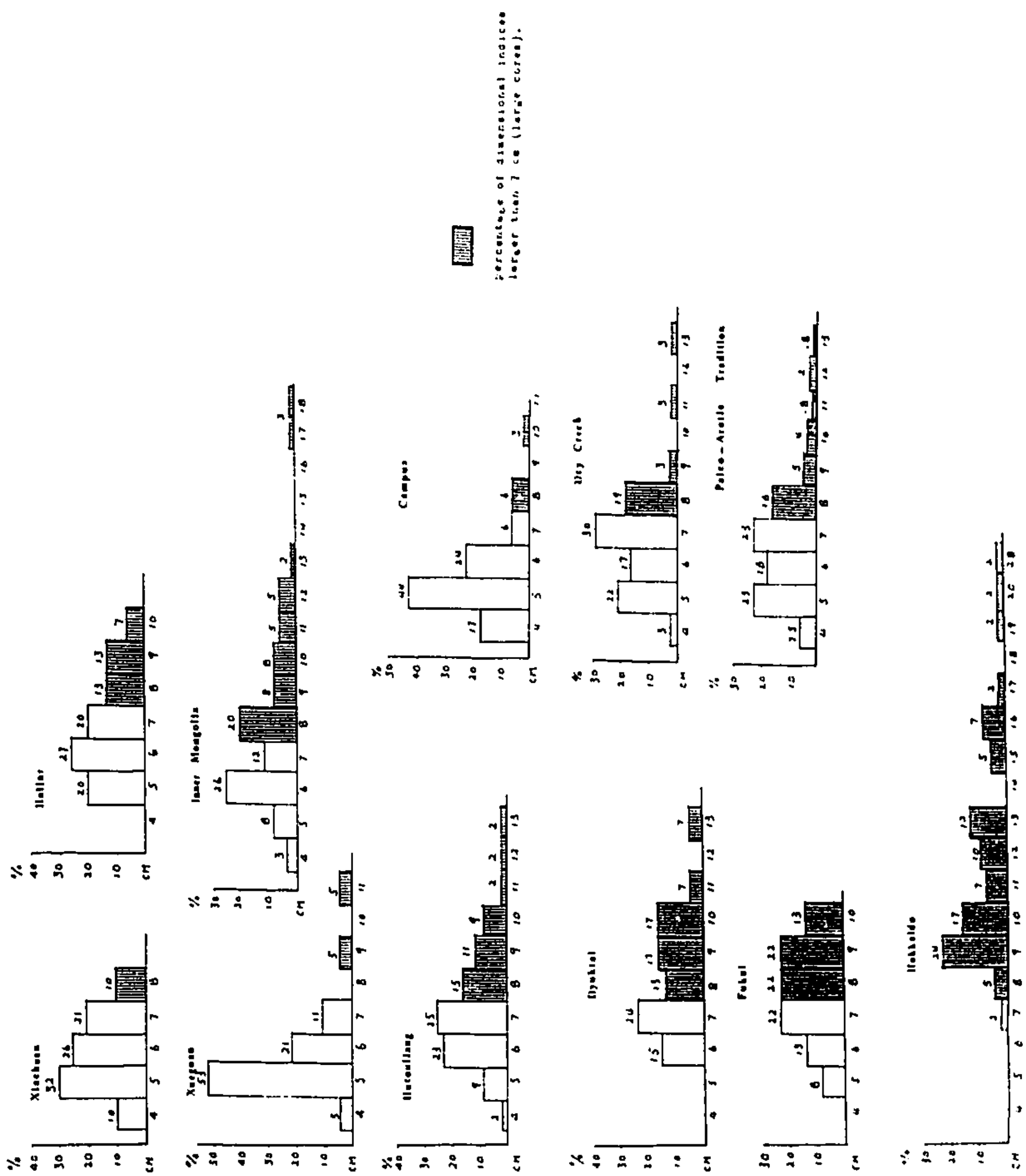


Figure 19: Comparison of Wedge-shape Core Dimensions in North China, Eastern Siberia, and North America

b. Boat-shaped cores are only found at Xiachuan and Xueguan. They are absent in more recent assemblages, suggesting that this type might be an archaic microblade core form or technology.

c. The predominance of wedge-shaped cores in the Xueguan assemblage and the Yangyuan Complex may be significant. It is possible that this represents a trend toward diversification in microblade manufacture during this period.

d. The Yangyuan Complex represents a well-developed and sophisticated microblade manufacture. The wedge-shaped core is the only type employed. They are characterized by variation in preform and platform preparation and by increase in size.

e. Although wedge-shaped cores are dominant in the Hailar assemblage, platform preparation reveals a trend toward simplification in comparison with those of the Yangyuan Complex. An outstanding feature is that the platform edge angles exceeding 90 degrees increased considerably, a major change from the situation in previous periods.

f. Microblade cores from assemblages in association with pottery and ground stone tools in Inner Mongolia and surrounding area reveal a specialization and diversification of core typology, simplified preform and platform preparation, high percentages of obtuse platform edge angles, and a wide range of core size indices. Large cores increase considerably in comparison with other assemblages.

g. Analysis reveals that very few wedge-shaped cores in the Xiachuan and Xueguan assemblages and the Yangyuan Complex exhibit edge angles of 90 degrees or more. This is in sharp contrast to the high percentages of edge angles of 90 degrees or larger in the Hailar assemblage and the assemblages associated with pottery or ground stone tools.

CHAPTER V. - ANALYSIS AND COMPARISON OF MICROBLADE CORES FROM NORTHWESTERN NORTH AMERICA

In this chapter, microblade cores from northwestern North America are analyzed and compared. These include the American Paleo-Arctic Tradition, the coastal microblade assemblages, the Plateau Microblade Tradition, and the Denbigh Flint Complex of the Arctic Small Tool Tradition. Two assemblages from Ice Mountain and Bezya which are not assigned to any tradition are discussed separately.

A. AMERICAN PALEO-ARCTIC TRADITION

The American Paleo-Arctic Tradition is the earliest microblade tradition in the western Arctic. The assemblages analyzed here include those from the Campus site, Dry Creek, Ugashik Narrows, Donnelly Ridge, the Noatak Drainage sites, Akmak, Tangle Lakes, Ground Hog Bay 2, Healy Lake, and Small Sites in northern Alaska.

1. Site Description

a. Campus Site

The site is located on the University of Alaska campus near Fairbanks, occupying the edge of a southeast-facing bluff that rises 20 m above the broad floor of the Tanana River valley. The site was discovered in 1933 and excavated in 1934. in 1966, 1967, and 1971 further excavations were conducted at the site. The site has no obvious cultural stratigraphy. The surficial layer is a dark organic soil about 5-10 cm thick. Beneath it is an unstratified loess averaging 35 cm thick. Downslope this loess lies directly on schist rubble about 1.5 m thick. Artifacts were found only in the loess (Mobley 1991:10). Research indicates that the Campus site represents multiple components and various lithic manufacturing technologies (Hosley and Mauger 1967:11-12; see Mobley 1991:11). The total number of artifacts recovered from different excavations is about 10,000, including 699 microblade remains (Mobley 1991:23,24) (Fig.20).

The age of this site has long been controversial. Based on the chronological range of the Denali Complex, West (1975) suggested an age between 12,000 and 8000 B.P. The first absolute dating test was made by Y. Katsui and gave a single obsidian hydration date of 8400 B.P. (Bandi 1969:52). Also using the obsidian hydration technique, John P. Cook (1975:129; Mobley 1991:73) arrived at a date of about 3,300 B.P. for the Campus site. Based on obsidian hydration rind measurements, Holmes (1978; see Mobley 1991:73) suggested a dating range of 4,500 to 1,000 for the Campus site. Mobley (1984, 1985, 1991) states that only limited soil disturbance had occurred. Charcoal and bone samples provided six radiocarbon dates, three of which are thought to represent the age of the Campus site, none dating older than 3,000 years B.P. (Mobley 1991:76,77):

Lab.No.	Date (BP)	Sample	Depth
Beta-7075	2725±125	charcoal	20-25 cm
Beta-4260	2860±180	charcoal	15-20 cm
Beta-6829	3500±140	charcoal	20-30 cm

Judging from the radiocarbon dating results of the Campus site, the age of the microblade assemblage from the site seems too young to be a component of the American Paleo-Arctic Tradition. In this study, I still prefer to include the microblade industry from the Campus site into this tradition based on the fact that the Campus core has been a representative of this tradition.

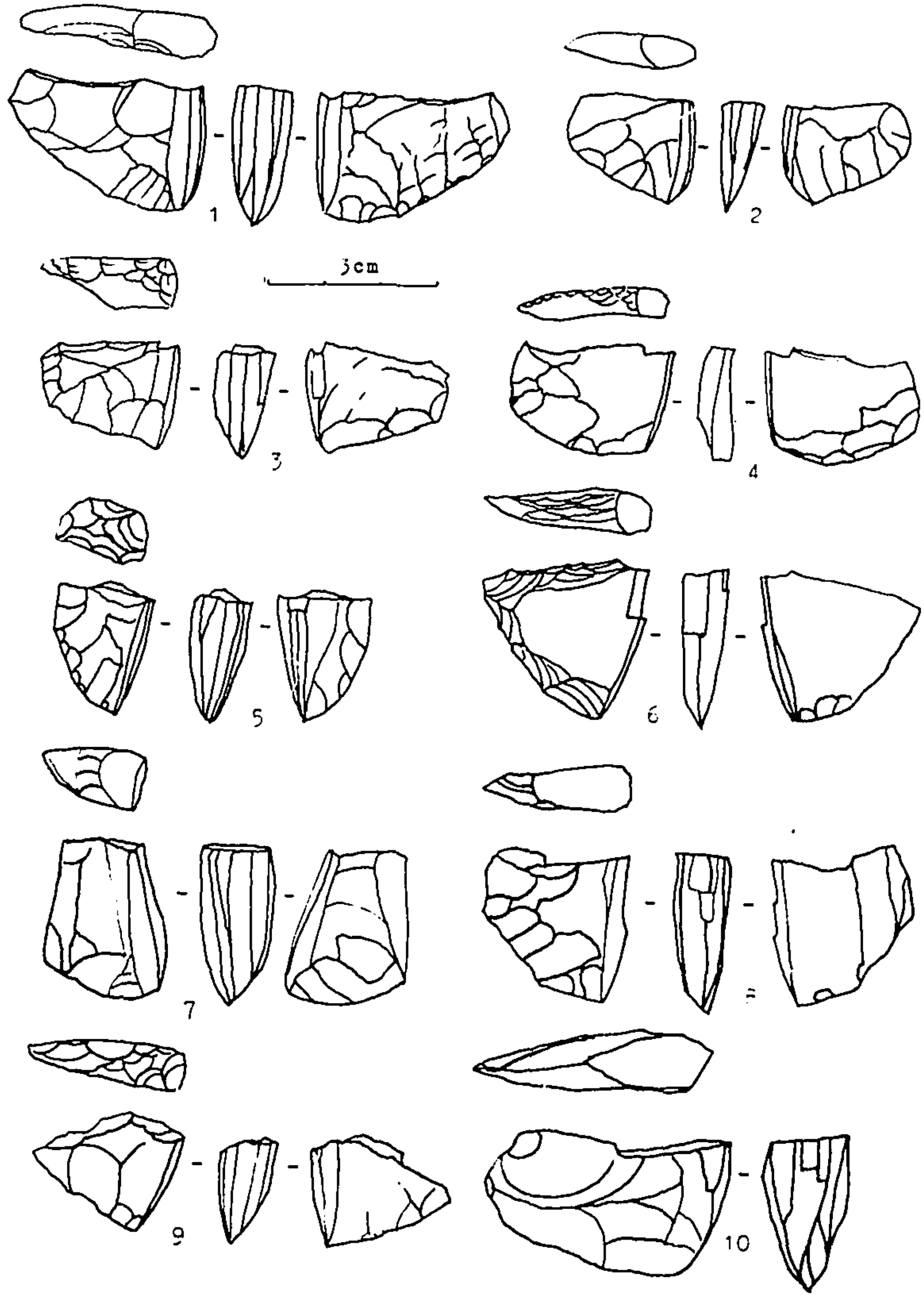


Figure 20: Wedge-shaped Cores from the Campus Site (by courtesy of the Museum of the University of Alaska)

b. **Dry Creek**

The archaeological components at Dry Creek are stratified within a 2 m section of eolian sediments and paleosols which overlie glacial outwash deposits. Test excavations have isolated three cultural components of late Pleistocene age and one of Holocene age.

Four stratigraphically distinct cultural horizons or components were distinguished. The total number of artifacts found from preliminary field work in 1973 and 1974 was 2827, of which 99 percent were flakes, blades, cores, and tools, and 1 percent water-rounded cobbles and small boulders presumed to have cultural significance (Powers and Hamilton 1978:75).

Microblade remains uncovered more recently from component II include 21 wedge-shaped cores (Fig.21), 1772 microblades, 8 broken cores, 3 preforms, 21 attenuated preforms, 45 core tablets, and other fragments. Other stone tools such as an end scraper, side scrapers, choppers, elongate bifaces, and one lozenge-shaped edge-ground point were also discovered (Powers *et al.* 1983).

Eighteen radiocarbon dates on charcoal and peat have been obtained at the site. The dates of 9340±195 (SI-2329) and 10,690±250 B.P. (SI-1561) belong to component II (Powers and Hamilton 1978:72; Powers and Hoffecker 1989).

c. **Ugashik Narrows**

The Ugashik Narrows phase of the American Paleo-Arctic Tradition was named after a locality situated on the east bank of the Ugashik Narrows at a point where upper Ugashik Lake constricts to form the Narrows. It lies on a high, grassy bluff overlooking the water's edge.

The stratum from which the overwhelming majority of Ugashik Narrows phase artifacts were excavated is located at the base and west end of the stratigraphic trench which was placed on an east-west axis across the length of the site. This deposit is composed of a loess-like soil some 30 cm thick that lies directly on glacial gravels (Henn 1978).

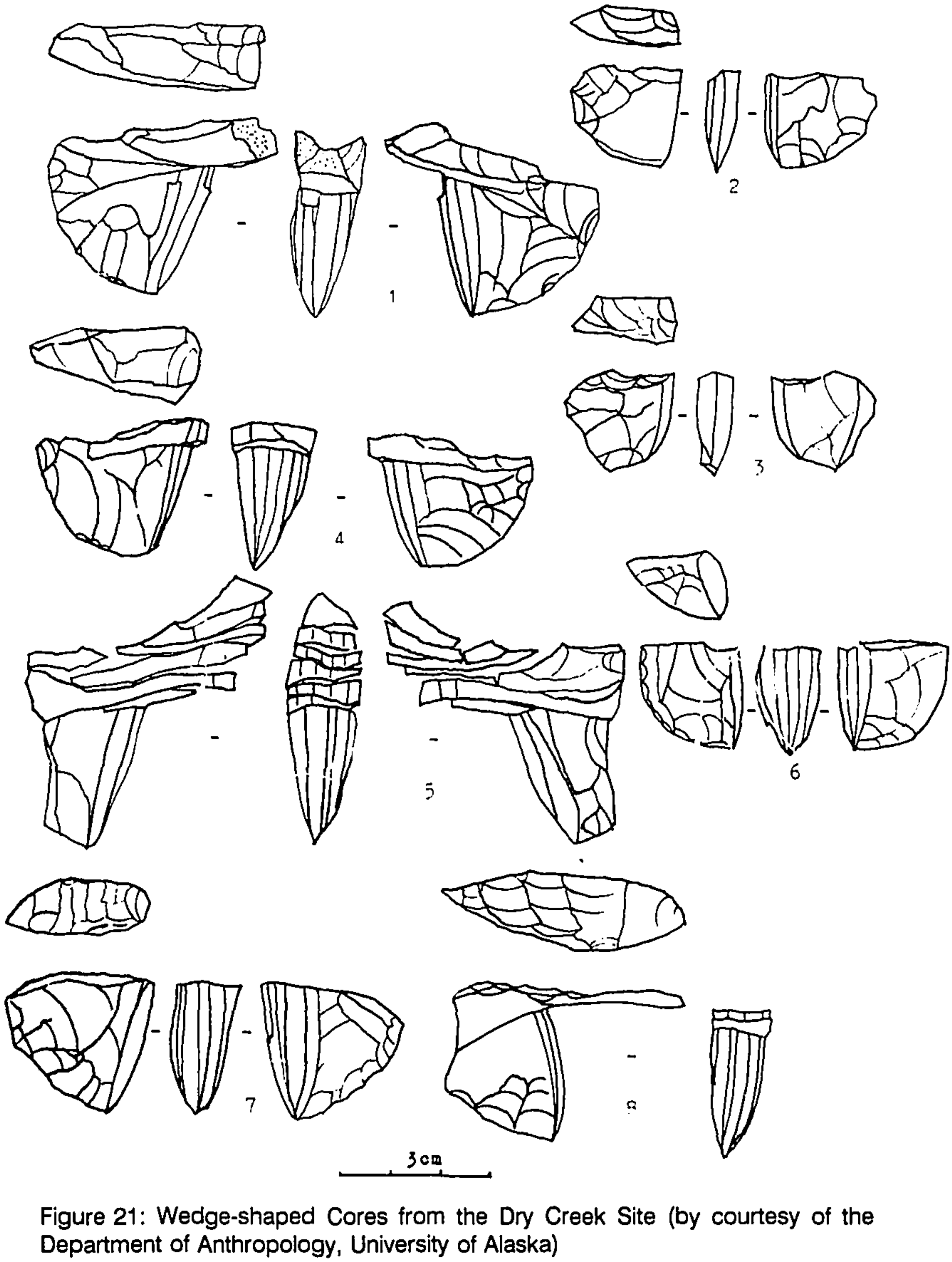


Figure 21: Wedge-shaped Cores from the Dry Creek Site (by courtesy of the Department of Anthropology, University of Alaska)

The lithic inventory of the assemblage includes 16 wedge-shaped cores (Fig.22), 705 microblades, large blade cores, core bifaces, projectile points, burins, end scrapers, bifacial knives, and many other stone artifacts (Dumond *et al.* 1976; Henn 1978).

d. **Donnelly Ridge**

Donnelly Ridge is the highest and most prominent of a series of terminal moraines of the Wisconsin glaciation of the Delta River. No stratigraphy was observed at the site. A number of artifacts occur on the gravel surface of the moraine. There is a loess-like soil covering in the vicinity. The column varied in depth but nowhere exceeded 60 cm.

A total of 1512 stone artifacts was found. The dominant elements are those relating to microblade core and blade industry. The lithic inventory includes 10 wedge-shaped cores, 20 core tablets, 323 microblades, 8 burins, 56 burin spalls, 5 end scrapers, 4 bifacial knives, 6 large blades and blade-like flakes, and more than a hundred worked flakes and fragments (West 1967).

Two samples yield radiocarbon dates of A.D. 120±200 (B-649) and A.D. 160±300 (B-650), respectively. West thought that they were incorrect and gave an estimation of 8000-10,000 B.P. for the microblade assemblage (West 1967:372-373, 1981:100).

e. **Noatak Drainage**

The Noatak is a major river draining the north Alaskan tundra. The river empties into Hotham Inlet just north of the Kobuk River delta. Archaeological sites mainly occur along the Noatak River and its tributaries, such as the Kelly, Kugururok, and Nimiuktuk Rivers. Most of them are unstratified lookout sites and chipping stations. Dwelling sites appear to be rare. The sites that belong to the American Paleo-Arctic Tradition are NR-8, NR-12, NR-30, Nim-5, and Kug 1-1.

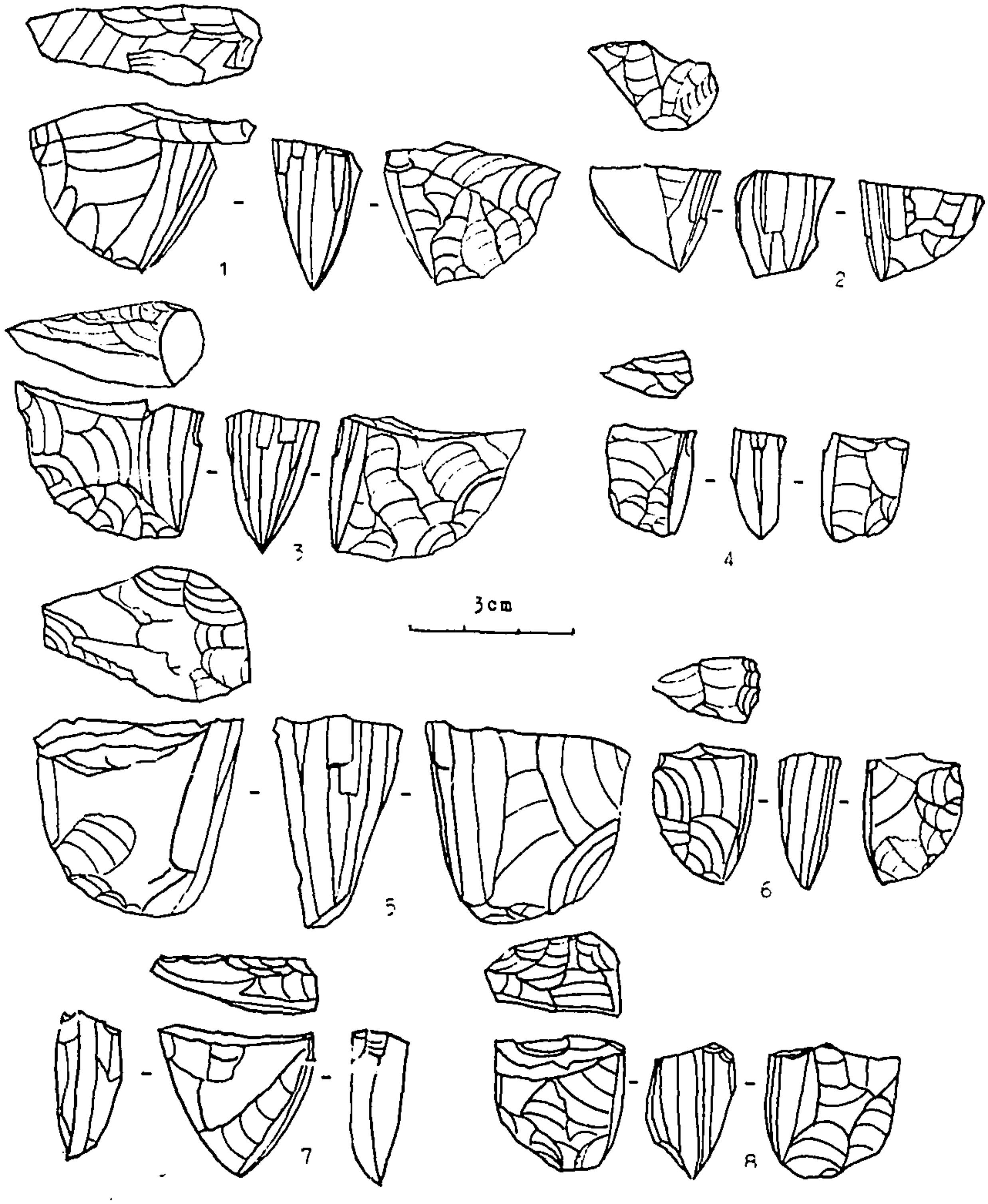


Figure 22: Wedge-shaped Cores from Ugashik Narrows (by courtesy of Don Dumond)

(1) *Kelly River*

NR-8 This site is situated along the eastern buffs overlooking Poktovik Creek, and is comprised of two areas of isolated surface finds. The area is below a narrow gorge in the creek valley. The bluffs. of small water-worn cobbles in a sandy matrix, were densely covered with sedges. Two wedge-shaped cores (Fig.23:3), one blade core, and many flakes were found at the site.

NR-30 This site, located on a bluff on the southern side of the Noatak, is covered with rounded cobbles in a sandy matrix. The bedrock, where exposed, is shale. The lithic inventory from the site includes one large biface, one knife biface, two wedge-shaped cores (Fig.23:1) and two microblades.

(2) *Kugururok River*

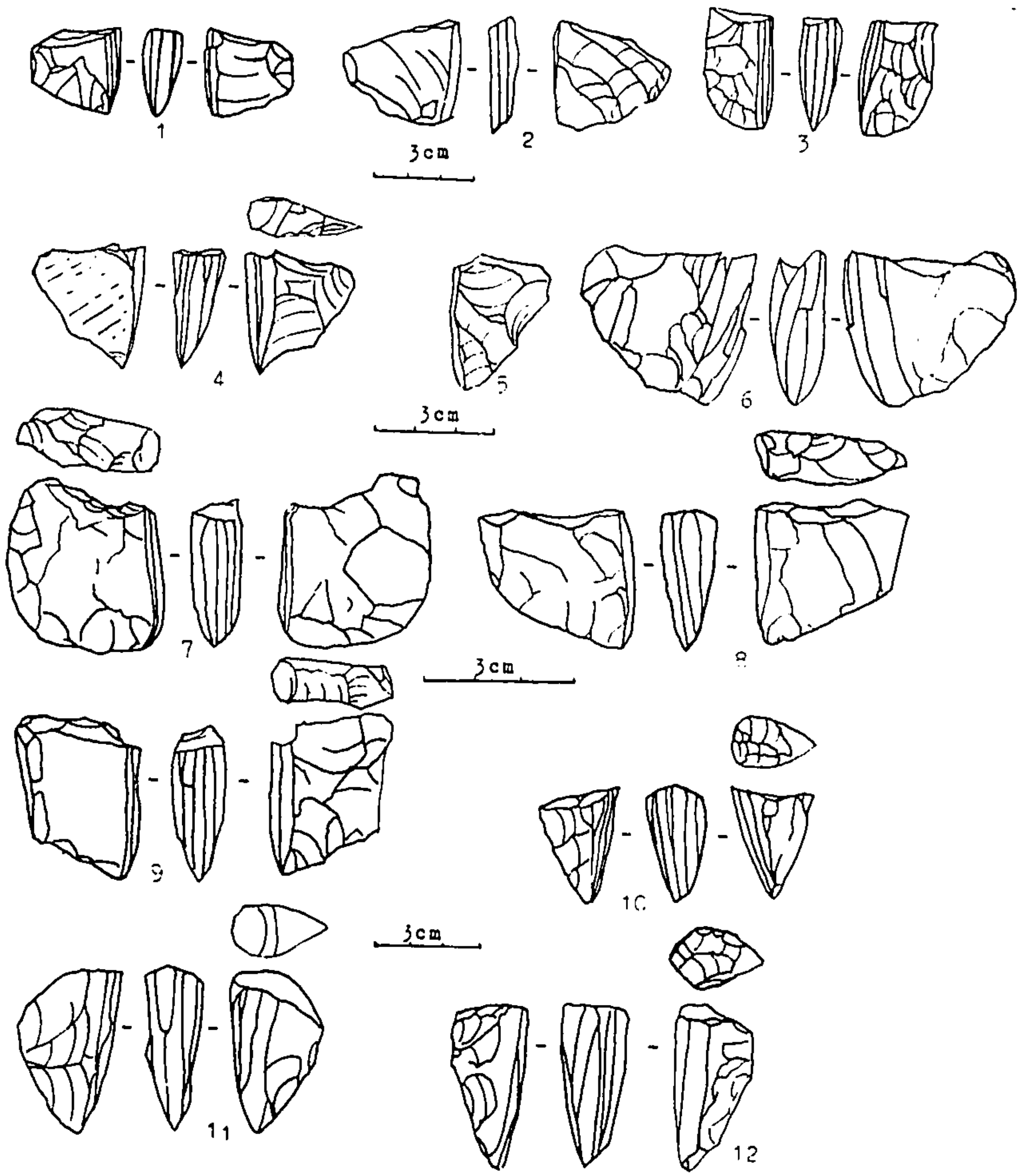
The Kugururok valley empties into the Noatak from the north just below the middle Noatak canyons.

Kug 1-1 This site is on a mountain, largely unvegetated, which is covered with highly fractured limestone and some chert. The site lies on the lower bench overlooking the Kugururok River to the east and northeast. A total of 36 artifacts were found, including 2 wedge-shaped cores (Fig.23:2), 4 core tablets, 10 microblades, 4 burin spalls, 1 face-faceted polyhedral core, 1 denticulate, 1 hammerstone, 1 whetstone, 2 large biface fragments, 1 side scraper, and 1 flake knife.

(3) *Nimiuktuk River*

The Nimiuktuk River is the third major tributary of the Noatak Drainage, flowing southward from the DeLong Mountains through a relatively low flat valley.

Nim- 5 This site includes a series of locations situated on a large knoll overlooking the river to the west and a broad upland to the east.



1-3. Noatak Drainage 4-6. Akmak 7-12. Small Sites in Northern Alaska

Figure 23: Wedge-shaped Cores from Alaska (from Anderson 1970a, 1972, Gal 1982, and Geriarch 1982)

The major artifacts occurred along the western side of the knoll. Microblades were scattered randomly over the entire area tested. The lithic inventory includes 1 wedge-shaped core, 10 microblades, 10 projectile points, 197 fragments of projectile points, 3 biface knife blades and 14 fragments, 4 drill fragments, 6 end and side scrapers, and numerous irregular cores.

Nim-12 This site is located on the western side of the river near the mouth of Kukukpilak. Microblade remains and associated artifacts were found in several localities on shale or slate outcrops near the river. The lithic inventory included 3 wedge-shaped cores, 4 microblades, 3 biface knives, 1 side scraper, and 1 point (Anderson 1972).

f. **Akmak (Onion Portage)**

This site is located at the upriver end of the portage on the Kobuk River, northwestern Alaska. Four topographic areas are present at the site. They are: the deeply stratified portion close to the river course, a high long level along the shore, the gully, and the hillside. The Akmak artifacts for the most part lay flat and at about the same level--30 to 50 cm below the modern surface, suggesting that they lay along an ancient surface. Neither unburnt organic material nor charcoal occurred at the same level. An observable living surface upon which the Akmak artifacts may have been dropped is totally absent. The wide variety of tools seems to indicate the site was very likely a permanent settlement area.

The Akmak assemblage contains over 500 artifacts and artifact fragments. Only some of them could be classified into specific categories and Anderson distinguished the following: large core bifaces; blade and microblade cores; burins and burin spalls; blades, microblades, and blade-like flakes; large flake bifaces; grooved stones; large flake unifaces; and utilized flakes.

A total of six microblade cores were found, all wedge-shaped (Fig.23:4-6) (Anderson 1970a).

g. **Tangle Lakes**

The Tangle Lakes are located 30 km west of Paxson Lake and immediately south of the Denali Highway. More than 220 sites were found in the area which might span the past 12,000 years. Virtually all sites in the Tangle Lakes are on the ridge surface which consists of unconsolidated gravels deposited by Wisconsin ice. There are now known 20 microblade sites of which half are assignable to the American Paleo-Arctic Tradition.

The lithic inventory includes wedge-shaped cores, microblades, medium-size conical cores, large blades, many bifaces, some side scrapers, and a few burins.

Seven radiocarbon dates were obtained from the sites. Two dates of 10,150±280 B.P. (UGa-572) and 9060±425 B.P.(UGa-941) were claimed by West to belong to the Denali Complex in the Tangle Lakes (Dixon 1985; West 1974, 1975, 1980, 1981).

h. **Ground Hog Bay 2**

The site is located on a marine terrace now overlooking a small embayment of Icy Strait. Because there is a historic village site nearby, the prehistoric one was called Ground Hog Bay 2 or GHB 2.

Three cultural components were identified at the site. Component II contained an assemblage characterized by two basic industries. One was a microblade and core industry (Fig.24:1-4), the other a macrocore and flake industry. Other tool forms include scrapers, choppers, hammer stones, abrading stones, utilized flakes, and irregular tablet pieces (Ackerman *et al.* 1979; Ackerman 1980).

i. **Healy Lake**

Healy Lake is a multicomponent site in the Tanana drainage. Data from the stratified Village site reveal that the level immediately below the sod produced microblades and cores, and notched projectile points. Below this level were two

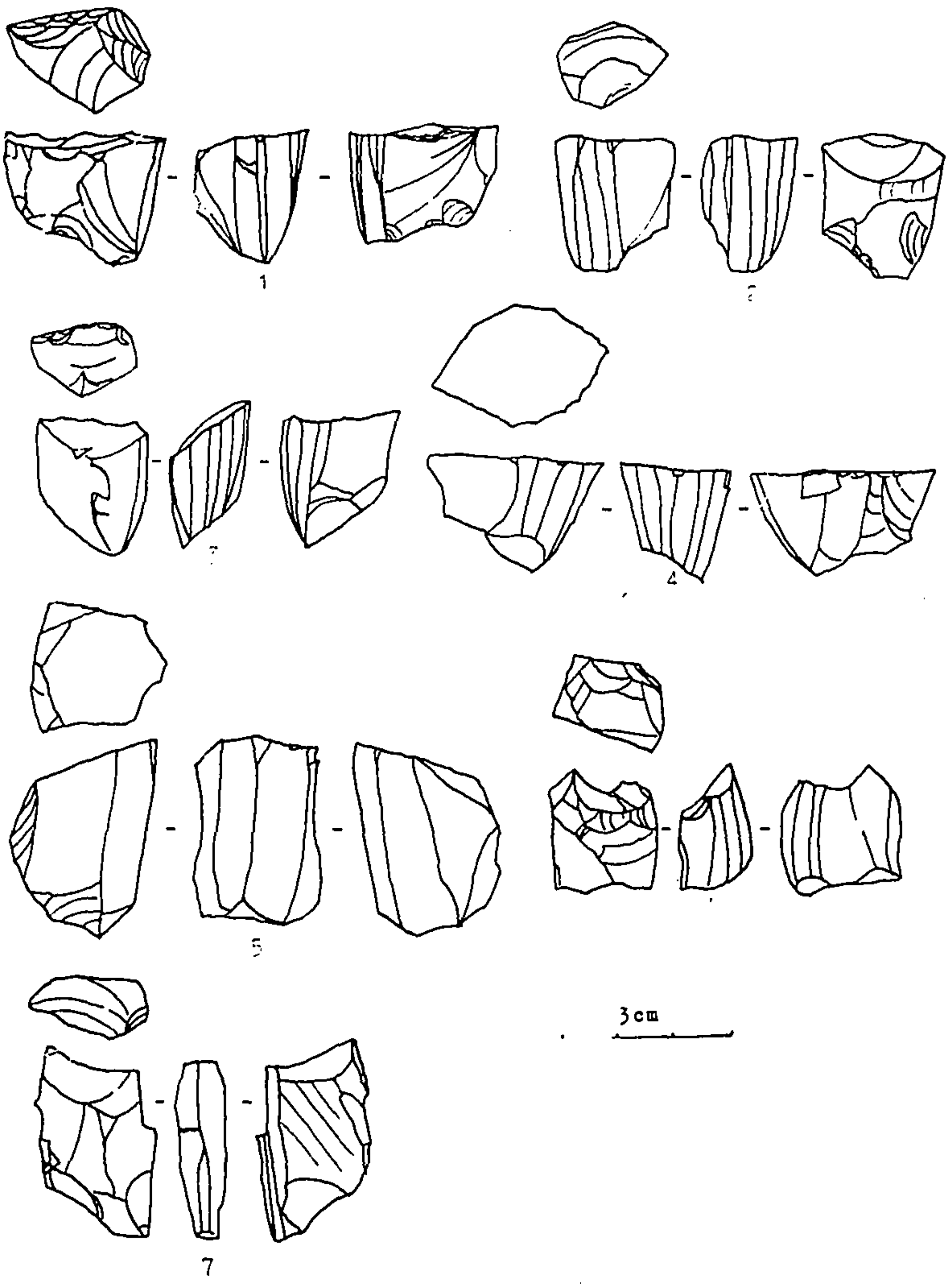


Figure 24: Microblade Cores from Ground Hog Bay (by courtesy of R. Ackerman)

"Campus-like" components. Artifacts from the lowest level, which Cook calls the Chindadn Complex, are characterized by microblade cores and a few microblades associated with triangular and teardrop-shaped points.

The radiocarbon dates from the Village site range between 1360±86 (Gak-1887) and 10,150±250 B.P. (SI-737). The Chindadn Complex was dated at ca. 9000 B.C. It is suggested that microblades appeared in the area possibly as early as 11,000 B.P. (Cook 1969; Dekin 1978; Dixon 1985; West 1981).

j. **Small Sites in Northern Alaska**

There are a number of small, shallow, or surface expressions of prehistoric activities intermittently exposed along the coast between Wainwright and Icy Cape in the National Petroleum Reserve, northern Alaska. A total of 17 prehistoric sites were located and tested. They are scattered along an elevated bluff remnant which rises 10 to 17 m above the coastal plain, following the 33 m contour, and trends southwest-northeast from the Utukok River to the vicinity of Wainwright, where it is truncated by the modern shoreline. Two major sites suggested by Gerlarch (1982) to belong to the American Paleo-Arctic Tradition are summarized below.

(1) *WAI-105*

This site is located relatively high on the shoreline bluff and commands an excellent view of the surrounding terrain in four directions. There are two surface localities, A and B. There were 83 lithic items recovered from WAI-105A, but only 25 from 105B. The assemblages from both A and B are comprised primarily of debitage. The lithic inventory included 3 wedge-shaped cores (Fig:23:7-9), 25 microblades, 1 core tablet, and 1 retouched flake tool.

(2) *WAI-107*

This site is situated on the low side of the shoreline bluff. A total of 197 lithic specimens were recovered during surface and sub-surface testing. They include 3 wedge-shaped cores (Fig.23:10-12), 3 core tablets, 119 microblades, 3 burins, 14 burin spalls, 2 bifaces, 1 flake tool, and 52 unmodified flakes.

2. Description of Raw Materials

The following table summarizes the raw materials used in the assemblages of the tradition.

Table 22. Raw Materials Used At the A.P.A T. Sites

	Chert	Jasper	Obsidian	Chalcedony	Argillite	Basalt
Campus	**	*	*		*	*
Dry Creek	**			*		
Ugashik	**			*		*
Donnelly	**		*			*
Noatak	**			*		
Akmak	**					
GHB 2	*		**		*	
Small	**		*			

** material is common * material is less common

With a few exceptions, most microblades belonging to the American Paleo-Arctic Tradition are made on chert.

3. Description of the Core Type

The microblade cores found in the assemblages of the American Paleo-Arctic Tradition are all wedge-shaped forms. The majority of them are broad bodied with the exception of a few specimens with a narrow body.

4. Preform, Platform, and Rejuvenation Pattern

Wedge-shaped cores of the American Paleo-Arctic Tradition reveal fairly homogeneous diagnostic attributes and many authors have provided detailed descriptions of their morphology and technology (Anderson 1970a, 1970b; Cook 1968; Morlan 1970, 1976; Powers *et al.* 1983; West 1967, 1981; Mobley 1991). Henn's brief description of wedge-shaped cores from Ugashik Narrows is representative:

> These were most commonly fashioned by bifacially flaking a thick flake to form a keel on the end opposite where microblades were to be removed. The platform was created either by extensive retouch or by removing a large flake (core tablet) from the edge adjacent to the keel. Rejuvenation of the core for further removal of microblades was done by removing another core tablet from the platform or by extensively retouching the platform (Henn 1978:61).

Owen also gives a description of core technology on the basis of her examination of wedge-shaped cores from the Denali sites:

> The wedge-shaped cores were produced mostly from nodules and pebbles. The lateral sides were bifacially flaked from their perimeters....The side of the wedge-shaped cores intersect at the bottom to form a keel which is often extensively battered along one side, probably to straighten it.
>
> Most of the platforms have flat or concave surfaces adjoining the fluted face. These surfaces were created by the removal of a single flake by a transverse blow to the fluted face. The flake scars often end in hinge fractures in the middle of the platform, but may also cover the whole platform. Platform rejuvenation occurred regularly, as witnessed by the numerous core tablets. The core platforms are usually flaked from one of the sides at the back. This is often accompanied by extensive battering on the platform along the same lateral edge (Owen 1988:99-100).

A detailed description of the Campus core technology was provided recently by Mobley (1991:87-88):

> The microblade technology began with selection of a suitable chert cobble. Rarely the cobble was simply split and the fresh facet used as a platform to produce microblades. More often a flake or biface was first manufactured to serve as the core from which microblades were to be removed. Unifacial and bifacial retouch was used to create a straight ridge on the intended blade face, to direct the first spall removal. The platform was sometimes prepared through removal of a single large spall that created one large facet, but more steep unifacial or bifacial retouch was used to form the platform. Microblade removal was accomplished unidirectionally, with no core rotation. Most often rejuvenation of the core platform was done using a single force executed head-on toward the blade face: less often the force was applied from other angles. One deliberate method of rejuvenation used sequential forces applied perpendicular to the long axis of the core, each oriented so that the bulb of force of the rejuvenation flake was aligned directly below the concavity left from the previous rejuvenation flake removal (resulting in distinctive rejuvenation flakes termed "gull-wing" flakes). When no longer serviceable, microblade cores were discarded with no apparent attempt at secondary use as tools.

Microblade cores from GHB 2 reveal a slightly different picture. Ackerman *et al.* (1979:198) mention that core preform and platform preparation varies according to the material utilized. The obsidian cores are the most elaborate in core preparation and include a number of diagnostic attributes that can be correlated with similar attributes on other microblade cores in the tradition. Cores made from small cobbles of obsidian were fashioned into a rough wedge-shape with a rather truncated keel. The platform was prepared by retouch from lateral margins and the fluted surface (Fig.24:1-3). One important feature is that there is no instance of core tablets pertaining to the platform rejuvenation, as is the common case in the Campus-type cores.

Cores made from chert and altered argillite have a platform based on a natural cleavage plane or a single flake surface. Cores of quartz crystal were apparently more difficult to flake and efforts seem to have been directed toward deriving blades along the faces of the crystal.

5. Edge Angle Variation

The edge angle variation of wedge-shaped cores in the assemblages of the American Paleo-Arctic Tradition reveals that the majority of cores exhibit an edge angle less than, but close to, 90 degrees. Only 24 out of 141 measurements (17%) exceed 90 degrees, whereas measurements ranging between 89 and 70 degrees account for 66%.

Table 23. Edge Angle Variations for American Paleo-Arctic Cores

Angle	50-59	60-69	70-79	80-89	90-99	>100	Total
Campus							
#	2	6	7	13	6	2	36
%	5.5	17	19	36	17	5.5	
Dry Creek							
#	1	7	10	14	5		37
%	3	19	27	38	13		
Ugashik							
#	1	4	6	7	2		20
%	5	20	30	35	10		
Donnelly Ridge							
#			3	1	1		5
Noatak & Akmak							
#	3	8	4				15
%	20	53	27				
Tangle Lake							
#	6	4					10
GHB 2							
#	2	1					3
Healy Lake							
#	5	1	2	1			9
%	56	11	22	11			
Small Sites							
#	1	4	1				6
Total	6	18	39	54	21	3	141
%	4	13	28	38	15	2	

6. Core Dimensions

a. Campus Site

Only three (9%) of the Campus site cores were large. Fifteen (44%) out of thirty-four cores yielded an index of 5 cm.

b. **Dry Creek**

Dry Creek cores were fairly large with indices ranging between 12 and 4 cm. Ten of thirty-six specimens were large, accounting for 28% of the total. It is noteworthy, however, that most large indices were derived from the refitting of specimens.

c. **Ugashik Narrows**

Ugashik Narrows cores were fairly large. Four of seventeen yielded large indices, accounting for 24% of the total. This distribution is close to that of Dry Creek.

d. **Donnelly Ridge**

Donnelly Ridge cores were generally small, only one out of seven (14%) yielding a large index.

Table 24. Dimensions for American Paleo-Arctic Cores

Index(cm)	4	5	6	7	8	9	10	11	12	13	Total
Campus											
#	6	15	8	2	2		1				8
%	17	44	24	6	6		3				
Dry Creek											
#	1	8	6	11	7	1			1	1	6
%	3	22	17	30	19	3			3	3	
Ugashik											
#	2	5	4	2	2	1	1				7
%	12	29	13	12	12	6	6				
Donnelly											
#	1	3	2	1							7
%	14	43	29	14							
Noatak & Akmak											
#	1	1	2	3		3		1			1
%	9	9	18	27		27		9			
GHB 2											
#	3	1									4
Healy Lake											
#	2	2	1	3	1						9
%	22	22	11	33	11						
Small Sites											
#	2	2	2								6
%	33	33	33								
total	9	28	22	27	19	6	5	1	2	1	120
%	7.5	23	18	23	16	5	4	.8	2	.8	

e. **Noatak & Akmak**

The dimensional data of 11 cores from Noatak and Akmak are based on measurements taken from illustration. Seven out of eleven specimens were large ones, accounting for 64% of the total.

f. **Ground Hog Bay 2**

Four measured cores from GHB 2 were all small.

g. **Healy Lake**

Nine cores yielded indices ranging between 8 and 4 cm. Only one (11%) was large.

h. **Small Sites in Northern Alaska**

Four out of six cores were large. Although the size index of wedge-shaped cores varied from assemblage to assemblage, the percentage of large cores was almost always lower than those of small ones. In total, 34 out of 120 measured from eight assemblages were large, accounting for 28%. This indicates that wedge-shaped cores in the American Paleo-Arctic Tradition are generally small.

B. COASTAL MICROBLADE ASSEMBLAGES

Several microblade assemblages discovered along the Northwest Coast have been analyzed. They are characterized by a slightly more recent chronology and different core technology in comparison with those of the American Paleo-Arctic Tradition. The assemblages include Namu, Queen Charlotte Islands, Heceta Island, San Juan Island, and Cadboro Bay.

1. Site Description

a. **Namu**

Namu is located in central coast of British Columbia, overlooking the mouth of the Namu River. Three areas of the site were selected for test excavations. All three contained assemblages overlain by shell midden deposits of younger age.

Three stratified zones were distinguished from bottom to top in the rear portion of the Main Trench at Namu. Zone I (the lowest) was yellow glacial till consisting of sand and boulders. Zone II comprised two parts, IIa and IIb. Zone IIa was black soil and only occurred at the rear of the site. Zone IIb was a black humic deposit and occurred in all three excavations. Zone III was the overlying shell midden deposit.

About 13,700 stone artifacts were recovered from Zone II in the rivermouth excavation. Of this total, about 1200 were debitage. The tool inventory includes microblade cores (Fig.25:1,2) and microblades, core scrapers, projectile points, "hand axes", scrapers, pebble tools, and some ground stones. Three radiocarbon dates from Zone IIa are: 9720±140 B.P. (WAT-452), 9140±200 B.P. (Gak-3244), and 7800±200 B.P. (Gak-3120). Six radiocarbon dates from Zone IIb are: 6060±100 B.P. (WSU-1941), 5740±100 B.P. (WSU-1940), 5700±360 B.P. (WSU-456), 5370±170 B.P. (WSU-1947), 5240±90 B.P. (WSU-1943), and 5170±90 B.P. (WAT-451) (Carlson 1979:214).

b. **Queen Charlotte Islands**

The Queen Charlotte Islands lie 60 to 120 km off the northern Pacific Coast of British Columbia, bordering southeastern Alaska in Dixon Entrance. Two localities, Lawn Point (FiTx-3) and Kasta (FgTw-4), were discovered on the Islands.

(1) *Lawn Point (FiTx-3)*

Lawn Point, 15 km north of the modern Haida Village of Skidegate Mission, is a small, steep-sided promontory on the east coast of Graham Island, overlooking Skidegate Inlet and Hecate Strait. Geological strata at Lawn Point reveal a visible sedimentary core of at least 6 m of glacio-marine stony clay, topped with about 9 m of outwash sands and gravels and 14 m of compact boulder-clay till. Six cultural components have been recognized at the site on the basis of sedimentary stratigraphy and the vertical distribution of artifacts. They are numbered 1 to 6, from the latest to the earliest. The dense lithic assemblage of Component 5 lies on top of about 40 cm of dipping, coarse, iron-stained beach sand capping Component 6, and under the clay and pebbles.

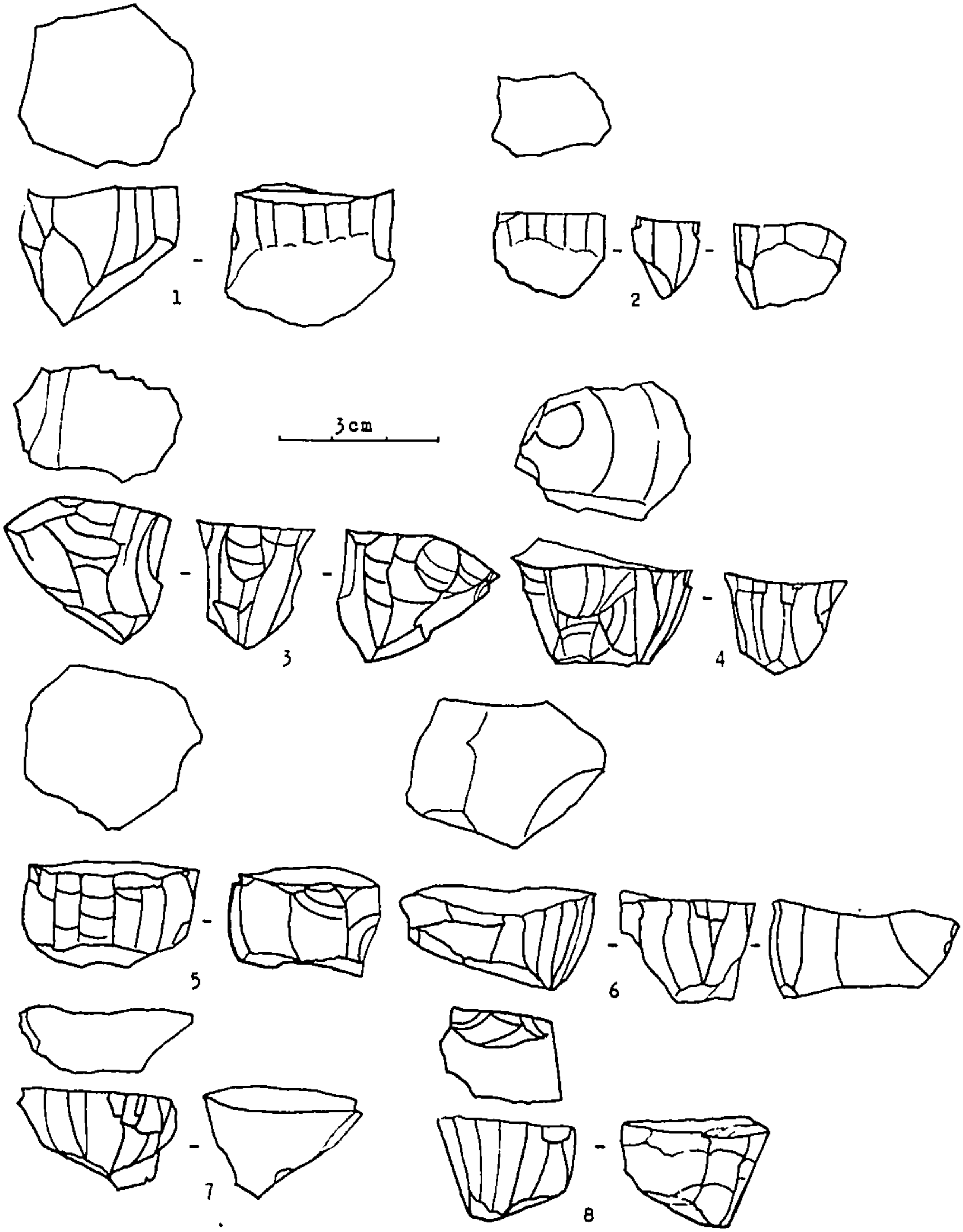


Figure 25: Microblade Cores from Namu (1-2) and Heceta Island (3-8) (by courtesy of R. Carlson and R. Ackerman)

A total of 551 artifacts and 2225 flakes were recovered from the whole site, including 16 microblade cores, 168 microblades, 18 choppers, 17 scraper-cleavers, 11 nosed scrapers, 11 gravers, 6 hammerstones, and 206 retouched and utilized flakes.

Four radiocarbon dates were obtained from charcoal: Component 1 - 2005±85 (S-678); Component 4 - 5750±110 (Gak-3271); Component 5 - 7050±110 (Gak-3272); and Component 6 - 7400±110 (S-679) (Fladmark 1986:52).

(2) *Kasta (FgTw-4)*

This locality is located about 10 km south of the airport community of Sandspit, northern Moresby Island. Cultural deposits were exposed in a road cut about 500 m inland from Copper Bay and 250 m from the Copper River.

Kasta possesses at least seven cultural levels marked by charcoal and thin lenses of small rounded pebbles, separated by sterile estuarine sand.

The lithic assemblage is similar to Lawn Point Components 2-5, in that all are dominated by microblade remains including some thick, curved specimens which were possibly discarded as unusable.

Two radiocarbon dates, 5420±100 B.P. (Gak-3511) and 6010±95 B.P. (S-677) on charcoal from cultural levels 3 and 4 were obtained at this locality (Fig.26) (Fladmark 1986:54).

c. **Heceta Island**

Heceta Island is bounded on the north, west, and south by Sea Otter Sound, Iphigenia Bay, and the Gulf of Esquibel. Tuxekan and Prince of Wales Islands lie to the east. The island, at its maximal extent, is roughly 26 x 16 km.

Archaeological surveys on the southwest side of Chuck Lake (CRG-237) resulted in the discovery of six artifact localities. Midden samples were recovered from Localities 1-3. Localities 4-6 did not contain any organic materials. All localities, except Locality 2, yielded lithic artifacts. Most of the artifacts were found in Locality 1 from a 2 x 5 m trench that was excavated into the shell midden. The

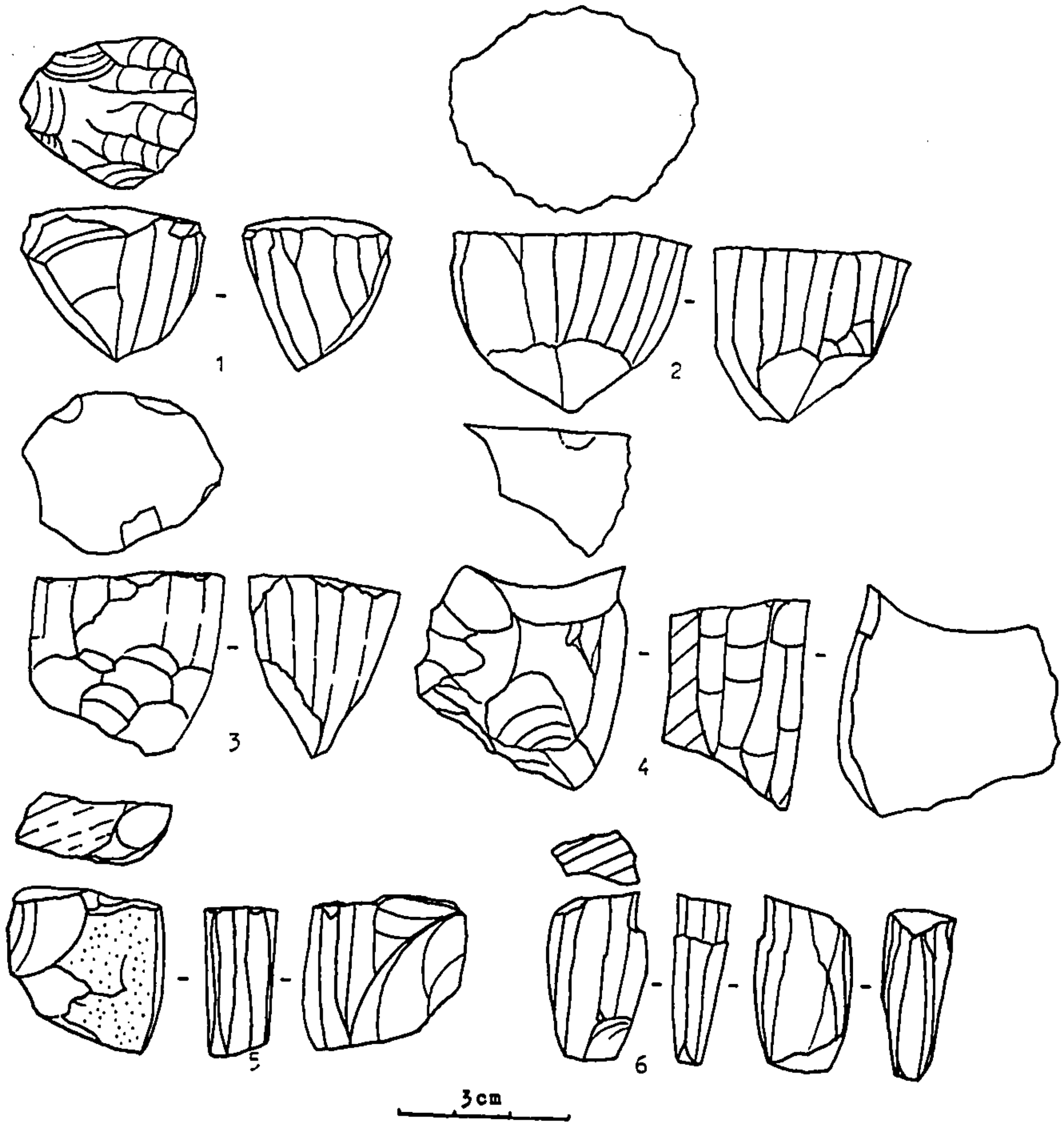


Figure 26: Microblade Cores from the Queen Charlotte Islands (by courtesy of K. Fladmark)

test squares and the trench excavation yielded 432 lithic artifacts from a black silty loam horizon located beneath the surface vegetation. From the underlying shell midden, an additional 18 artifacts, representing both pebble flake core and microblade core technologies, were discovered. In addition to the artifacts recovered in the excavations, 122 flakes and tools were recovered from the surface of Locality 1, and 38 artifacts from Locality 3-6 (Ackerman 1985:126).

A total of 610 lithic artifacts were found during the investigation of the six artifact localities at the Chuck Lake site. The majority of lithic materials were products of a microblade industry, including nine microblade cores (Fig.25:3-8), 11 microblade core preforms, 58 whole or broken microblades, 472 flakes and debitage.

Localities 1-3 of the Chuck Lake site yielded radiocarbon dates: Locality 1 (charcoal) - 8220±125 (WSU 3241); Locality 1 (charcoal) - 7360±270 (WSU 3242); Locality 1 (shell) - 8180±130 (WSU 3243); Locality 3 (shell) - 5240±90 (WSU 3244); and Locality 2 (shell) - 5140±90 (WSU 3245). Ackerman (1985:144) suggests that the microblade industry at Chuck Lake might be more recent than the American Paleo-Arctic Tradition in Alaska, and probably flourished around 8000 to 5000 years ago.

d. **San Juan Islands**

The San Juan Islands are located adjacent to the Fraser River delta, Washington. There are two sites which have yielded microblade remains. One is Argyle Lagoon on the southeastern side of the Islands. The other is Cattle Point on the edge of a natural prairie on the southwest shore of the Islands (Carlson 1960).

(1) *Argyle Lagoon*

The stratigraphy of this site indicated two major cultural layers. Stratum I was a dark, organic, clay-like soil lying immediately over the yellow clay or gravel subsoil, about 30 to 60 cm thick. Stratum II contained quantities of shell in addition to black dirt, fire-cracked rock, and was about 15 cm to 1 m in thickness. Microblades were found in stratum II. Cultural remains associated with the microblades include projectile points and fragments, five flake knives, two scrapers, one drill, one leaf-shaped knife, and many bone tools and ornaments.

(2) *Cattle Point*

This site exhibited a single cultural layer varying from less than 0.3 to about 1.2 m in thickness. It consisted of a heavy, black, sandy humus with scattered shell. Cultural remains from the site were similar to those from Argyle Lagoon, including a fair quantity of microblade remains, projectile points, many bone tools such as barbed spearpoints, awls, needles, chisels, tooth pendants, and other objects.

The age of the San Juan Islands microblade assemblages is not certain. Carlson (1960) has suggested that they might pre-date the Marpole phase components in the area which have been dated within the first millennium B.C.

e. Cadboro Bay

Several microblade cores found at a site at Cadboro Bay are included in this comparative study. Cadboro Bay is located on the southern end of Vancouver Island, southern British Columbia. Three microblade cores from a shell midden site (DcRt-15) were examined by Sanger in the British Columbia Provincial Museum, Victoria (Sanger 1968a). These cores are included with those from the San Juan Islands.

2. Description of Raw Materials

a. Namu

The lithic materials used to produce microblades are andesite, obsidian, and milky quartz, however, the complete microblade cores from the site are all made of andesite. Three core fragments, 28 microblades, and 270 microflakes of obsidian were recovered from the site, indicating that obsidian was also an important raw materials used for microblade production (Carlson 1979:216). According to Carlson (personal communication 1988), when obsidian microblade cores were exhausted, they might have been used to produce microflakes by means of bipolar percussion.

b. **Queen Charlotte Islands**

The Lawn Point and Kasta assemblages were dominated by the reduction of beach pebble or chert blocks into microblade cores, microblades, tool-flakes, and unifaces. Among nine microblade cores from Lawn Point, seven are of argillaceous slate, one of chert, and one of basalt. The chert, which was obtained from a bedrock source, is the dominant lithic material at Kasta (Fladmark 1986:45,53).

c. **Heceta Island**

At the Chuck Lake site, the lithic materials commonly selected for microblade production were sub-rounded to rounded pebbles of argillite, obsidian, marble, chert, and vein quartz. Fine-grained argillite in black, white, green, and reddish-brown account for nearly 90% of the sample. Other materials were less frequent: obsidian 4%, vain quartz 2.5%, marble 1.6%, and chert 0.9%. Argillite was locally available in the bed of Chuck Creek and along the gravel beach of Warm Chuck Inlet (Ackerman 1985:129).

d. **San Juan Islands**

The raw materials selected for the production of microblades were quartz crystal and obsidian. At Argyle Lagoon, a quartz crystal microblade core and two obsidian microblades were reported. There were three cores of quartz crystal, and seven microblades of quartz crystal and obsidian from Cattle Point (Carlson 1960:73,75). In 1967, Sanger (1968a) found an obsidian microblade core during a re-examination of the San Juan Islands collection.

e. **Cadboro Bay**

Although the microblade cores found at DcRt-15 were all of basalt, the presence of a considerable amount of quartz and obsidian microblades indicates these two materials were also important in local microblade production (Sanger 1968a:105).

Table 25. Raw Material Used in Coastal Microblade Sites

	Chert	Obsidian	Argillite	Quartz	Basalt	Andesite
Namu		**			*	
Queen	*		**		*	
Heceta	*	*	**		*	
San Juan		*		*		
Cadboro		**		**		

** material is common * material is less common

3. Description of Core Types

Microblade cores found in assemblages along the Northwest Coast have generally similar attributes. At present, no specific typological designation has been given to these cores. Morphologically and technologically, these cores most closely resemble the boat-shaped or funnel-shaped cores of East Asia. They are generally irregular in shape and show no specific preform preparation before microblade production.

4. Preform, Platform and Rejuvenation Patterns

a. Namu

No detailed description of core technology is available from Carlson's 1979 report. From my examination, these cores show little preform and platform preparation. They have a short body and a broad, oval platform consisting of a weathered or flake surface (Fig.25:1.2). Although core rejuvenation is unknown, the reduction of an exhausted obsidian core into microflakes might have been a significant part of this core technology.

b. Queen Charlotte Islands

According to Fladmark (1986:45), microblade cores were made from split pebbles. Their striking platforms vary from circular to oblong with fluted surfaces conical to triangular in cross section. Platforms are single, wide flake scars, with edges trimmed by slight retouch. In no cases do the platforms show any evidence of rejuvenation (Fig.26).

c. Heceta Island

Ackerman (1985:131-6) suggests a specific process was used for core preparation and microblade reduction here. First, heat treatment might have been applied to the argillite pebble to improve it flaking characteristics. Once the heat treating process was completed, the pebbles were reduced to core preforms. If the pebble exhibited a natural plane at an angle of 90 degrees or less to the working surface, then platform preparation was not required. If the pebble lacked a natural plane with the correct edge angle, a platform was established by direct free-hand percussion. The bipolar technique, used to split or fracture the pebble, could provide a flat platform as well. Large flakes removed from the pebble were also used to make core preforms, using their ventral surface as platforms.

Once a natural or single-faceted platform was established, the working face of the core preform was then prepared. The platform edge angle was also created at this time. No additional retouch was given to the platform during microblade production.

Microblade manufacture continued until the core was either exhausted, broken during manufacture, or was no longer needed. At this point, the core was discarded.

Six discarded microblade cores were found. All of the cores exhibited platforms consisting of an unprepared cortical surface, or a single flake surface. Viewed from the top, the platforms have roughly oval to rectangular outlines and from the side have a base that is flat to somewhat pointed (Fig.25:3-8).

d. **San Juan Islands**

According to Sanger (1968a:104), striking platforms on the quartz microblade cores were created by blows struck from the core edge, or front of the core, obliquely towards the back. Viewed from the back of the cores, the flake scars travel from the upper right to lower left. Some battering is evident on the core edge. The lateral edges were formed by natural crystal facets, which themselves superficially resemble microblade flutes. Keels are unmodified, being the end of the crystal.

e. **Cadboro**

According to Sanger (1968a:105), several basalt microblade cores utilized weathered and naturally roughened surfaces as unmodified striking platforms. Core edge preparation was almost non-existent. Lateral surfaces and keels exhibited little or no preparation.

5. Edge Angle Variation

a. Namu

Three cores yielded two measurements of 77 and one of 88 degrees.

b. Queen Charlotte Islands

Thirty eight out of 40 cores from Lawn Point and Kasta could be fully measured. The measurements range between 108 and 75 degrees.

c. Heceta Island

Six microblade cores yielded 9 measurements ranging between 93 and 80 degrees.

d. San Juan Islands & Cadboro Bay

Two microblade cores from the San Juan Islands and two from Cadboro Bay provided measurements. Three out of four have very acute edge angles (Sanger 1968a:118).

Table 26. Edge Angle Variations for Coastal Cores

Angle	<59	60-69	70-79	80-89	90-99	>99	Total
Namu							
#			2	1			3
Queen Charlotte							
#			1	8	23	6	38
Heceta							
#				5	4		9
San Juan							
#	2						2
Cadboro							
#			1	1			2
Total	2		4	14	27	7	54
%	4		7	26	50	13	

The edge angle variation of microblade cores from the coastal region reveals high percentages of edge angles exceeding 89 degrees, accounting for 63% of the total.

6. Core Dimensions

a. **Namu**

Three specimens yielded two indices of 8 and one of 5 cm.

b. **Queen Charlotte Islands**

A total of 32 specimens could be fully measured. The variation of indices ranges between 13 and 4 cm. Large cores account for 44% of the total.

c. **Heceta Island**

Core sizes tended to be large. Five specimens yielded indices of 9 and 8 cm, and only one of 7 cm.

Table 27. Dimensions for the Coastal Cores

Index(cm)	4	5	6	7	8	9	10	11	12	13	Total
Namu											
#		1			2						3
Queen Charlotte											
#	2	6	5	5	4	4	1	2	2	1	3
Heceta											
#				1	4	1					6
San Juan											
#	1										1
Cadboro											
#							1		1		2
Total	3	7	5	6	10	5	2	2	3	1	4
%	7	16	11	14	23	11	5	5	7	2	

d. **San Juan Islands & Cadboro Bay**

Only one out of three cores from San Juan Islands could be fully measured and provided an index of 4 cm (Sanger 1968a:118). As mentioned by Sanger (1968:104), the microblade cores from San Juan Islands are distinguished by their minute size.

Two microblade cores from Cadboro Bay yielded two indices of 5 and 6 cm, indicating their fairly small size (Sanger 1968a:118).

Although core dimensions vary from assemblage to assemblage, a general impression is that, except for those from San Juan Islands and Cadboro Bay, Northwest Coast microblade cores from Namu, the Queen Charlotte and Heceta Islands are relatively large in size.

C. PLATEAU MICROBLADE TRADITION

Microblade assemblages found on the Columbia Plateau were attributed by Sanger (1968a, 1969, 1970a, 1970b) to the Plateau Microblade Tradition. The assemblages discussed in this study include: Ryegrass Coulee, Drynoch Slide, Marron Lake, Windy Springs, and the Lochnore-Nesikep locality. The data summarized here are based on Sanger's illustrations.

1. Site Description

a. Ryegrass Coulee

Seven microblade cores and 206 microblades were excavated from a layer beneath more recent materials and in close proximity to a sediment of volcanic ash. Leaf-shaped points, side-notched points, and stemmed points are said to be associated with the microblades. Three radiocarbon dates for this assemblage were obtained: (charcoal) 3940±220 B.P. (GaK-1486); (charcoal) 3525±145 B.P. (UW-112); (shell) 6480±80 B.P. (UW-113). On the basis of the associated projectile points and the radiocarbon dates, Sanger (1968a:100) suggested that a date of between 2000 B.C. and 3000 B.C. is reasonable for the microblades at the site.

b. Drynoch Slide

This site is located on the Thompson River between Lytton and Spences Bridge, southern British Columbia. One microblade, several miscellaneous scrapers, flakes, and some animal bones were recovered from a deposit beneath a layer of volcanic ash. Associated charcoal was dated to 7530±230 B.P. (GSC-530). In addition, one microblade core was found by a geologist at a locality in the Salmon River valley, 6.5 km west of Falkland (Sanger 1968a:97).

c. Marron Lake

This site is located in the Canadian Okanagan, southern British Columbia. Eighty microblades and eight microblade cores were recovered. A detailed description of the stratigraphy and cultural associations is not available (Sanger 1968a:98).

d. **Central British Columbia**

Several microblade cores in the University of British Columbia holdings were examined by Sanger. They were collected by C.E. Borden in the early 1950s. The most significant collection comes from the Natalkuz Lake site. One microblade core and 26 microblades are recovered from the site. A radiocarbon date on charred material from the central fire hearth gave a date of 2415±160 B.P. (S-4) (Sanger 1968a:98).

Most microblade remains found in this area are from surface collections and of unknown age. On the basis of associated artifacts, Sanger (1968a:98) dated microblades and cores in central British Columbia to eight thousand years ago.

e. **Windy Springs**

This site consists of a recent house pit dug into an older occupation stratum. These are Horizon A and Horizon B respectively. The microblades and cores were derived from the older Horizon B. Five microblade cores and 22 microblades were found.

A radiocarbon date of 1080±200 B.P. (M-942), derived from a composite sample of turtle carapace and burned bone fragments, is considered unreliable. Sanger (1968a:102) suggests that the Windy Springs microblades are probably more recent than the 4000 to 5000 years old Ryegrass Coulee specimens.

f. **Lochnore-Nesikep Locality**

The Lochnore-Nesikep locality is located on Lochnore-Nesikep Creek a tributary of the Fraser River, southern British Columbia. It consists of numerous open archaeological sites. No stratigraphic context is available for the microblade remains. Sanger (1968a:97, 1970a:1) thought microblades in the locality might date from over 6000 to 2000 years ago.

2. Description of Raw Materials

a. Ryegrass Coulee

The raw materials utilized for microblade production were chalcedony and chert. There are no basalt examples. There are frequently areas of cortex on the cores, particularly on the backs of the cores, indicating that pebbles were selected as the raw materials at the site (Sanger 1968a:100).

b. Drynoch Slide

One microblade core recovered from the Salmon River valley is of chalcedony. Cortex is present on both lateral surfaces, indicating that pebbles might also have been the source of the raw material here (Sanger 1968a:97).

c. Marron Lake

The microblade cores from this site were made of variety of materials. Five were of basalt, and one each of chert, agate, and chalcedony. Of 80 microblades, most were of basalt, with only a few examples of chert and agate (Sanger 1968a:98).

d. Central British Columbia

One microblade core found at the Natalkuz Lake site is of obsidian. Microblades are mainly of obsidian and basalt. Other microblade cores from central British Columbia are commonly made of obsidian, although at least one is of grey chert (Sanger 1968a:98).

e. Windy Springs

Cryptocrystallines were mentioned as the microblade core raw materials, however, no specific names were given (Sanger 1968a:102).

Table 28. Raw Materials of the Plateau Microblade Tradition

	chalcedony	chert	basalt	agate	obsidian
Ryegrass	*	*			
Drynoch	*				
Marron	*	*	**	*	
Central BC			*		*
Lochnore	*	*	**		

** material is common * material is less common

f. Lochnore-Nesikep Locality

The majority of microblade cores from this locality were made from a local vitreous basalt. Similarly, most microblades are of vitreous basalt with very few chalcedony and chert specimens (Sanger 1968:94).

3. Description of Core Types

Like their counterparts from coastal microblade assemblages, no typological term has been given to microblade cores from the Columbia Plateau. Sanger (1968a:94) stated:

> In the North use has been made of terms such as 'wedge-shaped' and 'tongue-shaped' to describe microblade cores. Although I have employed the term 'tongue-shaped' to describe microblade cores from British Columbia, I now feel that it is undesirable to place the Pacific Northwest cores into named types.

4. Preform, Platform, and Rejuvenation Pattern

Microblade cores of the Plateau Microblade Tradition reveal fairly homogeneous attributes. Sanger (1968a:114, 1970b:103) summarized their characteristics as follows.

a. Microblade cores utilizing a weathered surface for a striking platform which is usually modified only at the core edge. Multiple blow striking platform preparation is scare, and core rejuvenation tablets are not known.
b. Microblades are usually removed from only one end of the core.
c. Core rotation, resulting in more than one striking platform is very unusual.
d. Fluted surfaces commonly contrast to a wedge-shaped keel.
e. The technique of preparing the fluted surfaces is currently unknown, but the apparent absence of ridge flakes may be very important in this respect.

5. Edge Angle Variations

The edge angle measurements for the Plateau Microblade cores were made from on Sanger's illustrations.

a. **Ryegrass Coulee**

Five out of seven cores were measured, and ranged between 80 and 65 degrees (Sanger 1968a:117).

b. **Drynoch Slide**

One microblade core yielded a measurement of 60 degrees (Sanger 1968a:98).

c. **Central British Columbia**

Five cores from this region yielded one measurement of 100 degrees, three of 90 degrees, and one of 45 degrees (Sanger 1968a:116).

d. **Lochnore-Nesikep Locality**

The edge angle variation of microblade cores from this assemblage ranged between 100 and 35 degrees (Sanger 1968a:116, 1970a:60). Sixty percent of measurements were between 100 and 80 degrees.

Table 29. Edge Angle Variation for Plateau Cores

Angle	35-43	44-55	56-67	68-79	80-91	92-100	Total
Ryegrass							
#			1	2	2		5
Drynoch							
#		1					1
central BC							
#			1		3	1	5
Lochnore							
#	2	2	4	7	21	3	39
Total	2	3	6	9	26	4	50
%	4	6	12	18	52	8	

6. Core Dimensions

Dimensional measurements for the Plateau cores are also based on Sanger's illustrations.

a. **Ryegrass Coulee**

Five cores provided a mean platform length and width of 2 cm, respectively. The mean core height was 2 cm. Therefore, the mean dimensional index of cores was 6 cm (Sanger 1968a:117).

b. **Drynoch Slide**

One specimen yielded an index of 4 cm (Sanger 1968a:97).

c. **Central British Columbia**

Five cores from this region gave two indices of 8 cm, two of 6 cm, and one of 4 cm (Sanger 1968a:116).

d. **Lochnore-Nesikep Locality**

Sanger (1968a:116, 1970a:60) provided two tables of dimensions for the Lochnore-Nesikep locality cores. One is for the Lehman site, the other for the Lochnore Creek site. The mean dimensional index for the Lehman site cores is 7 cm. The mean index for the Lochnore Creek site cores is 7 cm.

Table 30. Dimensions For the Plateau Cores

Index (cm)	4	5	6	7	8	9	total
Ryegrass(mean)			*				5
Drynoch	1						1
Central BC	1		2		2		5
Lehman(mean)				*			55
Lochnore(mean)				*			16

This summary reveals that microblade cores from the assemblages of the Plateau Microblade Tradition are generally small.

D. THE DENBIGH FLINT COMPLEX OF THE ARCTIC SMALL TOOL TRADITION-- A BRIEF REVIEW

Owing to the inaccessibility of firsthand data, only a few microblade assemblages from the Denbigh Flint Complex, Onion Portage, and Cape Krusenstern in Alaska were selected for comparison. All descriptions and measurements are based on published data.

1. Site Description

a. Denbigh Flint Complex

Two cultural layers were identified at a stratified site called Iyatayet. The upper layer yielded recent Eskimo remains called Norton. Under Norton was a thin deposit containing a lithic assemblage which Giddings named the Denbigh Flint Complex (Dekin 1978; Giddings 1951:193).

The lithic inventory of the Denbigh Flint Complex site includes two microblade cores, seven core fragments, 379 microblades, many burins and burin spalls, various scrapers including end scrapers, keeled scrapers or gravers (Giddings 1951, 1964).

Seven radiocarbon dates for the Denbigh Flint Complex were obtained: (P-105) 2204±288 B.C.; (C-793) 2542±293 B.C.; (C-793) 3242±344 B.C.; (P-102) 1452±206 B.C.; (C-793) 1559±237 B.C.; (P-103) 1627±206 B.C.; and (W-298) 2134±618 B.C. (Anderson 1970b; Giddings 1964). Both geological data and radiocarbon dating suggest a date of ca. 2000-3000 B.C. for the Denbigh Flint Complex component of the Iyatayet site (Dekin 1978; Irving 1962).

b. **Onion Portage**

This site is located at the upriver end of the portage on the Kobuk River which also yielded the Akmak assemblage. The lithic assemblages resembling the Denbigh Flint Complex were derived from six occupations which included the remains of numerous stone-lined hearths and six shallow house floors.

Three radiocarbon dates, representing different stages of the Denbigh Flint Complex, have been obtained for the site: 1876±65 B.C. (P-1070), 1863±62 B.C (P-1109), and 1681±62 B.C. (P-1068) (Anderson 1970b:9,10).

c. **Cape Krusenstern**

The site is located on the beach ridges of Cape Krusenstern, coastal Kotzebue Sound, northwestern Alaska. The lithic assemblages resembling the Denbigh Flint Complex were concentrated around hearths along the beaches. The hearths were probably built just above the shore line.

The assemblages were divided into three different time periods on the basis of their relative position in the beach ridge sequence and changes in the thickness of microblades. No radiocarbon dates are available for these assemblages (Anderson 1970b:10).

2. Description of Raw Materials

a. **Denbigh Flint Complex**

The raw materials utilized for microblade production in the Denbigh Flint Complex include obsidian (48%), chert (47.5%), jasper (2%), silicified slate (2%), and chalcedony (0.5%). Giddings (1964:204) pointed out that microblade cores of chert and obsidian were intentionally broken up once they could no longer produce microblades of useful size.

b. **Onion Portage**

Three cores were of obsidian and chert. The presence of cortex on one obsidian core suggests the use of pebbles as raw material (Owen 1988).

c. **Cape Krusenstern**

Two microblade cores each were of obsidian and chert. The presence of a large area of cortex on one core suggests that a pebble might have been the source of the raw material (Owen 1988).

Table 31. Raw Materials Used For Denbigh Flint Complex

	Chert	Obsidian	Jasper	Chalcedony	Slate
Denbigh	**	**	*	*	*
Portage	*	*			
Krusenstern	*	*			

** material is common   * material is less common

3. Description of Core Types

No specific typological designation has been given to microblade cores of the Denbigh Flint Complex. Owen (1988:107) mentions that the Denbigh Flint Complex cores have a wide variety of shapes and forms. Giddings (1964:203) described two microblade cores from the Denbigh Flint Complex as roughly cubical. Some specimens were described by different authors as cuboid, wedge-shaped, and barrel-shaped (Anderson 1970b:11,13; Morlan 1976:103; Owen 1988:106).

4. Preform, Platform, and Rejuvenation Pattern

Anderson (1970b:13) gave the following description of microblade cores from Onion Portage and Cape Krusenstern:

> The area opposite the platform and fluted surface is often keeled and nearly always irregular.
>
> Only one of the two lateral surfaces is carefully shaped, generally by the removal of small flakes from one lateral edge of the platform. The opposite lateral surface is either formed by one or two irregular flakes scars, or is primarily the original cortex surface. In general, the platform is prepared by random flaking from the lateral edges.
>
> A unique microblade core from Onion Portage Denbigh is barrel-shaped with a round platform produced or rejuvenated by the removal of a platform core tablet.

Owen (1988:106) gives a more detailed description of six microblade cores from these two sites. The following summarizes her description of the core preform, platform, and rejuvenation patterns.

The first core from Onion Portage has one side flaked from the platform, and the other created by removal of one large flake from the back. The platform is smooth and flat, and was formed by the removal of a large flake from the back of the core. The second core has both sides flaked from the keel. Its platform was extensively flaked from the front. The third core has one side which was less intensively flaked and covered by the cortex, and the other side was flaked from the back. The platform was extensively flaked from the front. The fourth core is roughly cuboid in shape. One side of the core is covered to a large extent with cortex, and the other flaked from the bottom and the back. The platform is flat and was created by a blow to the front of the core.

The first core from Cape Krusenstern has a side largely covered by cortex, and the other formed by more extensive flaking from its perimeter. The platform was created by the removal of two long flakes from the fluted face. The second core has both sides created by removal of one or two large flakes. Its flat platform was flaked from the fluted face at the front and from the side at the back.

Owen (1988:106-7) also mentions that the fluted face and the platform tablet of the original core were removed for rejuvenation.

On the basis of the preceding description, a general picture of microblade cores from the Denbigh Flint Complex can be obtained. Split pebbles and thick flakes were selected to produce core preforms which vary in morphology and might be controlled by the nature of the available raw material. The core preparation probably depended on the condition of the material. Cores were flaked unifacially or bifacially, either from the platform or from the keel or even from the back. The platform was usually a flat and smooth plane prepared by random flaking or by removal of a few flakes from the front. They were often cuboid, wedge-shaped, or barrel-shaped with platforms varying in shape. Rejuvenation was conducted occasionally by extensive flaking, battering on the platform along the edge of the fluted face, or by removing a core tablet to renew the effective platform. Rejuvenation of the fluted face was also conducted.

5. Edge Angle Variations

Edge angle measurements of microblade cores are based on Giddings, Anderson, and Owen's illustrations. Giddings (1964:203) mentioned that two cores from the Denbigh Flint Complex yielded two measurements of 75 and 85 degrees respectively. Six cores from Onion Portage and Cape Krusenstern yielded one measurement of 85 degrees, four of 80 degrees, and one of 60 degrees (Owen 1988:105).

It seems likely that the majority of microblade cores belonging to the Denbigh Flint Complex have acute edge angles.

6. Core Dimensions

Six cores from Onion Portage and Cape Krusenstern were measured by Owen (1988:105), yielding three dimensional indices of 9 cm, one of 8 cm, and two of 7 cm.

E. OTHER MICROBLADE ASSEMBLAGES

Two microblade assemblages from northwestern North America are discussed separately in this study because they possess distinctive attributes. These are Ice Mountain or Edziza in northern British Columbia, and Bezya in Alberta.

1. Site Description

a. Ice Mountain (Edziza)

The site is a rich obsidian source. Ethnographic and archaeological data indicate that obsidian exploitation and tool manufacture have gone on there for at least 5000 years, or probably much longer. The lithic inventory recovered from the site includes microblades and cores (Fig.27), projectile points, end scrapers, side scrapers, core scrapers, flake cores, and pecked and ground stone tools (Fladmark 1985; Smith 1971).

b. Bezya

Bezya is located in the east of the Athabasca River, northeastern Alberta. Several trenches were dug at the site. A total of 1329 artifacts were found at depths ranging from 15 cm to more than 60 cm below the surface. The assemblage was considered to represent a single component or single episode

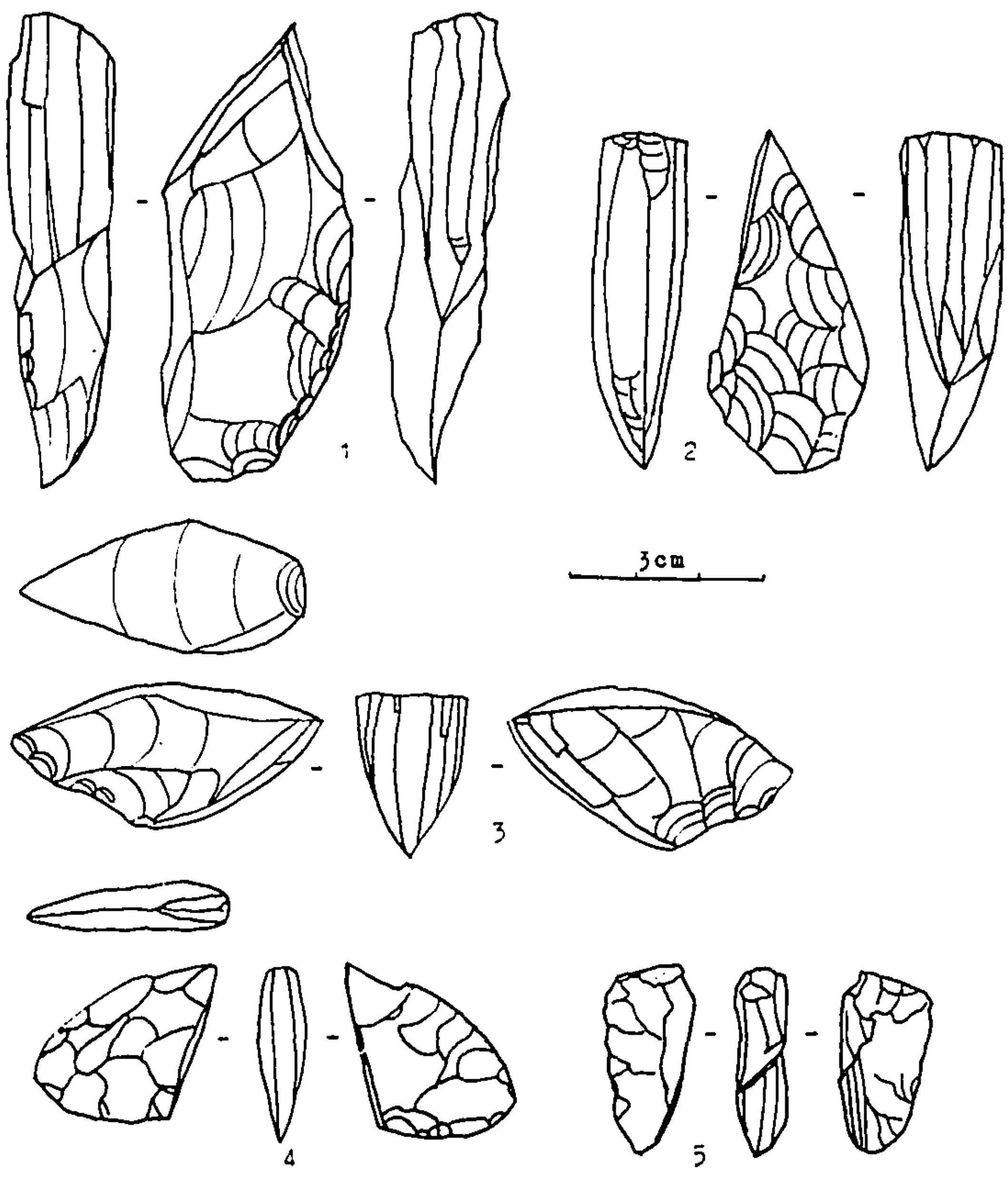


Figure 27: Wedge-shaped Cores from the Ice Mountain Site (from J. Smith 1971 and K. Fladmark 1985)

of lithic reduction and tool production. The lithic inventory includes 5 microblade cores, 27 ridge flakes from microblade cores, 3 core tablets, 103 microblades, 5 burin spalls, 1 notched transverse burin, 2 scrapers, 70 edge modified flakes, and 999 pieces of debitage. A single radiocarbon sample gave an age of 3990$\pm$170 B.P. (Beta-7639) (Le Blanc and Ives 1986).

2. Description of Raw Materials

a. Ice Mountain

All microblade cores, microblades, and stone artifacts were made of black obsidian (Smith 1971). There are many obsidian sources present in and around the Ice Mountain area. Among them, Goat Mountain might be the most intensely utilized source (Fladmark 1985:78,80).

b. Bezya

Microblades and cores from the site were made of black, brown, reddish-brown, green, or greenish cherts. The presence of cortex on four of the cores suggests that pebbles probably provided the raw material for the assemblage. This material could have been obtained from gravels in local streams or from naturally formed exposures in nearby till deposits (Le Blanc and Ives 1986:81).

3. Description of Core Types

a. Ice Mountain

A total of eight microblade cores and core fragments were reported by Smith (1971). Four of them can be classified as wedge-shaped. Several specimens described by Smith as elliptical-shaped, cylindrical-shaped, and pencil-shaped cores were probably fragments of cores.

Fladmark's report (1985) provides several distinctive microblade cores which differ from those reported by Smith. These Fladmark named the Ice Mountain Microblade Industry (IMMI). My examination revealed that these cores are generally wedge-shaped. However, very acute edge angles and the use of the fluted face as secondary striking platform are the most diagnostic features of these cores.

b. **Bezya**

No typological designation was given by Le Blanc and Ives (1986:67,70) to the Bezya cores. According to their morphology and technology, they can be defined as wedge-shaped.

4. Preform, Platform, and Rejuvenation Patterns

a. **Ice Mountain**

In Smith's (1971) collection, all wedge-shaped cores were bifacially prepared, and two specimens were made from biface preforms. The platform preparation differs. Specimen MBI-137 has a platform prepared by removing tiny burin spalls from the top of the edge. This technique closely resembles the Sanggan and the Oshoroko techniques of North China and Japan, but is unknown elsewhere in North America (Fig.27:4).

Specimens MBI-131 and MBI-221 have a platform consisting of several microfacets struck from the fluted face. Specimen MBI-248 has a platform formed by a single blow struck against the nonfluted lateral edge which cleaved the biface in half at the midpoint. The rest of the specimens are too fragmentary for typological identification, with the exception of one (MBI-189), which seems to be a fragment of a funnel-shaped core.

In Fladmark's (1986) collection, most cores are wedge-shaped with the exception of a few irregular forms. Bifaces were commonly used as the preform for these cores. Those which Fladmark called the IMMI cores reveal a very unique procedure in microblade reduction. Microblade removal began along one edge, using the other as a platform. When either platform conditions or hinge fractures on the fluted face prohibited further microblade removal in that direction, the fluted surface was turned over to become a striking platform for a series of blades removed down the original striking platform (Fig.27:1.2). Such alternation could occur several times, until the core remnant became too small, or failed for further effective microblade reduction.

b. **Bezya**

Preforms of five microblade cores from Bezya show both unifacial and bifacial preparation. Unifacially prepared cores usually have a side consisting of either an unmodified surface of the flake blank or a large flake scar. The presence of many ridge flakes is of significance in preform preparation. They are triangular in cross section and have transverse flaking scars on the dorsal surface. This demonstrates that, before microblades were removed from the fluted face, one or two transversely prepared ridges were produced to guide microblade detachments (Le Blanc and Ives 1986:71).

The platform preparation of Bezya cores is quite distinctive. First a bifacially prepared ridge was created on the tope of the core, and then this ridge flake was removed by using a longitudinal, burin-like blow. Some cores consist of a smooth plane extending from the edge of the fluted face to the posterior wedge element, but some exhibit a hinge fracture in the midpoint. Some cores reveal no further platform preparation and rejuvenation, but others have a platform rejuvenated by removing a core tablet from the edge of the fluted face.

5. Edge Angle Variations

The edge angle measurements of Ice Mountain cores are from specimens collected by Fladmark. The six cores yielded measurements ranging between 64 and 33 degrees. Only two out of five cores from Bezya provided measurements taken from illustrations. They are 60 and 70 degrees respectively.

Table 32. Edge Angle Variations for Ice Mountain and Bezya Cores

Angle	30-39	40-49	50-59	60-69	70-79	80-89	90-99	total
Ice Mt.								
#	1	2		3				6
Bezya								
#				1	1			2

6. Core Dimensions

Six Ice Mountain cores yielded dimensional indexes ranging between 15 and 7 cm. Five are large.

Table 33. Dimensions for Ice Mountain and Bezya Cores

Index(cm)	5	6	7	8	9	10	11	12	13	14	15	total
Ice Mt.												
#			1		2	1		1			1	6
Bezya												
#	2	2	1									5

The five Bezya cores are all small is size, yielding indices ranging between 7 and 5 cm (Le Blanc and Ives 1986:67). It is noteworthy that all measured specimens from Bezya are exhausted ones. Some refitting of specimens could yield larger indices. For example, the measurement of specimen No.462 by refitting its original platform tablet gave an index of 8 cm.

F. DISCUSSION OF MICROBLADE CORES FROM NORTHWESTERN NORTH AMERICA

Microblade cores of northwestern North America have been discussed in this study in terms of different traditions and regional assemblages. Although the cultural relationships between these traditions or assemblages have still not been thoroughly explored, it is quite certain that some technological traditions co-existed for a certain period of time.

The American Paleo-Arctic Tradition is considered to be the earliest microblade tradition in North America, although dating results from the Campus site tend to contradict this notion. The assemblages or industries belonging to this tradition occur mainly in Alaska.

A series of microblade assemblages, occurring along the Pacific Northwest Coast from southern Alaska to San Juan Island, is slightly more recent and partly contemporary with the American Paleo-Arctic Tradition.

The Plateau Microblade Tradition is represented by a series of microblade industries occurring in the Columbia plateau. This tradition exhibits apparent differences in core technology from the American Paleo-Arctic Tradition, but to a certain extent resembles the coastal assemblages. Radiocarbon dates indicate a younger chronological placement than the American Paleo-Arctic and partial overlap with the coastal microblade assemblages.

The Denbigh Flint Complex and two similar assemblages in Alaska belonging to the Arctic Small Tool Tradition appear to represent a much more recent and somewhat different microblade technology.

The microblade technology from Ice Mountain exhibits unique features. Its chronology and relationship to other microblade assemblages is unknown. The core technology of Bezya resembles that of the American Paleo-Arctic Tradition, but its chronology is much younger than the latter.

1. Raw Materials

a. American Paleo-Arctic Tradition

Chert was the dominant raw material employed in microblade production. Other materials, such as chalcedony, rhyolite, jasper, basalt, and argillite, were rare.

b. Coastal Microblade Assemblages

Materials such as argillite, basalt, obsidian were commonly employed in microblade manufacture. Other materials, such as chert and chalcedony, were relatively rare.

c. Plateau Microblade Tradition

Raw materials in the assemblages of this tradition vary according to their local availability. They include basalt, obsidian, chert, chalcedony, and jasper.

d. Denbigh Flint Complex of the Arctic Small Tool Tradition

Microblades in the Denbigh Flint Complex in Alaska were mainly made of chert, obsidian, and chalcedony.

e. **Ice Mountain and Bezya**

The raw material at Ice Mountain is obsidian, and at Bezya it is chert.

There are two possible explanations for different raw material selections and different microblade technologies among these traditions and regional assemblages. One is that microblade using groups might have exercised specific preferences in material selection and techniques. On the other hand, the availability of local materials might have determined the material used and the techniques that were employed.

2. Core Typology

Most microblade cores of the American Paleo-Arctic Tradition are classified into the category of wedge-shaped cores or "Campus-type" in much of the literature.

The microblade cores from the assemblages of the coastal region, the Plateau Microblade Tradition, and the Denbigh Flint Complex differ considerably from those of the American Paleo-Arctic Tradition. No specific typological names have been offered for these cores, although some authors described them as wedge-shaped. The core morphology is principally controlled by the nature of the raw material. Some are wedge-shaped and cuboid in form, but are more similar to boat-shaped and funnel-shaped types.

Microblade cores from Ice Mountain and Bezya are mostly wedge-shaped in form.

3. Preform, Platform, and Rejuvenation Patterns

Microblade cores from the American Paleo-Arctic Tradition apparently differ from those of other traditions and complexes in preform and platform preparation and core rejuvenation. Generally, the specimens from the American Paleo-Arctic Tradition reveal elaborate preform preparation and were "wedge-shaped" in form. Microblade cores from the Northwest Coast, Columbia Plateau, and the Denbigh Flint Complex show little preform preparation. Similarly, intentional and careful platform preparation and rejuvenation were the diagnostic feature for the American Paleo-Arctic Tradition cores, but these attributes were unknown for the cores from the Northwest Coast and Columbia Plateau. Platform rejuvenation was present, however, in the Arctic Small Tool Tradition.

Ice Mountain and Bezya are two distinctive microblade assemblages. Although the morphology of Ice Mountain cores is obviously wedge-shaped, their platform preparation and rejuvenation are unique in the study area. Bezya microblade cores are basically wedge-shaped, revealing many similarities to the Campus core in platform preparation and rejuvenation, although there is a long temporal span between them.

4. Edge Angle Variations

High frequencies of edge angles less than 90 degrees were the common characteristics shared by most microblade traditions and complexes in northwestern North America. No obvious differences in edge angle variation can be identified between microblade core assemblages of northwestern North America.

5. Core Dimensions

Core dimensions vary both between assemblages within traditions and between traditions. Generally, dimensional variation of microblade cores from the American Paleo-Arctic Tradition is small. Inter-assemblage comparison reveals, however, that the cores from some assemblages, such as the Campus site, are slightly smaller than those from other assemblages, such as Dry Creek, in the same tradition. This difference is not likely significant.

Microblade cores from the Northwest Coast and Columbia Plateau are larger in size in comparison with the American Paleo-Arctic Tradition cores. The samples from the Denbigh Flint Complex are too small to provide a meaningful result.

Ice Mountain cores are large, but Bezya cores are fairly small.

6. Summary

On the basis of the foregoing analyses and comparison of microblade cores in northwestern North America, seven significant observations can be summarized as follows:

a. Lithic raw material might have played an important role in the differentiation of microblade traditions and some regional assemblages. The selection or accessibility of local raw material might have made a considerable impact on the variation of core typology, technology, and rejuvenation patterns. It seems highly likely that distinct granular textures or physical properties of certain materials might have made some techniques unworkable. Raw material and its accessibility may also have influenced core size and the point at which cores were abandoned.

b. The wedge-shaped cores of the American Paleo-Arctic Tradition have distinctive typological or stylistic characteristics. Cores from the coastal microblade assemblages, the Plateau Microblade Tradition, and the Denbigh Flint Complex reveal less distinctive traits. The wedge-shaped core in the American Paleo-Arctic Tradition exhibits a characteristic manufacturing process in preform, platform preparation, and core rejuvenation.

c. Microblade cores from the Coastal microblade assemblages and the Plateau Microblade Tradition exhibit very rough preform preparation and little platform preparation and rejuvenation. Microblade cores from the Denbigh Flint Complex of the Arctic Small Tool Tradition show rough preform preparation, and intentional platform preparation and rejuvenation.

d. The majority of microblade cores from the American Paleo-Arctic Tradition, the Plateau Microblade Tradition, and the Denbigh Flint Complex contain edge angles less than 90 degrees. The percentage of edge angles greater than 89 degrees is somewhat higher in the Coastal assemblages.

e. With the exception of a few assemblages such as the Queen Charlotte Islands, the majority of microblade cores from the American Paleo-Arctic Tradition, most Coastal microblade assemblages, the Plateau Microblade Tradition, and the Denbigh Flint Complex are small in size.

f. The Ice Mountain site contains a unique microblade industry. It exhibits a distinctive process of microblade reduction involving alternation of platform and fluted face. Several Ice Mountain wedge-shaped cores are the largest so far known in North America and contain very acute platform edge angles. This may represent an isolated or idiosyncratic phenomenon possibly related to the abundant obsidian available at the site.

g. Wedge-shaped cores from Bezya resemble their counterparts of the American Paleo-Arctic Tradition in morphology, technology, edge angle variation, and core dimension in spite of its much younger age. This assemblage appears to show recognizable influences from the American Paleo-Arctic Tradition, although more information is needed to assess the significance of this observation.

CHAPTER VI. - ANALYSIS OF MICROBLADE CORES FROM EASTERN SIBERIA AND JAPAN

A. EASTERN SIBERIA -- THE DYUKTAI CULTURE

Eastern Siberia is an important region connecting East Asia and North America. The analysis of the microblade cores in eastern Siberia conducted in this dissertation will be focused on the Dyuktai Culture only, because the question of technological development and cultural change in other regions remains unsolved. The exclusion of some areas from the analysis, such as Lake Baikal and the Amur River, is due to the uncertainty of the cultural context of published collections, the absence of a firmly dated chronological sequence, and the lack of availability of these specimens for direct study. Although the Dyuktai Culture itself is still surrounded by a heated controversy over the credibility of its early chronological placement, the availability of its relatively well-detailed description provides us with valuable information on its diagnostic attributes.

According to Mochanov's definition (Mochanov 1980; Powers 1973), the Dyuktai Culture represents an ethnocultural unit which covers the territory to the east of the Lena River and north of the Amur River, including Kamchatka, Sakhalin, and even a large part of Hokkaido. Wedge-shaped cores are considered the diagnostic element of the culture.

The sites which are currently assigned to this culture in eastern Siberia are: Layers III-XIV in the Dyuktai Cave, Ust-Dyuktai I, Ikhine I and II, Verkhne-Troitskaya, Sumnagin I, Ust-Mil, Ezhantsy, Layers V-VI at the Ushki Lake sites, Tumuluur, and Maiorych.

1. Site Description

a. Layers III-XIV in the Dyuktai Cave

In the Dyuktai Cave, three natural layers were identified. All of the Paleolithic remains were found in the lowest layer (III) (Tseitlin 1979). Mochanov subdivided these layers into twelve cultural layers (Tseitlin 1979:224). The lithic inventory includes blades, microblades and wedge-shaped cores (Fig.28:1-4), double transverse and multi-facet angle burins, a *skreblo* with a bifacial edge on a split pebble, sub-discoidal cores, ski spalls from wedge-shaped cores, two bifacial knives or points, a point on an ivory blade, and split pebbles.

Radiocarbon dates from charcoal yielded dates of 12,100±120 B.P. (LE-907) for the upper part, and 12,690±120 B.P. (LE-860), 13,070±90 B.P. (LE-784) and 13,110±90 B.P. (LE-908) for the middle part of the Paleolithic layer (Mochanov 1980:122).

b. Ust-Dyuktai I

The site is located on the fourth elevated floodplain terrace, on the east bank, at the confluence of the Dyuktai and Aldan Rivers. There are four distinct layers at the site. All of the cultural remains were located in the upper horizon of the second layer.

A total of 397 stone artifacts were found by Mochanov, but nothing specific has been published about these excavations. The surface find and the excavated materials have been assigned to the Dyuktai Culture, but no radiocarbon date is available for the site (Michael 1984; Powers 1973).

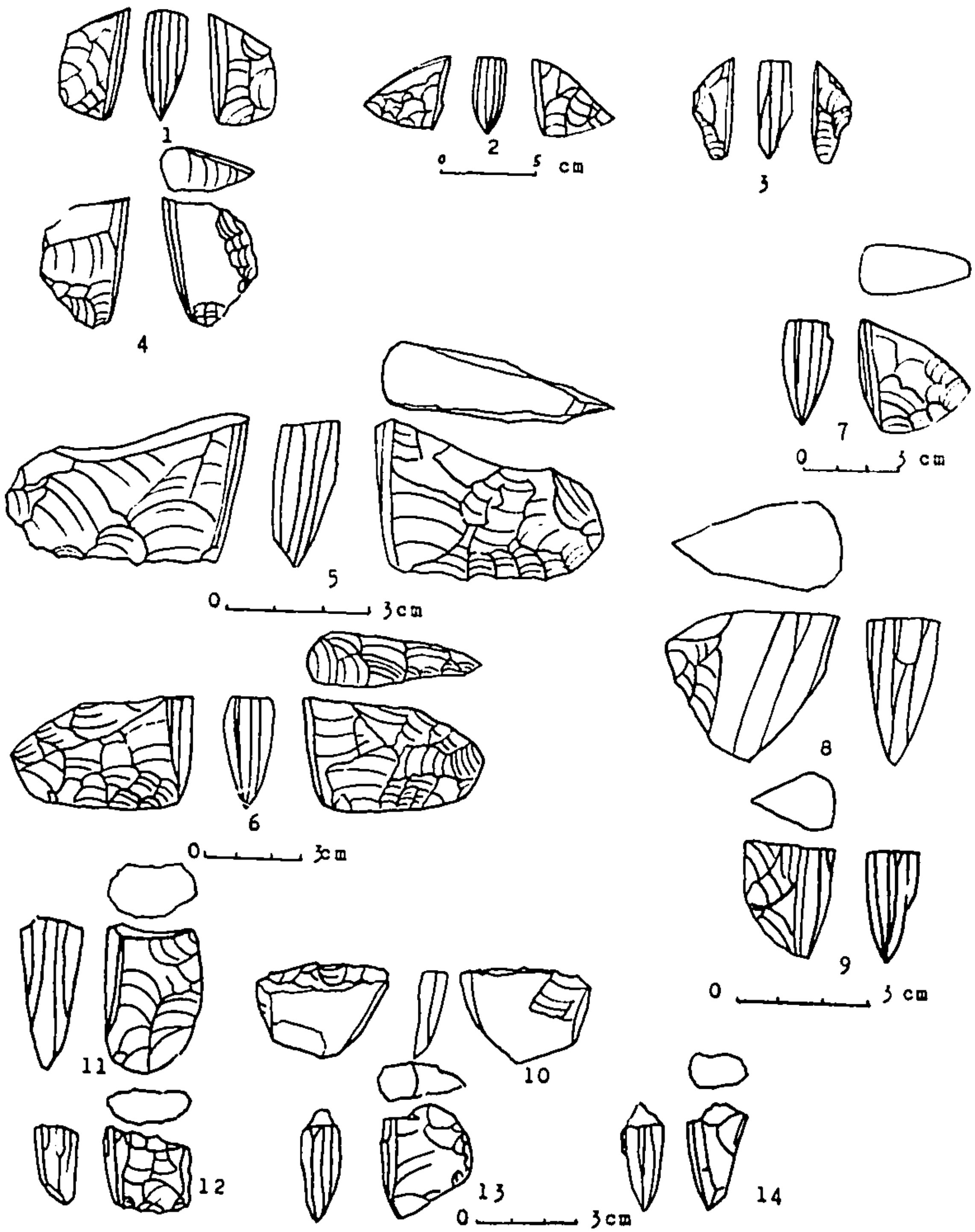


Figure 28: Wedge-shaped Cores from the Dyuktai Culture (after N. Dikov 1987, Yu. Mochanov 1978a, 1980, W. Powers 1973, and F. West 1981)

c. Ikhine I and II

At Ikhine I, two cultural layers were identified in Terrace III. A wedge-shaped core (Fig.28:5), a round scraper, a chisel-shaped implement, and a few flakes were found in the lower cultural layer in association with mammoth, woolly rhinoceros, bison, and northern deer bones (Tseitlin 1979:233).

At Ikhine II, as at Ikhine I, the flood-plain alluvium is represented by horizontally-bedded brownish-grey loams. Three horizons A, B, and C were identified by Mochanov in the lower part of the alluvial band. In these horizons the bones of woolly rhinoceros, mammoth, bison, horse, northern deer, polar fox, fox, and fish are encountered together with a small number of paleolithic artifacts--altogether 21 pieces (Mochanov 1978:56; Tseitlin 1979:234).

Several radiocarbon dates were obtained from level II. Five dates from wood for the middle part of Level IIB are: 24,330±200 B.P. (LE-1131), 24,500±480 B.P. (IM-203), 24,600±380 B.P. (IM-153), 27,400±800 (IM-205), and 30,200±300 B.P. (GIN-1019). Four dates from wood for Level IIA are 26,600±900 B.P. (IM-201), 31,200±500 B.P. (GIN-1020), 26,500±540 B.P. (IM-202), and 26,030±200 B.P. (IM-239) (Tseitlin 1979:233).

d. **Verkhne-Troitskaya**

Seven natural layers were identified by Mochanov, from the top to the bottom, as: (1) turf, (2) sand loam, (3) humus loam with traces of solifluction, (4) layered sandy loam and sand, (5) silty aluerites (6) grained sand, pebble with ice wedges, (7) sand and gravels (Michael 1984:18).

Paleolithic finds (chips) were present in Layer 3. The majority of the faunal and stone objects was found in Layers 4, 5, and 6. A total of 134 stone tools were reported (Michael 1984:16). The lithic inventory includes: wedge-shaped cores (Fig.28:6), other types of cores, bifacially-worked spear-points and knives, burins, and scrapers. The cultural finds are associated with remains of mammoth, woolly rhinoceros, bison, and musk oxen. The radiocarbon dates obtained from wood for Layer 6 are 14,530±160 B.P. (LE-864), 15,950±250 B.P. (GIN-626), 17,680±250 B.P. (LE-906), and 18,300±180 B.P. (LE-905) (Michael 1984:16; Mochanov 1978:58,62; 1980:123, Powers 1973:57; Tseitlin 1979:230).

e. **Ust-Mil II**

Five natural layers were identified by Mochanov from the top to the bottom: (1) turf, (2) covering loam, (3) layered sandy loam, (4) stratified loam, (5) sand and interlayer of loam. A wood sample from the middle part of Layer 3 gave a radiocarbon date of 12,200±170 B.P. (LE-953). The cultural remains from this layer were labelled Complex A.

In the upper part of Layer 4, flint chips were found together with fragmentary bones of mammoth and woolly rhinoceros. One radiocarbon date gave an age of 23,500±500 B.P. (LE-999). They are assigned to Complex B.

In the middle part of Layer 4, stone artifacts and fragmentary bones of mammoth, woolly rhinoceros, bison, and horse were found. The radiocarbon dates for these remains are 33,000±500 B.P. (LE-1000), 30,000±300 B.P. (LE-1001), and 35,400±600 B.P. (LE-954). They are assigned to Complex C.

The number of artifacts from Complexes A and B is too small to permit satisfactory interpretation. The Ust-Mil II artifacts were mainly found in Complex C (Michael 1984:11-14; Tseitlin 1979:226). They include a small wedge-shaped core, a massive pebble core, several bifacial, partially finished artifacts, and a transversally split mammoth bone (Mochanov 1978:56, 1980:122; Tseitlin 1979:228; Powers 1973:69).

f. **Ezhantsy**

Four stratigraphic layers were identified at this site. All of those underlying the turf were disturbed in a number of places by frost cleavage. Most stone artifacts and Pleistocene fauna were found in the third layer (Michael 1984:16; Mochanov 1978:56).

The cultural remains from the lowest parts of Terrace III include a great quantity of large diabase pebble cores, a broken bifacial oval knife, and several wedge-shaped cores. The associated fauna include mammoth, woolly rhinoceros, bison, and horse. On the basis of the radiocarbon dates from Ust-Mil II and the geological position, the age of Ezhantsy was established by Mochanov at approximately 30,000-25,000 or perhaps even 35,000 B.P. (Michael 1984:16; Mochanov 1978:62, 1980:123).

g. **Tumuluur**

The Paleolithic remains were found in the upper horizon of Layer 4, the lowest and thickest level. The lithic inventory includes: wedge-shaped cores, laurel leaf-shaped points, blades and blades with bevelled edges, inset blades, perforators, pointed blades, and chisel-like tools. The leaf-shaped points at Tumuluur constituted 83% of all tools, and were all located in a heap on a small platform. No radiocarbon dates are available for the site. Since the leaf-shaped points from the Tumuluur site are very similar to those from the Dyuktai Cave, it is suggested that these assemblages are of a similar age (Michael 1984; Powers 1973).

h. **Malorych**

This surface collection includes one wedge-shaped core, two flint tools, and three grey flint flakes, (Michael 1984; Powers 1973).

i. **Ushki Lake Sites**

Five layers separated by volcanic ashfalls were identified at Ushki I. In 1963, low water levels resulted in the discovery of four more horizons. These layers were divided into eight cultural layers. Layers VII-V belong to the Upper Paleolithic. Layer VII, the earliest Paleolithic one, contained no microblade remains. There were two dwelling complexes and burial pits. The radiocarbon dates from this layer ranged between 14,300±200 B.P.(GIN-?) and 13,600±250 B.P.(GIN-167).

Layer VI contained stone artifacts different from those underneath. There were 13 semi-subterranean dwellings. Most artifacts were found around fire pits. Microblade remains first appeared in this layer, including: wedge-shaped cores, microblades, ski spalls, elongated leaf-like arrowheads, bifacially worked knives, and small pieces of polished abrasive pumice. Radiocarbon dates derived from this layer are 10,360±350 B.P. (MO-345) and 10,760±110 B.P. (Mag-219) and 21,000±100 B.P. (GIN-186).

Layer V belongs to the terminal Paleolithic. Four above-ground dwellings were unearthed. Only one dwelling yielded artifacts. Cultural remains were concentrated in and around the fire pits. Wedge-shaped cores and regular cores dominated the stone objects. Two leaf-shaped arrowheads, five scrapers, four knives, one burin, and large numbers of obsidian and flint microblades and flakes were also found.

Ushki II is located 500 m to the east of Ushki I. The stratigraphy was similar to that of Ushki I, except that there is only one Paleolithic layer equivalent to Layer V. A number of artifacts including wedge-shaped cores, end scrapers, unfinished cores and sub-prismatic and truncated core forms, blades, and flakes, were found.

Ushki IV is situated midway between Ushki I and II. Two separate excavations were carried out. The geological stratigraphy was the same as in the two previously mentioned sites. Layer IV is the only Upper Paleolithic stratum. Most artifacts were found in the lower part of the layer. An oval surface dwelling measuring 5 m in diameter was found in the eastern part of Ushki IV. Five wedge-shaped cores, several bifacially worked points, an unfinished leaf-shaped knife, scrapers, blades, and two grinders were also recovered. The western part of Ushki IV also contained a dwelling. The stone artifacts included wedge-shaped cores, ski spalls, microblades, narrow leaf-like arrowheads, fragments of bifacially worked knives, scrapers, large pounding tools, spokeshaves, and a slab for grinding ochre.

Ushki V is located to the west of Ushki I. The finds at this site were not numerous, but they were similar to the Paleolithic artifacts of Ushki I, II, and IV (Dikov 1965, 1968, 1987; Michael 1984; West 1981).

2. Description of Raw Materials

Raw materials of the Dyuktai Culture are flint, jasper, chalcedony, or some other fine grained, siliceous materials (Flenniken 1987:118).

In the Dyuktai Cave, the raw materials were various kinds of flint and a few diabase. Wedge-shaped cores and many other stone tools were made on flat pebbles (Michael 1984:7; Powers 1973:52).

The wedge-shaped cores and other stone artifacts from Ust-Mil II, Verkhne-Troitskaya, Ezhantsy, Ikhine, and Maiorych are made on flint. According to the descriptions, pebbles were the main source of the lithic materials (Mochanov 1978, 1980; Powers 1973).

The materials at the Ushki Lake sites included grey and green siliceous slate, grey-green and yellow flint, chalcedony, volcanic tuff, different kinds of obsidian, basalt, and argillaceous slate (Powers 1973:83). Microblades and cores were made on flint, black andesite, chalcedony, obsidian, grey siliceous slate, and grey silicified argillaceous shale (Dikov 1968:194).

3. Description of the Core Type

The wedge-shaped core is the only type identified at the different sites of the Dyuktai Culture (Fig.28).

4. Preform, Platform, and Rejuvenation Patterns

Wedge-shaped cores exhibited sophisticated skill in core preparation. Many specimens showed careful preform and platform preparation. For example, wedge-cores from the Dyuktai Cave (Fig.28:1-4) and Verkhne-Troitskaya were described as produced by the Yubetsu technique:

> They are flat and elongate with both sides carefully worked and with the bottom and back well-shaped. The platform is apparently formed by a single longitudinal blow and has blades facets running down one end (Powers 1973:57).

It is noteworthy, however, that one wedge-shaped core from Verkhne-Troitskaya exhibits a different method of platform preparation illustrated by Mochanov (1978:65). Its platform was prepared by multiple transversal flaking, then trimmed by longitudinal blows from the fluted end (Fig:28:6).

One wedge-shaped core from Ikhine (Fig.28:5) was also produced by the Yubetsu technique. "Both sides are carefully worked....The platform was prepared by a longitudinal blow with no additional preparation" (Powers 1973:57,58).

Some specimens exhibited rather rough preform preparation, although exhibiting the Yubetsu technique. One wedge-shaped core from Tumuluur, for example,

> ...appears to have been made on a long river pebble. One lateral surface is almost completely cortex while the other retains cortex near the back of the core. The back itself was shaped by a series of blows from left to right. The platform was prepared by one

longitudinal blow which runs the full length of the core (Powers 1973:68).

The wedge-shaped core from Maiorych was also a Yubetsu type. "Both sides are covered with facets of careful flat retouch, the back is well-shaped and the base of the core bears supplemental facets...[and]...the platform was formed by longitudinal blows" (Powers 1973:76).

Flenniken (1987) defined the Dyuktai technique based on the manufacture process of Dyuktai cores, which includes (1) selection of raw materials; (2) bifacial preform preparation; (3) heat treatment of preforms; (4) edge preparation and ski spall removal; and (5) pressure blade production.

No detailed description is available for wedge-shaped cores from the Ushki Lake sites, however, some general technological attributes can be obtained on the basis of the artifact illustrations (Dikov 1965, 1968, 1987; Powers 1973). The preforms of wedge-shaped cores exhibit careful bifacial or unifacial preparation. The presence of a large number of ski spalls and core tablets indicates that removal of ski spalls and tablets was the common technique utilized in platform preparation (Fig.28:7-9). Some specimens found on the eastern Chukchi Peninsular exhibited a platform prepared by multiple transversal flaking. Some have a hinge fracture in the midpoint of the platform, indicating that a core tablet was removed to rejuvenate the platform (Fig.28:10-14).

On the basis of the preceding descriptions, three platform technique or patterns are identified from the wedge-shaped cores of the Dyuktai Culture. In Pattern I, the platforms consisted of a single flake scar passing through the whole length of the body. The specimens from Ikhine represent the best example of this pattern (Fig.28:5). In Pattern II, the platforms were first prepared by multiple transversal flaking, then trimmed by longitudinal blows to adjust edge angle. One specimen from Verkhne-Troitskaya is the best sample of this pattern (Fig.28:6). In Pattern III, the platforms were first prepared by transversal flaking, then a single blow was delivered from the fluted end to create a platform or to rejuvenate it. One specimen recovered from Talyain I, eastern Chukchi Peninsula, is the best sample of this pattern (Fig.28:13) (Dikov 1978:12).

5. Edge Angle Variations

A total of 46 wedge-shaped cores were measured from their illustrations. They included five specimens from the Dyuktai Cave, five from Ezhantsy, two from Verkhne-Troitskaya, three from Tumuluur, one from Ikhine, one from Maiorych, sixteen from Ushki Lake, and thirteen from surface collections on the Chukchi Peninsula (Dikov 1965, 1968, 1987; Mochanov 1978, 1980; Powers 1973; West 1981).

The platform edge angle variation ranged between 95 and 56 degrees. Those exceeding 89 degrees totalled 20%, indicating that edge angles tended to be acute.

Table 34. Edge Angle Variation for Dyuktai Cores

Angle	56-59	60-69	70-79	80-89	90-95	total
#	2	5	9	21	9	46
%	4	11	20	45	20	

6. Core Dimensions

Dimensional indices reveal that the Dyuktai Culture cores are fairly large. The distribution of the indices ranges between 13 and 6 cm. Large cores totalled 61%.

Table 35. Dimensions for Dyuktai Cores

Index(cm)	6	7	8	9	10	11	13	total
#	7	11	6	8	8	3	3	46
%	15	24	13	17	17	7	7	

B. JAPAN

Microblade remains are widespread over almost all the Japanese archipelago and comprise the most diagnostic cultural feature from the late Preceramic to the early Ceramic periods. However, precise information concerning their stratigraphic context is not always available. Because of the unavailability of specimens from many collections for study, it is impossible to conduct a comprehensive analysis. In this study, therefore, the analysis will focus on microblade cores from the sites of Yasumiba, Fukui Cave, Araya, and Shirataki.

1. Site Description

a. Fukui Cave

Fukui Cave is one of the best stratified sites in Japan and has yielded successive cultural layers from the Upper Paleolithic to the Jomon periods. The site is located in extreme western Kyushu, about 60 km north of the city of Nagasaki. It is a medium-sized overhang at the base of a sandstone outcrop, open and well lighted, with a southwestern exposure looking out over the Fukui River. A trench dug from the front to the back of the shelter cut down through 15 natural strata extending to a depth 5.5 m beneath the surface, where bedrock was finally encountered. The cultural remains came from Strata 1 to 4, 7, 9, and 15, while Strata 5, 6, 8, and 10 to 14 were essentially sterile.

Layer 7 yielded a small blade industry. A number of small parallel-sided, end-blow blades and roughly cylindrical and half-cylindrical cores were found. The blades were rather short and broad.

Microblades and cores first appeared in Layer 4. They were characterized by conical or semiconical forrns. No ceramics were found in Layer 4. The microblade cores found in Layers 3 and 2 can be defined as wedge-shaped (Fig.29). The pottery that first appeared in Layer 3 in association with microblades is among the earliest known from Japan.

The following radiocarbon dates have been obtained: Layer 4 - 14,400±400 B.P. (I-945), Layer 3 - 12,700±500 B.P. (GaK-950), and Layer 2 - 12,400±350 B.P. (GaK-949). It is noteworthy that the dates obtained from the underlying layers are in reverse order: Layer 7 - 13,600±600 B.P. (GaK-951), Layer 9 - 13,130±600 B.P. (I-947), and Layer 12 - 10,700±600 B.P. (I-946) (Aikens and Higuchi 1982). The reason for the reversal is unknown.

b. **Yasumiba**

Yasumiba is located about 40 km east of the city of Shizuoka, on the Pacific coast of central Honshu. The site lies at the junction of the relatively gentle slope of the fan and the much steeper slope of the mountain. The cultural materials were uncovered from the upper part of a brownish volcanic loam stratum buried some 2 m beneath the modern surface.

Along with two hearths, over 4400 artifacts were found, of which approximately 1000 specimens were microblades. Some 20 microblade cores were also found. All were conical forms. Wedge-shaped cores did not occur at all. Other artifacts included end scrapers, side scrapers, knives, and gravers.

A radiocarbon date of 14,300 B.P. on a hearth and an obsidian hydration date of 11,100 B.P. were obtained for the assemblage (Aikens and Higuchi 1982:69).

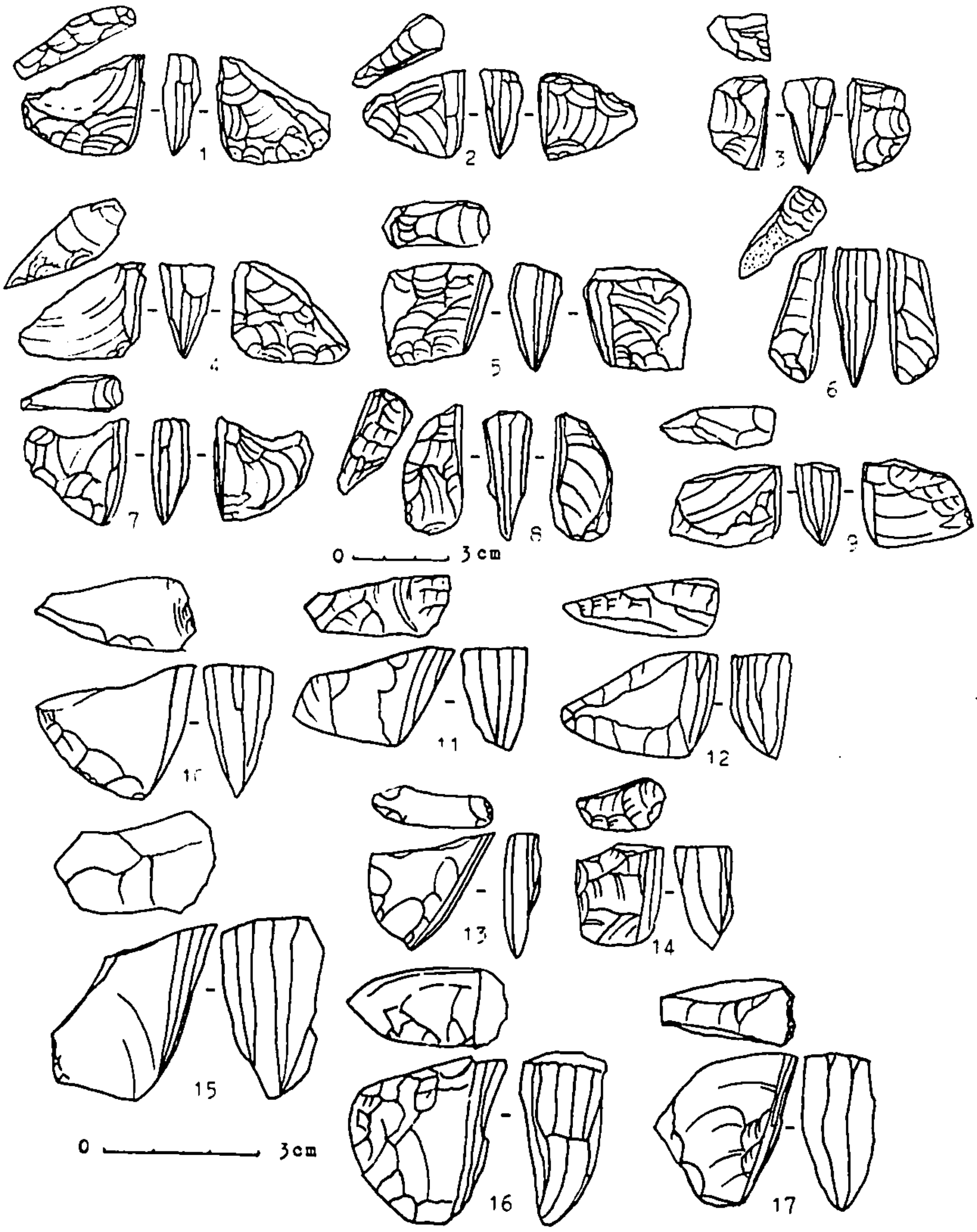


Figure 29: Wedge-shaped Cores from the Fukui Cave Site (after K. Hayashi 1968 and C. Aikens and T. Higuchi 1982)

c. **Shirataki**

Shirataki contains 74 localities. It has a considerable time depth from the preceramic to the post-Jomon periods (Morlan 1967a; Serizawa and Ikawa 1960).

Locality 13, yielding the earliest microblade remains, is located on Terrace 4. Boat-shaped cores, large- and medium-size blades, end scrapers, side scrapers and handaxe-like tools were discovered in a level 2 m below surface. Obsidian hydration measurements gave a date of 17,000 B.P. to these artifacts (Morlan 1967a:171).

Locality 4 on Terrace 3 yielded the earliest conical cores. Four conical cores with plain platforms were found along with small boat-shaped cores, a few end scrapers and crude medium-size blade-like flakes. An obsidian hydration date of 16,800 B.P. has been obtained for this locality (Morlan 1967a:171).

Locality 33 on Terrace 4 yielded the earliest Yubetsu cores. The cultural layer is about 40-50 cm below the surface. Other stone tools included a variety of burins, end-scrapers, crude blades, and ski spalls. An obsidian date of 15,200 B.P. was obtained for the locality (Morlan 1967a:177).

d. **Oshorokko**

The Oshorokko site is located at the village of Nishiokoppe, Mombetsu County. The stratigraphy of the site is unknown. The lithic inventory included wedge-shaped cores of the Oshorokko form, stone axes, blades, points, Araya burins, and transverse burins. Obsidian hydration gave an age of 12,300 B.P. (Morlan 1967a:188).

e. **Togeshita**

The majority of lithic remains from this site was surface collected, but about one-fifth was obtained from the excavation. Most finds were assigned to the preceramic period except for a few surface collected items which were assigned to the Jomon period. The preceramic lithic inventory included wedge-shaped, conical, and boat-shaped cores, microblades, end scrapers, bifacial points, and burins. No absolute dates were available for the site (Morlan 1967a:197).

f. **Araya**

The Araya site lies on a river terrace at the junction of the Shinano and Uono Rivers. Numerous artifacts were recovered from a loamy sand bed, about 1 m thick, underlying the humus. The lithic inventory includes 600 microblades, some two dozen boat-shaped cores, some 400 distinctive Araya burins, over 1000 burin spalls, and a few miscellaneous points, choppers, and scrapers. The Araya site was dated by the radiocarbon method to 13,200±350 B.P.(GaK-948) (Aikens and Higuchi 1982:74,78; Ikawa-Smith 1976:82; Serizawa and Ikawa 1960:16).

2. Description of Raw Materials

At Fukui Cave, high-quality obsidian was employed in the production of microblades and other stone artifacts (Tachibana 1979:136).

According to Suzuki (1979:109), obsidian dominated the raw materials at Yasumiba. Of a total of 152 microblade cores from the assemblage, 143 were of obsidian (94%), 6 of shale (4%), 1 of crystal, and 2 of silicified wood (2%).

Microblade remains and other stone artifacts in northern Hokkaido were mainly made of obsidian, while those in southwestern Hokkaido and northern Honshu were of shale. (Morlan 1967a:168; Serizawa and Ikawa 1960:6).

3. Description of Core Types

Microblade cores found in Layer 4 at Fukui Cave were defined as conical, semi-conical, and cylindrical. Those found from Yasumiba can be included in the same category. These cores form either a rectangle, a short equilateral triangle, or an elongated trapezoid in cross-section (Hayashi 1968:132; Kobayashi 1970:40). I prefer to include all of them into the category of conical cores.

Microblade cores found in Layer 3 and 2 at Fukui Cave were wedge-shaped (Kobayashi 1970:41), although some authors refer to them as boat-shaped (Hayashi 1968; Aikens and Higuchi 1982).

There are three core types so far identified in northern Honshu and Hokkaido: wedge-shaped, conical, and boat-shaped. Several different types of wedge-shaped cores, such as Yubetsu, Togeshita, Oshorokko, and Rankoshi, have been defined on the basis of different manufacturing processes (Morlan 1967a; Tsurumaru 1979). A number of Japanese archaeologists have suggested that the Yubetsu core can be further divided into two subtypes, Shirataki and Sakkotsu, on the basis of both core and microblade attributes, including core size, the presence or absence of platform striation, and the width and the retouch of the microblades. However, Chin-Yee (1980:67,115) has argued that these differences are not significant enough to separate them as two subtypes since they are related to the mechanical requirements of manufacture and not to cultural differences.

4. Preform, Platform, and Rejuvenation Patterns

a. Conical Cores from Fukui Cave

Hayashi (1968:132) has described Fukui conical cores as follows:

> The specimens of this kind do not retain any trace of regularly patterned retouch on the side.

> The platform had usually been formed before manufacture of the sides was started because in the case of the majority of specimens the margins of the platform are intersected by scars which form the sides. There is no standardized pattern for removing the flake scar to form the platform. It is usually formed by a single blow scar.

Kobayashi (1970:41) also provided a description on the conical core technology at Fukui Cave:

> An obsidian cobble is split into two parts of different sizes; usually the largest part is rejected, the smallest part which has a hat-like shape is used as a core for production of small blades. The original flake surface of this hat-shaped core is used as a striking platform. This core is rarely shaped prior to the detachment of small blades.

b. **Conical Cores from Yasumiba**

According to Masao Ambiru (1979:159,160,166), the Yasumiba cores were produced by the Yadegawa technique. These cores usually consisted of five to six sides and resemble a cuboid conical form. Sometimes, microblades were directly detached from chunks without any preform preparation. Cortex can be seen on lateral sides and on the back. In others, split cobbles were used for preforms. In these cases, cortex can be seen from one lateral side and from the back. It is apparent that raw material usually determined the shape of the cores; there was no intentional shaping of the preform. The platforms consisted of a single flake scar or multiple blows from the fluted end.

c. **Wedge-shaped Cores from Fukui Cave**

According to Hayashi (1968:140,149), wedge-shaped cores were bifacially or unifacially prepared. Three patterns of platform preparation and rejuvenation were identified: (1) platform laterally retouched by multiple flaking, (2) platform retouched by multiple flaking at apex, and (3) platform formed by a longitudinal blow. He named this technique "the Fukui technique."

Kobayashi (1970) mentioned that Fukui Cave wedge-shaped cores were bifacially or semi-bifacially prepared before platform production. The platform was first prepared by more or less extensive retouch then by a fine retouch limited to the striking platform, and rejuvenated by a longitudinal blow (Fig.29:1-17).

Another technological term for the Fukui core is the "Saikai technique" (Akazawa *et al.* 1980; Ambiru 1979; Aso 1965), whereby

> a flat obsidian pebble was worked bifacially to form an oval object usually retaining some cortex. This is split laterally to make a wedge-shaped core (Akazawa *et al.* 1980:23).

d. **Conical Cores from Hokkaido**

According to Kobayashi (1970:41), the conical core found on Hokkaido was produced by his System B. In this system, the first step is to obtain a platform, usually with a single blow. This is followed by core shaping. Conical cores found in Layer 4 at Fukui Cave and at Yasumiba may exemplify this process. However, conical cores from the sites of Momijiyama and Okedo-Azumi exhibit a more slender appearance and a more sophisticated technology than their counterparts in southern Japan (Kobayashi 1970:55).

e. **Wedge-shaped Cores from Hokkaido**

Wedge-shaped core techniques on Hoddaido are discussed according to core type: Yubetsu, Togeshita, Oshorokko, and Rankoshi.

(1) *The Yubetsu Core*

Morlan (1967a:177) translated Yoshizaki's definition of the Yubetsu core as follows:

> Beginning with a thick bifacial point, blows are struck longitudinally on the tip of the point so that long narrow flakes are removed from the edge. These flakes are rectangular in cross-section except for the first one which, of course, has a triangular cross section since it bears the edge of the original biface. These flakes are called ski

> spalls since they more or less resemble skis. By the time several such ski spalls have been removed the biface has begun to look half its original size, as if it were cut in two longitudinally. The new flat edge then becomes the platform of the core on the end of which blows are struck at a right angle to the long axis of the original biface. These blows cause the removal of long, thin, narrow (prismatic) flakes resembling microblades, and removal of these flakes gives the end of the biface (core) a fluted appearance (Fig.30:1, Fig.6:3).

According to Chin-Yee (1980:43,55,57,58,65), several more detailed observations were made. First, preparation of a perfect biface is not essential in the Yubetsu. In some sites, such as Shirataki 32, incomplete bifaces were also used as cores, and unifacial core preforms accounted for 15-20%. Second, half of the Shirataki cores are fluted at both ends of the core. Third, some Yubetsu cores bear evidence of platform retouch or secondary trimming. Fourth, a considerable number of Yubetsu cores have platform striations which resulted from grinding the platform in order to prevent the punch from slipping. Fifth, at some Yubetsu sites in Honshu, ski spalls were absent.

Removal of ski spalls or tablets is the most diagnostic manufacturing process for Yubetsu cores. It is not only used to create the initial platform, but also used to correct the initial platform angle, or to create a new platform surface. Such platform rejuvenation was also conducted during the manufacture of microblades (Chin-Yee 1980:53,56,57).

(2) *The Togeshita Core*

Morlan (1976:99) outlines this core technique on the basis of Yoshizaki's description:

> The ventral surface of the flake is nearly always the reverse face of the core, though it occasionally forms the obverse face, and it receives little or no facial retouch. The platform is produced by a burin blow along one long margin and spans 50-100 percent of the platform element. The obverse-reverse juncture in the platform

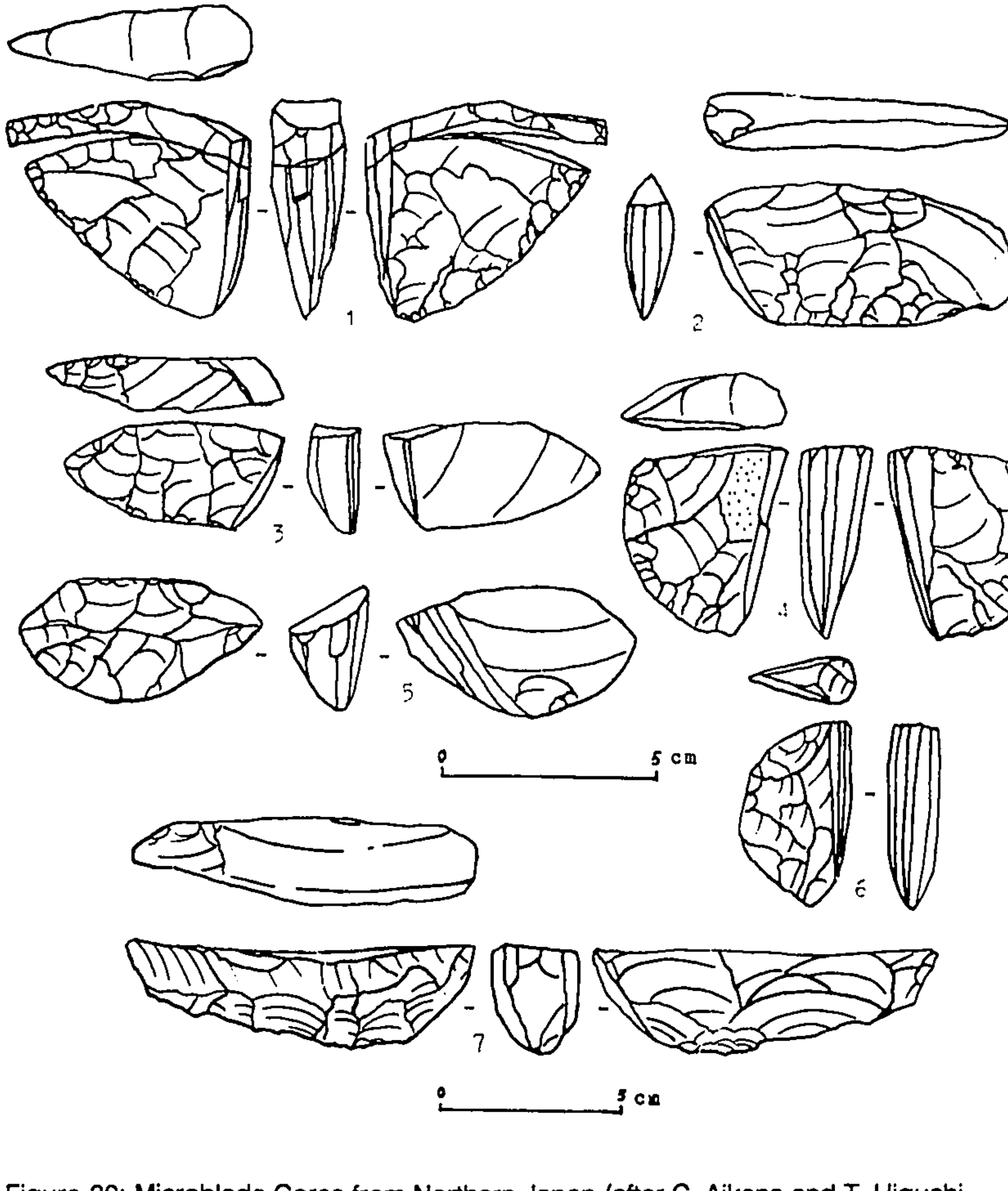


Figure 30: Microblade Cores from Northern Japan (after C. Aikens and T. Higuchi 1982 and T. Tsurumaru 1979)

> element, when it occurs, is a unifacially flaked edge on which the flaking sometimes becomes so steep that it can be described as a laterally flaked part of the platform itself. More frequently, however, the platform consists entirely of a longitudinal burin facet on the proximal end of which blows are struck to remove microblades (Fig.30:3,5, Fig.6:4)

Chin-Yee (1980:43) has pointed out that in the Togeshita, the preform can be a semi-biface made on a D-shaped flake or blade.

(3) *The Oshorokko Core*

Morlan (1967a:188) translated Yoshizaki's description of these cores as follows:

> They are made on heavy bifacial points by first striking a single blow on the tip and then, using this first facet as a platform, by striking several diagonal blows in the opposite direction on the tip. The result is a burin with a single facet on one edge and multiple facets on the other (Fig.30:2, Fig.6:5).

(4) *The Rankoshi Core*

This technique began with the preparation of a bifacial preform which was split in half along the short axis. A side blow was then delivered along part of the edge to shape the platform (Fig.30:4,6, Fig.6:6) (Chin-Yee 1980:23; Tsurumaru 1979:33).

f. **Boat-shaped Cores from Northern Honshu and Hokkaido**

Morlan (1967a:173) defined the Horoka core or Horoka technique on the basis of his own observations:

> A large broad flake, of variable thickness, is struck from a cobble or other large piece of stone. The ventral surface of this flake becomes the "platform" of the finished tool, and the sides of the tools are formed by blows struck on the "platform." Material is thus removed along one edge of the flake until one side of the tool is finished. (Fig.30:7)

The boat-shaped cores from the Araya site were attributed to a slightly different core preparation process which was defined as "the Araya technique" (Otsuka 1968; see Akazawa *et al.* 1980:23):

> The blank for the core is worked bifacially to form a foliate tool which is then split in half tr make a core. At the Araya site these blanks were struck obliquely, resulting in two boat-shaped cores, both of which were used for producing microblades.

5. Edge Angle Variations

a. **Wedge-Shaped Cores from Fukui Cave**

The edge angle variation is unknown for the conical cores from Fukui Cave. A total of 23 wedge-shaped cores were measured from their illustrations, providing 21 measurements (Aikens and Higuchi 1982; Hayashi 1968). The edge angle variation ranged between 90 and 52 degrees. In general, Fukui cores have very acute edge angles.

b. **Conical Cores from Yasumiba**

According to Tadashi Suzuki (1979), the average edge angle of conical cores from Yasumiba is 69.5 degrees. He also mentions that the average edge angle for the Yadegawa cores is 74.4 degrees. Apparently, conical cores in southern Japan exhibited rather acute platform edge angles.

c. **Wedge-shaped, Boat-shaped Cores from Northern Japan**

A total of 40 wedge-shaped cores, measured from their illustrations (Aikens and Higuchi 1982; Kobayashi 1970; Morlan 1967a; Tsurumaru 1979), yielded 39 measurements. The edge angle variation ranges between 107 and 60 degrees and those exceeded 89 degrees accounted for 26% of the total.

A total of 13 boat-shaped cores measured from illustrations yielded variation between 100 and 55 degrees. Only one specimen yielded a measurement of approximately 100 degrees. Most edge angles were less than 90 degrees.

No measurements were available for conical cores.

Table 36. Edge Angle Variations for Japanese Cores

Angle	50-59	60-69	70-79	80-89	90-99	>99	total
Fukui(wedge)							
#	1	3	9	7	1		21
%	5	14	43	33	5		
Hokkaido & Araya (wedge)							
#		3	13	13	6	4	39
%		8	33	33	15	10	
(boat)							
#	3	1	3	5		1	13
%	23	8	23	38		8	

6. Core Dimensions

a. **Wedge-Shaped Cores from Fukui Cave**

Dimensional indices of 23 wedge-shaped cores ranged between 10 and 5 cm. Large specimens totalled 57%.

b. **Yasumiba**

Fourteen specimens were measured from their illustrations. The majority of cores (93%) were small.

c. **Northern Japan**

Wedge-shaped and boat-shaped cores of northern Japan, measured from their illustrations, were quite large. A total of 40 specimens gave 41 indices. The dimensional variation ranged between 28 and 7 cm. Large specimens accounted for 98%.

The dimensional indices of boat-shaped cores ranged between 22 and 7 cm. Larger cores predominate, accounting for 92%.

No dimensional measurements are available for conical cores from northern Japan.

Table 37. Dimensions for Japanese Cores

Index(cm)	<8	8	9	10	11	12	13	15	16	17	18	19	
>19	total												
Fukui(wedge)													
#	10	5	5	3									23
%	43	22	22	13									
Yadegawa(conical)													
#	13	1											14
%	93	7											
North (wedge)													
#	1	2	10	7	3	4	5	2	3	1		1	24
%	2	5	24	17	7	10	12	5	7	2		2	5
(boat)													
#	1			2	1	1	3	1	1		1		23
%	8			15	8	8	23	8	8		8		15

C. DISCUSSION OF MICROBLADE CORES FROM THE DYUKTAI CULTURE IN EASTERN SIBERIA AND JAPAN

1. Raw Materials

a. Dyuktai Culture

At most Dyuktai Culture sites, flint was the dominant raw material utilized to produce microblades and other stone artifacts. Other materials such as chalcedony, argillaceous shale, siliceous slate, andesite, and obsidian were also used at the Ushki Lake sites.

b. Japan

In Japan, obsidian was the dominant raw material utilized in microblade production. Hard shale was very common in southern Hokkaido and northern Honshu. At Yasumiba, a few microblade cores were made of shale, crystal, and silicified wood.

2. Description of Core Types

a. Eastern Siberia

In eastern Siberia, wedge-shaped cores were the only core type used for microblade production during the late Pleistocene and are considered an important characteristic of the Dyuktai Culture. When the Dyuktai Culture declined about 10,000 years ago, wedge-shaped core technology was replaced by the conical core technology of the Sumnagin Culture which endured in the early Holocene from about 10000 to 6000 B.P. (Powers 1973:71,72).

b. **Japan**

In Japan, conical cores were thought to represent a different microblade tradition from wedge-shaped cores, and they seemed to have mutually exclusive distributions (Morlan 1967a:206)

Conical cores appeared earlier than wedge-shaped ones in the south. At the Fukui Cave site, conical cores appeared in Horizon 4 and were dated to 14,400±400 B.P. (I-945). The microblade assemblage at Yasumiba, characterized by conical core technology, yielded a radiocarbon date of 14,300 B.P. and an obsidian hydration date of 11,100 B.P. (Aikens and Higuchi 1982:69,103; Hayashi 1968).

Wedge-shaped cores occurred in Horizons 3 and 2 at the Fukui Cave site, and were dated to 12,700±500 B.P. (GaK-950) and 12,400±350 B.P. (GaK-949), respectively.

In Hokkaido, conical cores at Shirataki 4 were dated to 16,800 B.P. by the obsidian hydration method. These conical cores, together with several boat-shaped cores, were regarded by Yoshizaki as possible evidence of an incipient blade technology (Morlan 1967a:171). However, the chronology of conical cores in Hokkaido is still a controversial issue. Some Japanese archaeologists consider them to be older than wedge-shaped core technology. For example, Kobayashi has agreed with the opinion that conical technology at Momijiyama might be temporally placed with the earliest stage of microblades, while others regarded them as younger (Hayashi 1968:153; Kobayashi 1970:42).

According to Morlan (1967a:192, 1978:100), boat-shaped or Horoka cores appeared at the very beginning of the known sequence of preceramic industries about 17,000 B.P. in Hokkaido. However, Ikawa-Smith (1976:82) has argued that they might not be so early, since fission-track determinations have suggested that all the assemblages from the Shirataki area are younger than 13,000 B.P.

Yubetsu core technology was considered to have flourished between about 15,800$\pm$380 B.P. (GaK-212) (Shirataki 31) and 12,700 B.P. (Shirataki 32) (Chin-Yee 1980:12). However, the same challenge to these early dates has been made on the basis of the fission-track results (Ikawa-Smith 1976:82).

Other wedge-shaped core types, such as Togeshita and Oshorokko, have been considered younger than Yubetsu (Morlan 1967a:192). One obsidian hydration date for the Oshorokko site is 12,500 B.P. No chronometric dates are available for Togeshita and Rankoshi cores.

Different temporal ranges and mutually exclusive distributions of different core types in eastern Siberia and Japan might reflect the intrusion of different microblade using groups with radically different knapping techniques and lithic tool kits.

3. Preform, Platform, and Rejuvenation Patterns

a. **Dyuktai Culture**

Wedge-shaped cores from Dyuktai Culture sites were mainly produced by the Dyuktai technique. They exhibited totally or partially bifacial preform preparation. Platforms were created or rejuvenated by removal of ski spalls. One wedge-shaped core from Verkhne-Troitskaya seems to have been made by the Xiachuan technique (Mochanov 1978:65). The bifacial preform exhibited a platform retouched first by multiple transversal flaking, then trimmed by blows delivered from the fluted face. The Dyuktai technique might be also a dominant technique employed in the Ushki Lake sites; the presence of large numbers of ski spalls and core tablets is suggestive (Dikov 1968; Powers 1973), although no detailed description of core technology is available. Recent discoveries at Upper Paleolithic sites on the eastern Chukchi Peninsular have produced several wedge-shaped cores with a unifacially or semi-bifacially prepared preform. Their platforms exhibit multiple transversal flaking and some specimens had a hinge fracture in the midpoint of the platform indicative of rejuvenated by removal of a core tablet (Dikov 1987:12,13). They were similar to the cores made by the Togeshita or Saikai techniques, and resembled the Campus cores in Alaska.

b. **Japan**

(1) *Conical Cores*

Conical cores from Horizon 4 at Fukui Cave and from Yasumiba exhibited very rough preform and platform preparation. Split cobbles and chunks were initially used as indicated by many specimens with cortex on their sides or distal ends. Platforms preparation ranged from complete to partial to none at all (Hayashi 1968:133,135; Kobayashi 1970:40).

Conical cores from Momijiyama on Hokkaido were considered to be very different from their counterparts in the south. Their preforms exhibited little side and edge retouch. Platforms had not been formed or retouched in a consistent manner and the orientation of the retouching blows and flaking varied considerably (Hayashi 1968:152).

(2) *Wedge-Shaped Cores*

Wedge-shaped cores from Fukui Cave were produced by the Fukui technique (Fig.6:1) (Hayashi 1968:148,149) or the Saikai technique (Fig.6:2) (Ambiru 1979:155).

The Fukui technique was named after Hayashi's Type Ia core. Its platform was produced after preform formation. Platforms were usually concave and prepared by transverse flaking, then rejuvenated by multiple short longitudinal flaking.

Masao Ambiru mentioned that his Saikai technique somewhat resembled the Togeshita technique on Hokkaido. The core has a bifacially prepared preform, but was not D-shaped in cross-section like the Togeshita cores. Platforms were prepared by multiple transversal flaking, and rejuvenated by removal of a core tablet to renew the edge angle.

From the definitions given by Hayashi and Ambiru, it is suggested that the slight differences of core preparation and microblade reduction are not sufficient to warrant their definition as separate techniques.

On Hokkaido, wedge-shaped cores produced by several different techniques, such as Yubetsu, Togeshita, Oshorokko, and Rankoshi, have been identified (Fig.6:3-6). The temporally exclusive distributions of these cores suggest that they might have been the product of different microblade using groups.

(3) *Boat-Shaped Cores*

Boat-shaped cores occurred only on Hokkaido and northern Honshu and were produced by the Horoka technique. The platform was produced first, and the sides were formed by striking blows on this platform. The wedge or keel was formed by the intersection of the scars from the two sides, and lacked any direct flaking. The platform was never retouched or rejuvenated.

4. Edge Angle Variations

a. **Dyuktai Culture**

Edge angle measurements indicate that the Dyuktai Culture cores have a fairly low frequency (20%) of edge angles exceeding 89 degrees.

b. **Japan**

(1) *Conical Cores*

Yasumiba conical cores have very acute edge angles, averaging 74 degrees.

(2) *Wedge-Shaped Cores*

Wedge-shaped cores from Fukui Cave and those from Hokkaido and northern Honshu show slight difference in edge angle variation. Fukui cores exhibit a very low frequency (5%) of edge angles greater than 89 degrees. Wedge-shaped cores from Hokkaido and northern Honshu exhibit a slightly high frequency (25%).

(3) *Boat-Shaped Cores*

Edge angles greater than 89 degrees are very low in frequency (8%) among boat-shaped cores.

5. Core Dimensions

a. **Dyuktai Culture**

The Dyuktai Culture cores are fairly large, accounting for 61% of the total. The largest specimens give indices of 13 cm.

b. **Japan**

(1) *Conical Cores*

Dimensional information is only available for the Yasumiba cores. Most are small with large specimens only accounting for 7%. The largest core has an index of 9 cm.

(2) *Wedge-Shaped Cores*

Core dimensions exhibit differences between the south and the north. At Fukui Cave, the percentage of large cores is relatively high (57%). The largest specimens have indices of 10 cm. However, on Hokkaido and northern Honshu, wedge-shaped cores are extremely large and account for 98% of the total. The largest specimen has an index of 28 cm.

(3) *Boat-Shaped Cores*

Boat-shaped cores are also dominated by very large specimens, accounting for 92% of the total. The largest one has an index of 22 cm.

6. Summary

During the late Pleistocene, Hokkaido was contiguous with Siberia while the remaining islands were very briefly connected to or accessible from the mainland at either end. Wedge-shaped core technology in this region is obviously related to the spread of this technology throughout mainland Northeast Asia (Chard 1974:45,50) and Mochanov (see Powers 1973:71) has suggested that the Dyuktai Culture covers not only most of eastern Siberia but also a large part of Hokkaido.

In Japan, although microblade technologies were parallel in the north and south, many archaeologists agree that the manufacturing techniques of microblades and associated artifacts are quite different. It is thought that Hokkaido might have been connected to mainland Asia more frequently and continuously than Kyushu. Thus, it is argued that mainland traits which may appear as exotic intrusive factors in the Japanese context are really nothing but ingredients of a different local tradition with roots in mainland Asia (Hayashi 1968:150-158; Morlan 1967a:206).

On the basis of the preceding analysis of microblade cores from the Dyuktai Culture in eastern Siberia and Japan, seven key observations can be summarized as follows:

a. Only wedge-shaped cores characterize the Dyuktai Culture. Conical and cylindrical cores with advanced technology appeared more recently in eastern Siberia. In Japan, conical cores appeared earlier than wedge-shaped cores in the south, and probably also earlier in the north. They are rough in appearance in the south and delicate in the north.

b. It seems likely that the early stage of microblade technology in Japan might have been influenced more by microblade traditions in mainland North China than by those of eastern Siberia. The occurrence and the early chronological placement of boat-shaped cores in Hokkaido and northern Honshu supports this hypothesis. To date this core type is best known from Xiachuan and Xueguan in North China, and is poorly represented eastern Siberia.

c. The Dyuktai or Yubetsu technique is the principal core technology of the Dyuktai Culture as well as on Hokkaido and northern Honshu, suggesting a close relationship between these two regions. However, wedge-shaped core technologies in these two regions are not totally coincident. The absence of some core techniques, such as Oshorokko in eastern Siberia, may indicate other influences in these regions.

d. The Fukui or Saikai technique in Kyushu resembles the Togeshita technique of Hokkaido. Some wedge-shaped cores from the Chukchi Peninsula might also have been produced by these techniques. It has been suggested that the exclusive occurrence and resemblance of these two techniques in Japan are probably due to a common origin rather than direct cultural contact (e.g. Hayashi 1968:180).

e. The majority of the Dyuktai Culture cores and Japanese wedge-shaped cores have edge angles less than 90 degrees. This might indicate that an acute platform edge angle was crucial in microblade production for most Northeastern Asian wedge-shaped cores.

f. Raw materials may play an important role in core technology and dimensions. For example, the distinctive technique of platform striation on many wedge-shaped cores in Hokkaido is probably related to the slippery nature of the raw material, obsidian. The very small size of Yadegawa conical cores and the extremely large size of Hokkaido wedge-shaped and boat-shaped cores might be related to the different sources of obsidian, although more detailed information is needed to determine this. Wedge-shaped and boat-shaped cores in northern Japan are the largest specimens so far known both in East Asia and North America.

g. If we leave aside the controversy of the early chronological placement of some Dyuktai Culture sites, such as Ezhantsy, Ust-Mill, and Ikhine, three general periods of microblade development can be established in northeastern Asia. The first period is characterized by the appearance of rough conical cores in Layer 4 of Fukui Cave, Yasumiba, and of boat-shaped and conical cores in Hokkaido and northern Honshu. This period is so far undocumented in eastern Siberia. The second period is characterized by the widespread occurrence of wedge-shaped core technology in northeastern Asia. These cores occurred in most Dyuktai

Culture sites, Layers 3 and 2 in Fukui Cave, and at many preceramic sites in Hokkaido. The third period witnessed the intrusion of an advanced conical and cylindrical core technology in eastern Siberia. This latter period of microblade development was absent in Japan. The first and second periods belong to the late Pleistocene and the third period belongs to the early Holocene.

CHAPTER VII. - CONCLUSIONS

This chapter summarize the techno-typological study of microblade cores from the four major geographical areas: North China, eastern Siberia (mainly the Dyuktai Culture), Japan, and northwestern North America. As mentioned in Chapter I, a techno-typological approach refers to a typological study based on the analysis of technology or manufacturing patterns. This approach has been advanced and employed by Japanese archaeologists in their microblade analyses (Hayashi 1968; Yoshizaki 1961; see Morlan 1967a) and is now commonly used by many Old World and New World archaeologists to analyze their microblade data (Akazawa *et al.* 1980; Ambiru 1979; Chen and Wang 1989; Gai 1984; Gai and Wang 1983; Mobley 1991; Morlan 1967a, 1970, 1976; Tsurumaru 1979). Although this study is mainly a comparison of microblade technologies in North China and North America, an examination of associated technologies in adjacent eastern Siberia and Japan provides valuable information to help clarify our understanding of cultural change and development throughout this region.

This summary concludes that the patterns of raw material, core types, core technologies, edge-angle variations, and core dimensions support a hypothesis of prehistoric cultural continuity, and that migration and diffusion provide appropriate explanations for the widespread distribution of microblades in East Asia and North America.

A. Distribution Patterns of Microblade Cores

1. Raw Materials

Microblades in East Asia and northern North America were predominantly made out of high quality non-crystalline silica such as chert, flint, obsidian, and chalcedony. Some kinds of softer or coarser lithic raw materials such as basalt and argillite were also used in certain assemblages.

Chert and flint are the most common raw materials encountered at Xiachuan, Xueguan, Hailar, most Dyuktai Culture sites, and almost all American Paleo-Arctic Tradition sites. Flint and chert are very rare in China, and are totally absent in many regions. In Chinese Paleolithic sites, quartzite was one of the most popular raw materials utilized in stone tool production. Quartzite is coarser but workable like chert. It is the dominant raw material utilized in the Yangyuan Complex. In Inner Mongolia, Northeast China, a series of Mesozoic-Tertiary volcanic rocks such as chalcedony, argillite, agate, and jasper, were the most popular.

Obsidian is the predominant raw material in Japan and is also commonly encountered in many northwestern North American assemblages, especially in the regions of the Pacific Coast and Columbia Plateau. Hard shale was used in southern Hokkaido and northern Honshu.

Basalt is a young magmatic rock with rough, uneven fracture characteristics. It is a raw material commonly encountered in the Pacific Coast and Columbia Plateau.

Generally, the technologically most suitable raw materials for microblade production include flint, chert, chalcedony, obsidian, jasper, agate, and high quality quartzite. Microblades were also made of some poor quality stones such as shale, basalt, and argillite, but certain techniques were unworkable using these materials and the resultant cores exhibit a rather crude appearance.

2. Core Typology

Core typology is regarded as the decisive factor in tracing cultural contacts or relationships. Typological variation of microblade cores is thought to be stylistically significant.

In North China, conical and boat-shaped cores are the two dominant types at the Xiachuan site. The percentage of wedge-shaped cores is very low. This phenomenon is, to a degree, also common in Japan. Conical and boat-shaped cores are two early core types in the north. Conical cores are so far unknown in more recent microblade assemblages in Japan and northwestern North America. Boat-shaped cores are unknown in more recent assemblages in North China, Japan, eastern Siberia, and northwestern North America.

Wedge-shaped cores became the most frequent core type at Xueguan and in the Yangyuan Complex in North China. Conical cores were very rough in appearance at Xueguan and completely absent in the Yangyuan Complex. The same phenomenon is also seen at Hailar which was tentatively dated to the Mesolithic. The exclusive use of wedge-shaped cores in the Dyuktai Culture, Layers 3 and 2 in Fukui Cave, Senpukuji Cave, the Onbara site of southwestern Japan, many Shirataki sites in Hokkaido, and the American Paleo-Arctic Tradition should not be seen as an accidental coincidence with North China.

During the more recent period in North China, wedge-shaped cores on the one hand, and conical and cylindrical cores on the other, constituted the two most frequent typological groups in microblade assemblages associated with ceramics or polished stone tools. Conical and cylindrical cores exhibited a sophisticated technology and slender appearance. Similar core types appeared in the

Sumnagin Culture in Siberia during the early Holocene and were totally absent in southern Japan and northwestern North America (Figure 31).

No specific typological terms have been given to microblade cores discovered on the Pacific Coast, the Columbia Plateau, and in the assemblages of the Denbigh Flint Complex. The amorphous appearance of these cores might be related to the technological constrains imposed by a shortage of high quality raw materials, perhaps reflecting the lesser mobility of prehistoric peoples in these regions.

3. Core Techniques

Technological investigation is considered to be an important supplement of typological studies. The reconstruction of core techniques is regarded as a crucial step in identifying fundamental similarities between morphologically similar cores. The following discussion focuses on wedge-shaped cores.

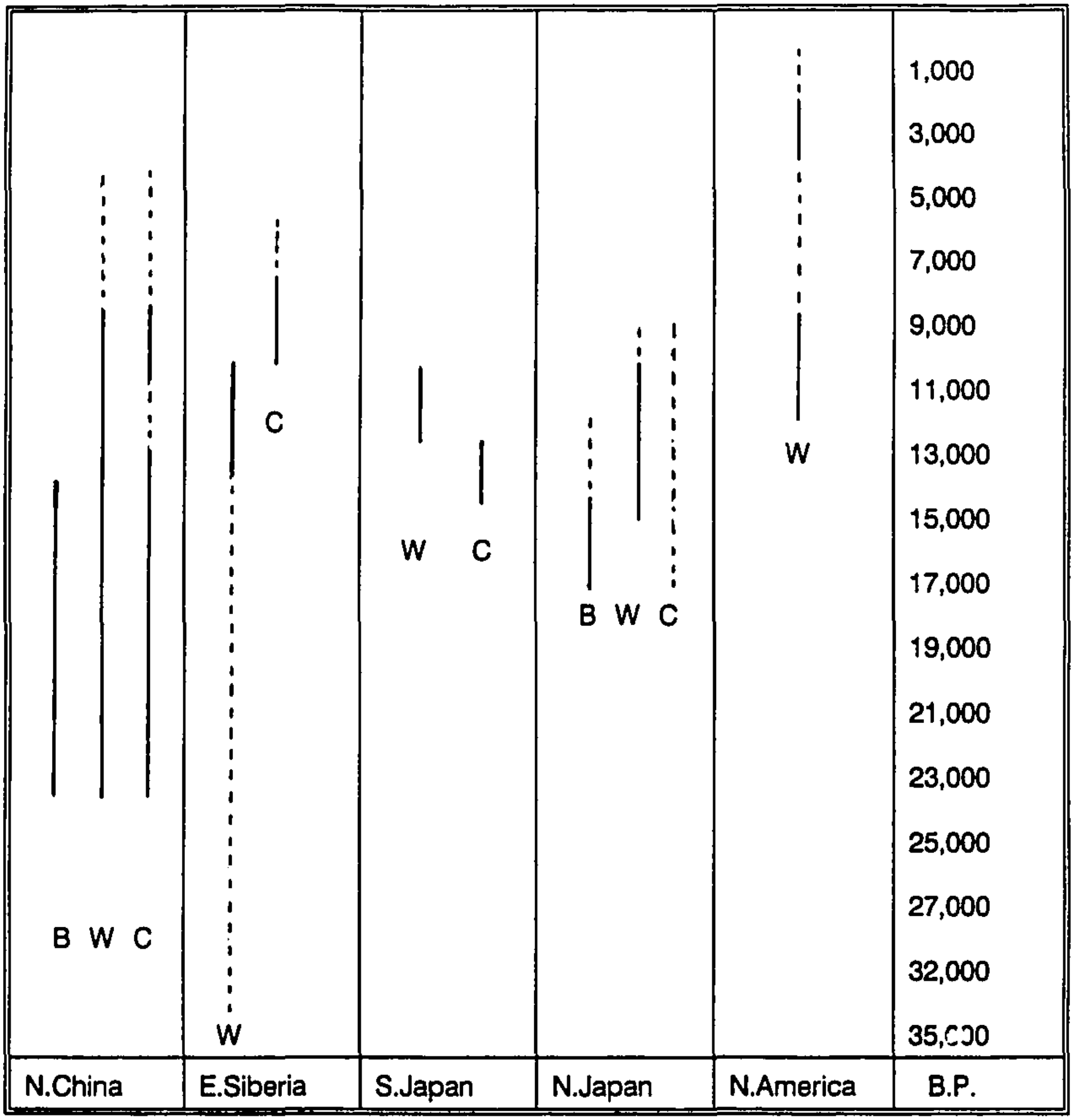
During the late Pleistocene, wedge-shaped cores in North China were made by the Xiachuan, the Sanggan, the Hetao, the Yangyuan, and the Hutouliang techniques. During the Holocene, additional techniques such as the Hailar, the Yingen, and the Zhalainor techniques were developed.

In Japan, the Fukui or Saikai technique has been identified in the southwestern coast, and the Yubetsu, the Oshorokko, the Togeshita, and the Rankoshi techniques has been reported in the north.

In the Dyuktai Culture, wedge-shaped cores were made using the Dyuktai, the Xiachuan, and the Togeshita techniques.

In northwestern North America, the Campus technique, the Denbigh technique, and the Lehman technique have been identified.

Judging from preform and platform preparations of wedge-shaped cores, the Xiachuan, the Hutouliang, the Yangyuan, the Fukui, the Togeshita, and the



B: boat-shaped cores; W: wedge-shaped cores; C: conical cores

.... = Chronology Controversial or Not Firmly Established

Figure 31: Temporal and Spatial Changes of Three Types of Microcores.

Campus techniques are very similar in their manufacturing patterns, especially in preform and platform preparation. The principle difference between these techniques is in platform rejuvenation. The Xiachuan, the Hutouliang, and the Fukui techniques rejuvenated platforms by multiple faceting whereas the Yangyuan, Togeshita, and the Campus techniques usually rejuvenated platforms by removing one or more tablets in addition to multiple faceting retouch.

The technical processes of the Yubetsu, the Dyuktai, and the Hetao techniques are identical. This technique occurred in North China, Japan, and eastern Siberia but is poorly represented in northeastern North America, although a few specimens found in Alaska were thought by Morlan (1976:102) to be remarkably similar to Yubetsu cores.

The processes of the Sanggan and the Oshorokko techniques are similar. This technique is present in North China and Hokkaido, although one specimen from the Ice Mountain site in North America looks very similar to a Sanggan or a Oshorokko core. No evidence is available at present to explain their similarities.

The Hailar, the Yingen, and the Zhalainor techniques are three commonly encountered in the assemblages associated with pottery and ground stone tools in Inner Mongolia, Northeast China, and probably also in Outer Mongolia. The wedge-shaped cores from Shabarakh-usu might have been produced by these techniques. Morlan (1976:101) gives the following description of the wedge-shaped core from Shabarakh-usu:

> Platforms are nearly always shorter than the flute elements and frequently are shorter than the flute chord, that is, the straight-line distance between the lateral edges of the most lateral flutes. Flaking of the faces on many specimens originates entirely from the wedge, which more frequently forms an effective and apparently more often utilized cutting edge than in Hokkaido. The faces were almost always formed before the preparation of the platform..

The Denbigh and the Lehman techniques are quite different from wedge-shaped core techniques in East Asia and the Campus technique in northwestern

North America, and probably represent locally developed variants of microblade technology.

It can be concluded that the Xiachuan, the Hutouliang, the Yangyuan, the Fukui or Saikai, the Togeshita, and the Campus techniques can be included within a single technological complex, representing the most widespread and long-lasting wedge-shaped core technology, which extended from North China to North America during the late Pleistocene.

4. Edge Angle

The discussion of variation in edge angles focuses mainly on wedge-shaped cores from East Asia and northwestern North America.

In North China, the majority of wedge-shaped cores from Upper Paleolithic assemblages yielded edge angles less that 90 degrees. The percentage of edge angles greater than 89 degrees increased remarkably in the assemblages of more recent periods (Fig.18).

Wedge-shaped cores found in the Dyuktai Culture, Fukui Cave in southwestern Japan, Hokkaido in northern Japan, and the American Paleo-Arctic Tradition shared similar attributes with the Upper Paleolithic cores of North China, and contrast sharply to those from Hailar and the assemblages associated with pottery and ground stone tools (Fig.31).

Using acute edge angles to produce microblades was also a significant attribute in the assemblages of the Pacific Coast, the Plateau Microblade Tradition, and the Arctic Small Tool Tradition.

It can be concluded that wedge-shaped cores from the Upper Paleolitnic assemblages in North China, the Dyuktai Culture, Japan, and northwestern North America have very similar edge angle distributions.

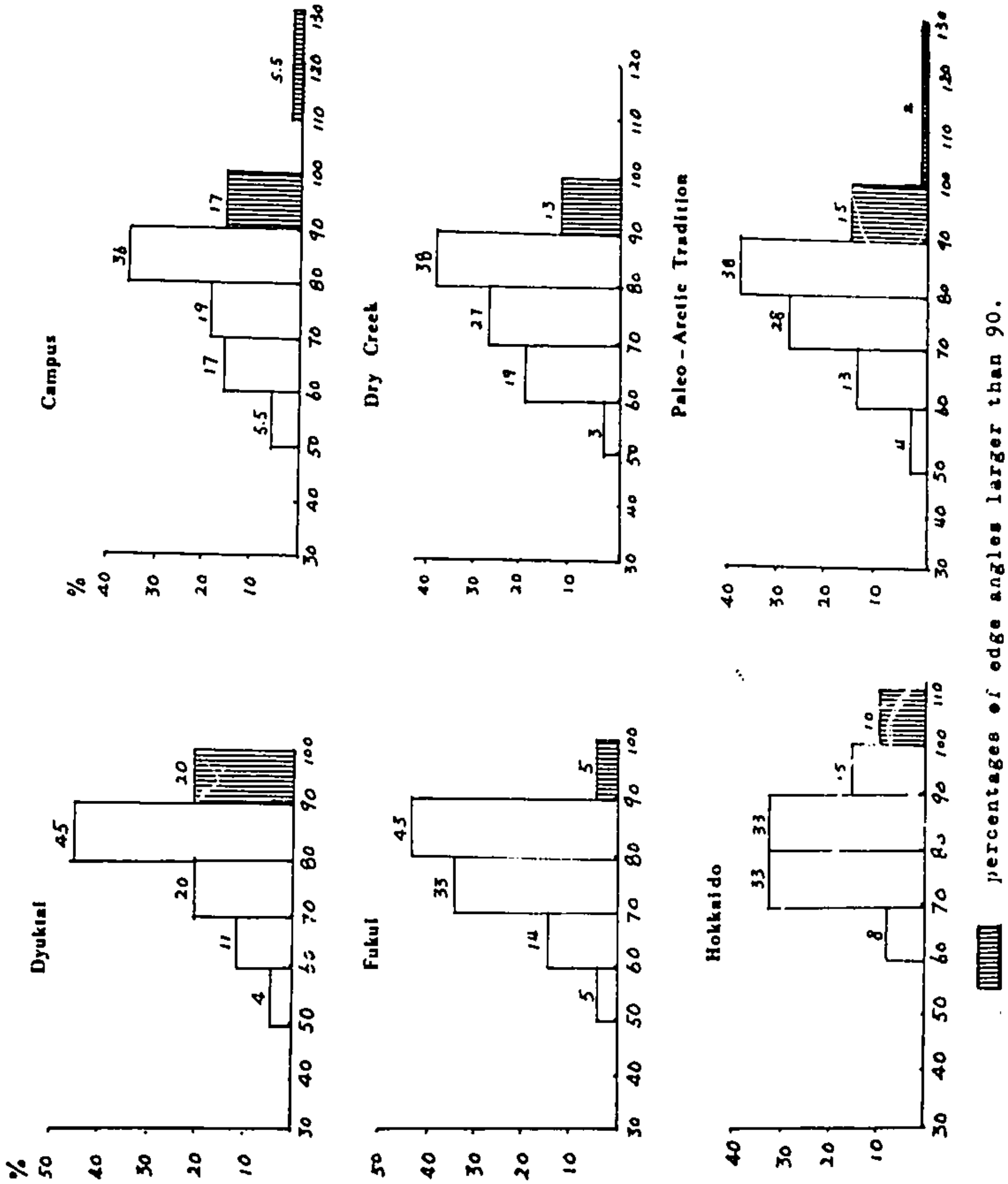


Figure 32: Comparison of Wedge-shaped Core Edge Angles in Eastern Siberia, Japan, and North America

5. Core Dimensions

The size of wedge-shaped cores from two Upper Paleolithic assemblages, Xiachuan and Xueguan, is small. The percentage of large cores increased considerably in the Yangyuan Complex, but most specimens yielding large measurements are preforms. The large cores increased remarkably in the assemblages associated with pottery and ground stone tools, and most large specimens are exhausted ones (Fig.19). Although the wedge-shaped cores in the Yangyuan Complex, the Hailar assemblages and the assemblages associated with pottery and ground stone tools in North China are somewhat larger, they are smaller than those from the Dyuktai Culture, the Fukui Cave, and Hokkaido (Fig.19).

The wedge-shaped cores of the American Paleo-Arctic Tradition are small. Their dimensional variations are similar to those of the Upper Paleolithic assemblages in North China, but they are much smaller than those of the Dyuktai Culture and Hokkaido (Fig.19). Morlan (1976:102) has also noted that the small size of the Campus cores was one of the major differences between them and the Yubetsu cores of Hokkaido.

B. Interpretation of Migration and Diffusion

1. Raw Material, Technology and Mobility

On the basis of the paleoenvironmental evidence, with a few exceptions, most northern parts of East Asia and northwestern North America were cold and arid during the late Pleistocene. The occurrence of microblades in these areas might be seen as a specific technological response to this harsh environment. Microblade-using groups living in these areas may have depended mainly on faunal resources and maintained a highly mobile life style. It is suggested that such a life style would have led to gradual expansion and diffusion of microblade technology and eventually to a long distance migration.

An examination of the selection of raw materials and the curation of lithic technology can help to differentiate mobility patterns of hunter-gatherers since recent research into the technology of hunter-gatherers has indicated that mobility and scheduling are the factors that most influence the organization of technology (Koideoff 1987). High mobility requires a portable technology which allows artisans to produce sufficient tools from a small amount of raw material or to produce standardized tools that are long-lasting and multifunctional (Parry and Kelly 1987:298). At the same time, a standardized core technology such as microblade technology requires fine quality materials.

In contrast, low mobility or sedentism poses other problems. As sedentism increases, on the one hand, artisans may face raw materials depletion within their immediate living areas or face restricted access to necessary resources. Artisans have to resort to using inferior materials or alter the stone to improve its quality (Lurie 1989:47). On the other hand, increasing sedentism reduces the need for more costly, standardized, portable tools and expedient lithic tools became more common. Parry and Kelley mention three trends in lithic technology derived from ethnographic data and related to sedentism. First, cores are not prepared or preformed and flaking is not formally controlled. Second, no differences can be identified between flakes and tools. Third, the tools are seldom modified (1987:287).

As far as microblades are concerned, sparse information about raw material distribution in these broad areas makes the investigation of mobility extremely difficult. Ives (1985:212) has listed three requirements for such research: (1) a knowledge of raw material sources; (2) a knowledge of non-local materials; and (3) a correlation of artifacts with sources. These requirements cannot currently be met. Nevertheless, the microblade assemblages from North China, Japan, the Dyuktai Culture in eastern Siberia, and the American Paleo-Arctic Tradition in North America reveal notable consistency in raw material selection and core technology.

There were no signs of depletion of suitable raw materials or of devolution or degeneration in microblade technology at some possibly sedentary or semi-sedentary sites such as Fuhegoumen in Inner Mongolia, Fukui Cave, Sunpukuji Cave in Japan, and Ushki sites in eastern Siberia. This suggests that the people who produced these assemblages might have maintained a certain degree of mobility or distant exchange to procure suitable materials.

The raw material of the Columbia Plateau and the Northwest Coast shows quite a different picture. The local materials, such as basalt and argillite, were widely used in microblade manufacture. In Namu, exhausted obsidian microblade cores were saved to produce microflakes by the bipolar technique (Carlson 1988, personal communication). In the Chuck Lake site on the Heceta Island, a wide range of raw materials including argillite, obsidian, marble, chert, and vein quartz was used in microblade production. Heat treatment was applied to all of these materials (Ackerman *et al.* 1985). In the Columbia Plateau and the Northwest Coast, knappers produced crude and formless cores. Raw materials predetermined core preform. Little attention was given to platform preparation.

It seems reasonable to suggest that the relative consistency of raw material selection and wedge-shaped core technology in East Asia and North America was the result of high mobility and cultural contact. The change of raw materials and the shift to an expedient technology in the Columbia Plateau and the Northwest Coast may have been a response to decreased mobility when microblade using groups became established in these areas.

2. Style and Ethnicity

Style is used in archaeology as an analytical tool to write prehistory and to tell us about such things as society or ethnicity (Conkey and Hastorf 1990:3). In this study, morphology and technique are two steps or levels used in the typological classification of microblade cores. Core attributes, including shape and manufacturing techniques such as preform and platform preparation and rejuvenation, are thought to be stylistically significant because they reveal the choices dictated by technological traditions. In contrast, no differences can be identified among microblades which were produced from various core types or from different techniques. Thus, core shapes (types) and techniques can be seen as selectively neutral. Sackett notes that such "...choices tend to be quite specific and consistently expressed within a given group at a given time....Hence each social group or unit of ethnicity tends to process its own distinctive style, and the overall degree of stylistic similarity represented by two groups' material culture taken as whole can be regarded as a direct expression of their ethnic relatedness" (1990:33). Hill (1985:364) points out that since aspects of style are taught or communicated by person to person and people to people, style will remain stable as long as the interaction process is not interrupted. Therefore, the extent of stylistic similarity or difference is a reasonable criterion to measure cultural affinity or distance.

In terms of cultural considerations, lithic technology is part of the body of knowledge a society used to extract and collect materials, to fabricate tools, and process resources. A technology such as blade manufacture is thought to be highly patterned behaviour which was passed on from one generation to the next (Hofman 1987:91; Wiant and Hassen 1985:101). Analyzing blade manufacture in Mesoamerican civilizations, J. Clark has stated that blade manufacture is a consequence of group-level consumption. Individual consumers would not need blade technology under normal conditions since it involves too much work for too little benefit. Thus, blade manufacture required planning, skill, and consistency and should be regarded as an organized craft specialization within a socially complex group (1987:269-271).

At least six different core types and about a dozen wedge-shaped core techniques (many techniques defined by different researchers referring to the same manufacturing process) have been identified. These core types and techniques can be seen as parallel elaborations, derived from a basic technology, because new stylistic elements can be invented in the course of cultural development. Such innovations will be an extension of the previously existing pattern, on the one hand, and provide more information to measure social interactions within the cultural system on the other. As one lithic assemblage usually contains more than one stylistic element, the complexity and quantity of stylistic elements may be used as additional evidence to measure relationships. Sackett (1982:74) has mentioned that assemblages that are close in time and space tend to share more stylistic similarities. Such similarities may progressively attenuate temporally and spatially from each other.

In North China, six core types but one wedge-shaped core technique reveal typological diversity combined with technological simplicity in the Xiachuan assemblage. The Xueguan assemblage, the Yangyuan Complex, and the Hailar assemblage indicate a trend of core typology simplification and elaboration of wedge-shaped core technology; wedge-shaped cores became dominant in microblade manufacture and more diversified in technical process. During more recent periods, wedge-shaped and conical cores dominate the typology in most assemblages, but wedge-shaped core techniques differed in many respects from those of the Upper Paleolithic.

In eastern Siberia, the exclusive use of wedge-shaped cores and different core techniques by people of the Dyuktai Culture reflects a similar trend to that encountered in the Xueguan assemblage and the Yangyuan Complex in North China. Three techniques were used in microblade manufacture. During the early Holocene, wedge-shaped technology was replaced by the conical core technology of the Sumnagin Culture.

The Yadegawa and Yasumiba industry, characterized by a conical and semiconical cores, was replaced by a wedge-shaped technology in southwestern Japan. This trend of techno-typological transition resembles the change encountered in the Xiachuan and Xueguan assemblages, and the Yangyuan Complex in North China but exhibits less technical diversification. In Hokkaido and northern Honshu, wedge-shaped and boat-shaped cores are two common core types. Wedge-shaped cores show diverse techniques. Most of them have their counterparts in North China. Conical cores are more delicate than the Yadegawa and Yasumiba cores but their age is still unknown.

Only one core type and one technique were identified in the American Paleo-Arctic Tradition.

Techno-typological analysis and comparison of microblade technology reveal a progressive attenuation of stylistic elements from East Asia to northwestern North America during the Late Pleistocene. If we consider each core type and each wedge-shaped core technique to represent one stylistic element, the Xiachuan, the Xueguan, and the Yangyuan Complex in North China exhibit 11 stylistic elements (six core types and five wedge-shaped core techniques: Xiachuan, Hetao, Hutouliang, Yangyuan, and Sanggan), the Dyuktai Culture exhibits four elements (one core type and three technique: Xiachuan, Dyuktai or Yubetsu, and Yangyuan or Campus); southwestern Japan exhibits three elements (two core types and one wedge-shaped core technique); Hokkaido exhibits at least seven elements (three core types and four wedge-shaped core techniques: Yubetsu, Oshorokko, Togeshita, and Rankoshi) and the American Paleo-Arctic

Tradition has two elements (one core type and one wedge-shaped core technique).

The relative stability of stylistic attributes of wedge-shaped cores in East Asia and North America indicates a close interaction process. The techniques of Xiachuan, Hutouliang, Yangyuan, Fukui, Togeshita, and Campus share very similar manufacturing processes in preform and platform preparation with the exception of removing tablets from the platform shared by the Yangyuan, the Togeshita, and the Campus techniques. The Hetao or Yubetsu cores and the Sanggan or the Oshorokko cores might characterize these innovations or the extension of previously existing patterns.

In contrast, technical and formal variability of microblade cores, in the assemblages associated with pottery and ground stone tools in Inner Mongolia and in the assemblages in the Columbia Plateau and the Northwest Coast, reveal a stylistic change which might be caused by an interruption of cultural interaction or technological attenuation in an area far from the parent tradition.

3. Metric Attributes

Although it is difficult to attribute core dimension and edge angle variation to either functional or stylistic causes, to a certain extent they may provide historically meaningful information which is helpful in verifying stylistic comparisons.

There are two factors which affect the dimensional comparison of wedge-shaped cores. One is the raw material; the size of a core is restricted by the size of nodules or chunks available in different regions. The other is the dynamic process of core reduction. Core size decreases through successive microblade removals and the reasons for discard were usually varied and not always discernable. Nevertheless, in this case dimensional variations do appear to be a sensitive indicator of cultural similarities. Cook (1968:121-122) demonstrated that microblade dimensions are more useful than other attributes for comparative purposes when he found highly consistent microblades widths in the northern microblade complex. McGhee (1970:91) also noted that overall microblade size, from large microblades in Newfoundland Dorset to the smallest at the late Dorset site of Niaqunqut, might be the result of changes in the cultural behaviour involved in microblade production. It follows, therefore, that cultural similarity and change indicated by microblade dimensions should also be recognizable from core dimensions.

Dimensional variations of wedge-shaped cores are quite similar between North Chinese Upper Paleolithic assemblages and the American Paleo-Arctic Tradition (Fig.19). The frequencies of large cores is fairly high in the Dyuktai Culture, and Fukui Cave (Fig.19). Core size is extremely large in Hokkaido and northern Honshu (Fig.19). These comparison may imply the following.

1. Techno-typological similarities of wedge-shaped cores between Upper Paleolithic assemblages in North China and the American Paleo-Arctic Tradition are further indicated by their dimensional consistency.
2. Although the high frequency of large cores in the Dyuktai Culture, Fukui Cave, and Hokkaido might have been the result of either material or functional factors, this phenomenon indicates to a certain extent that the Campus cores in North America are not an exact copy of those in the Dyuktai Culture. Great differences in core dimensions indicate that the relationship of wedge-shaped cores between North America and Hokkaido is not so intimate as some researchers have thought.
3. Obvious differences in core dimensions between Fukui Cave and Hokkaido support the hypothesis that wedge-shaped technologies in northern and southern Japan had different origins.

Edge angle variation is determined by technical limits and is directly related to microblade manufacture. Diverse platform techniques and different rejuvenation patterns are closely related to the attempt to control edge angle. Despite the fact that the edge angle of a discarded core may no longer be effective, the range of variation found in assemblages should be technologically and culturally significant. McGhee (1970:91) mentioned a consistency of edge angle variations of microblade cores within and between his ten Dorset assemblages. He stressed that the stability of the edge angle is a useful characteristic in cultural comparison.

A sharp contrast in the edge angles of wedge-shaped cores has been identified between the assemblages of the upper Paleolithic and those of more recent periods in North China (Fig.18). The variations in the Dyuktai Culture, Fukui Cave, Hokkaido, and the American Paleo-Arctic Tradition are fairly consistent with each other and share close similarities with those of upper Paleolithic assemblages in North China (Fig.31).

4. Summary and Conclusion

Both the consistent selection of raw materials and the elaboration of microblade core technology reveal that a highly mobile subsistence strategy characterized microblade-using groups during the late Pleistocene. The stylistic similarity and widespread distribution of wedge-shaped cores from North China, eastern Siberia, Japan, and northwestern North America imply a close cultural relationship. Trigger (1978:105) notes that among less sedentary hunting groups, such as the Eskimo, basic tool assemblages range over vast distances cross-cutting obvious cultural boundaries due to unstable band composition and frequent contact. The distribution and similarity of microblade toolkits might provide a good example of such mobility. On the other hand, stylistic elements of microblade cores and core techniques exhibit a progressive attenuation from North China to the peripheral areas including eastern Siberia, Japan, and northwestern North America. In addition, the metric comparison of core dimensions and edge angle variation also support this techno-typological comparison. The analytical results suggest that migration and diffusion provide the best explanation for the prehistoric cultural relationship between East Asia and North America, and that North China was the likely place of origin of this microblade technology.

This thesis, although traditional in orientation, contributes to the understanding of the widespread distribution of microblade remains. In the last thirty years, the traditional approach has been stigmatized as being descriptive and lacking theoretical content. Nevertheless, understanding and reconstructing cultural history in terms of the process of invention, migration, and diffusion remains one of the goals of archaeological research (Binford 1968; Trigger 1978). Artifact typologies and traditionally oriented approaches are still essential for developing detailed chronologies and answering cultural-historical questions. The accumulation of a large amount of microblade data and the elaboration of microblade research in last sixty years now permits a general reconstruction of their relationship that can serve as a test for earlier migration theories. The data assembled and analyzed in this thesis represent the first stage of our efforts towards understanding the process of prehistoric human movements between the Old and New Worlds.

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