12 CONCLUSION: IN SEARCH OF THE ORIGINS OF MICROBLADES AND MICROBLADE TECHNOLOGY

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INTRODUCTION

Apart from the *Foreword* (by Carlson) and the *Introduction* (by Kuzmin, Keates and Shen), the body of this volume is made up of ten papers, representing different approaches and perspectives on the emergence and dispersal of microblade technology in Northern Asia and North America. The ten chapters cover a vast area, with two each focusing, though not exclusively, on five regions, four in Northern Asia and one in North America: namely, chapters 2 and 3 on China, chapters 4 and 5 on the Japanese Archipelago, chapters 6 and 7 on the Korean Peninsula, chapters 8 and 9 on Siberia, and chapters 10 and 11 on northwestern North America. The time range covered is also great, ranging from the Late Pleistocene before the Last Glacial Maximum (LGM) (chapters 8 and 9 for Siberia) to the Early and Middle Holocene in North America (chapters 10 and 11). The subject matter discussed is highly varied, not only because of the immense range of time-space distribution of the materials and the research interests of the authors, but also because of the differences in the history of research and the academic traditions of the countries where the materials were investigated.

The problem orientations of the two papers on each of the five regions are complimentary in some cases, and overlapping in others. In the case of China, Siberia, and the New World, three of the chapters present an overview of the archaeological assemblages (Chun Chen on China, Keates on Siberia, and Ackerman on North America), while the other chapters pursue a particular line of inquiry, such as a re-evaluation of a cultural complex as constructed for a certain part of the region (Chen Shen on the Shandong Peninsula of China), examination of the chronometric dates and the palaeoenvironmental backgrounds for the microblade assemblages (Kuzmin on Siberia and surrounding regions), or demonstration of the dispersal patterns by means of modern data processing methods (Magne and Fedje on northwestern North America). On the other hand, we have two overview papers each for Korea and Japan, set in similar, but not identical, techno-typological frameworks, leading to somewhat different interpretations about the emergence and dispersal of microblade technology in the peninsular regions of Northeast Asia.

Unevenness of data across the regions, arising in part from the difference in research history and approaches, makes inter-regional comparison a challenging task. The unevenness is quite striking, for example, in the numbers we are dealing with. The extremes are offered by Japan, on the one hand, and northern North America, on the other. Sato and Tsutsumi report that, as of 2003, 83,137 microblades have been recovered from as many as 1792 sites in the Japanese Archipelago. For the total area of 378,000 km^2, the density of microblade sites would be at the rate of one site per 211 km^2 of the land surface. For northwestern North America, Magne and Fedje were able to collect information on 59 archaeological sites where microblades have been recovered in Alaska, Washington, and Oregon states (with the total area of 1,959,000 km^2) and 196 sites from the Canadian provinces of Alberta and British

Columbia, and the Yukon and Nunavut territories, and Northwest Territories (with the combined area of 5,526,000 km^2). The North American total of 225 sites in 7,485,000 km^2 works out at one microblade site in an area of 33,267 km^2. On the other hand, 329 individual ^{14}C dates have been obtained from 117 of the 255 North American sites, representing 45.9% in contrast to less than 1% of the 1792 Japanese sites that have been chronometrically dated. The very detailed chronology of microblade assemblages for various areas of Japan is based on stratigraphic positions of the cultural layers, in relation to each other and to ^{14}C-dated tephra horizons, as well as on techno-typological reasoning. I will return to the techno-typological analyses later in this paper.

BIRTHPLACE OF MICROBLADE TECHNOLOGY

We might now turn to the major theme of the Montreal 2004 Symposium, and this book that followed it, by sorting the data in search for the place where microblade technology may have originated. In the first place, two of the five regions under consideration are NOT claimed to be such a place by both sets of the authors. For North America, where the earliest acceptable radiocarbon date for an assemblage containing microblades is c. 11,600 BP (Magne and Fedje, this volume) or c. 12,360 BP according to Bever (2006) for the Denali complex horizon at Swan Point in central Alaska, both Ackerman (this volume) and Magne and Fedje (this volume) find that this represents one of the oldest evidence left by the migrants from Northeast Asia. Association of this complex with the Na-Dene speakers has been suggested by several authors in the past, and is supported in this volume by Magne and Fedje. This is followed by the appearance in the coastal area of southern Alaska and British Columbia of what is called the Northwest Coast variant at about 9500 BP, and by the Late Tundra tradition that echoes the Sumnagin complex of Siberia. The dates of the first occurrences of these complexes/variants/traditions clearly suggest that they represent the last episodes of microblade dispersal out of Northern Asia.

For Japan, the word "emergence" is sometimes used by the authors, but it actually means, both to Sato and Tsutsumi (this volume) and to Sano (this volume), the appearance by migration or diffusion of microblade technology from the continent. It is thought to have reached the northern end of the archipelago, by way of the Sakhalin-Hokkaido route in the north, and to Kyushu in the south by way of the Korean Peninsula. Disregarding an outlier date in excess of c. 30,000 BP, the earliest accepted ^{14}C date for microblades in Japan is 20,790 ± 160 BP for layer 4 of the Kashiwadai 1 site in southwestern Hokkaido (Hokkaido Maizobunkazai Centre 1999; for a brief discussion in English, see Ikawa-Smith 2004:304). The appearance of microblade technology in Kyushu, by way of Korea, is thought to be somewhat later than in Hokkaido. The earliest ^{14}C date of about 15,000 BP is for the microblades detached from sub-conical cores at the Chaen site in Nagasaki Prefecture, not far from the famous Fukui Cave, where the wedge-shaped microcores, associated with linear relief pottery, have been dated to about 12,700 BP.

Although the total number of archaeological sites where microblades were recovered is much smaller in the Korean Peninsula than in Japan, in the neighbourhood of some 30, a greater proportion of those have been chronometrically dated. The ^{14}C dates indicate that microblade industries were well-established in Korea before the LGM. The earliest ^{14}C dates are 24,400 ± 600 BP and 24,200 ± 600 BP for the Jangheung-ri assemblage. The dates compare favourably with the two earliest ^{14}C dates from China, namely, 25,650 ± 590 BP for Chaisi and the oldest of the Xiachuan layer 2 dates of 23,900 ± 1000 BP. In view of this, and in view of the fact that a large part of the present Yellow Sea was dry during the cold phases of the Pleistocene, Seong (this volume) feels that the appearance of microblade technology in Korea should not be seen simply as the result of southward diffusion from the continent. Rather, he seems to favour the view that the Korean Peninsula was a part of continental Asia, where the ecological and evolutionary processes leading to the emergence of microblade technology took place. Norton and co-authors (this volume), on the other hand, who find it difficult "to develop a rationale for the indigenous development of microlithic technology in Korea" state that "Korean microliths are considered as one branch of the general East Asian tradition developing sometime after" their initial appearance in northern China between c. 50,000 and c. 28,000 years ago. It is interesting to note that neither Chen Shen (this volume) nor Chun Chen (this volume) presents a strong argument for the indigenous origin of microblade industries in China. Chun Chen simply states that the similarities of microblade remains in East Asia and North America, particularly the wedge-shaped cores, lead him to believe that they share a common, single origin, whose exact location at the moment remains unknown.

This leaves us with Siberia and the area immediately surrounding it. The task of reviewing the evidence here is made easy by Keates' (this volume) discussion of relevant archaeological assemblages and Kuzmin's (this volume) systematic examination of the ^{14}C dates and the environmental contexts, accompanied by a table of 66 ^{14}C values from 18 sites (Table 8.1), and the useful maps showing the distribution of the dated sites in four temporal segments (Figures 8.2–8.5). While his chart starts with Ust-Karakol 1, layers 10 and 9 C, dated to about 35,000–30,000 BP, he and Keates cite Russian sources (Derevianko *et al.* 2000b), which suggest that the microblade technology emerged in the Gorny Altai (Altai Mountains) area during the process of the Middle to Upper Palaeolithic transition. The examples include layer 12 of Anui 3 (with a radiothermoluminescence (RTL) date of 54,000 ± 13,000 years ago), the occupation levels 6 and 5 (^{14}C dates of 43,200 ± 1500 BP and 43,000 ± 1600 BP, respectively) of Kara-Bom, and layers 11, 9 and 7 of Denisova Cave (with the earliest date of c. 37,000 BP), where the assemblages that consist of "Levallois-Mousterian" as well as early Upper Palaeolithic artifacts, also contain microblades and small cores that are variously described as "wedge-shaped", "proto-wedge-shaped", "monofrontal", "flat-faced", or "butt-ended".

This reminds us of the "transitional industries" in the Levant, about which Meignen and Bar-Yosef (2002:17) remarked: "The lithic assemblages from the early Upper Paleolithic are characterized by the production of blades and bladelets." Indeed, Derevianko and Rybin (2003:47–48) observed that the Middle to Upper Palaeolithic transition occurred approximately at the same time in the Altai and in western Eurasia, and that the striking parallelism may be due in part to the "interaction between migrating human communities", as well as to ecological and demographic conditions some 50,000–40,000 years ago. It appears that the archaeological materials recovered at the Obi-Rakhmat Cave in Uzbekistan, located between the Altai Mountains and the Levant, indicate that the Middle to Upper Palaeolithic transition took place in this region of Central Asia almost contemporaneously as in the Gorny Altai and the Levant, and that the assemblages also include a small number of microblades and "flat-faced" cores (Krivoshapkin *et al.* 2006). In this connection, it is interesting to note the presence at Denisova Cave of a single geometric microlith, as well as the fact that these very early microblades from the Gorny Altai sites, such as Denisova Cave and Anui 2 and 3, are often retouched. The backed bladelets, sometimes made into geometric forms, are characteristic of the microlithic industries of western Eurasia and Africa. These, probably, are among the indications of such interactions between human communities referred to above. The Gorny Altai area, then, is more likely to be part of the general area in Eurasia where blade-based technologies developed, rather than the direct ancestral homeland of the microblade industries of Northeast Asia and northern North America.

In any event, few archaeologists would object to describing these small cores of the Gorny Altai as "proto-wedge-shaped". Few would disagree, either, with a statement that what we have here in the Altai Mountains area, dating back to at least c. 35,000 BP, is probably a "precursor" of the microblade industry, which later spread widely through Northeast Asia and eventually reached the New World. This area of Siberia, after all, is where we find the earliest occurrence of blade technology in northeastern Eurasia, and various procedures for microblade core preparation and microblade detachment are variations of the classic blade technique. The question is how

Table 12.1. Numerical significance of microblades in early assemblages with comparative figures from Japan.

Site	Stratum/ Horizon/ Layer	^{14}C Date, BP	Total lithic specimens reported	Microblades (backed or retouched)	Percentage of microblades in total lithics	"Wedge-shaped" microblade cores reported	Source
Gorny Altai							
Denisova Cave	Str. 11	>37,235	2,611	15 (some)	0.5%	>1	Keates (this volume); Kuzmin (this volume)
	Str. 9	N/A	466	77 (most)	16.5%	—	
Ust-Karakol 1	Str. 11	N/A	365	17	4.7%	2 (?)	
	Str. 10	35,100±2850	679	16 (some)	2.4%	—	
	Str. 9	From 33,400±1285 to 29,720±360	1,099	29	2.6%	3	
Anui 2	Hor. 12	27,930±1590 26,810±360	761	4 (yes)	0.5%	—	
	Hor. 11	N/A	3,501	2 (yes)	0.06%	1	
	Hor. 10	N/A	6,509	>1 (yes)	—	—	
	Hor. 9	27,125±580	2,666	1 (yes)	0.04%	—	
Upper Yenisei River Basin							
Novoselovo 13	Layer 3	22,000±700	26,488	67	0.3%	1 (?)	Keates (this volume); Kimura (1997:228–229); Kuzmin (this volume); Vasil'ev *et al.* (2002)
Kashtanka 1	Layer 2	21,800±200 20,800±600	5,400	86	1.6%	—	
Ui 1	Layer 2, Hor. 3	22,830±530 19,280±200 17,520±130 16,767±120	4,416	321	7.3%	2 (preforms)	
	Layer 2 Hor. 2		851	60	7.1%	1	
Kokorevo I	Layers 2 & 3	From 15,900±250 to 12,940±270	65,072	809	1.2%	69	
Angara River Basin							
Mal'ta	Layer 8	From 21,700±160 to 19,900±100	14,513	6 (yes)	0.4%	Yes	Keates (this volume); Kuzmin (this volume)
Krasny Yar	Layer 6	19,100±100	>2,000	?	?	17	
	Layer 7	N/A	369	8	2.2%	—	
Lena River Basin							
Ikhine 2	Str. 2b	From 30,200±300 to 24,330±200	6	0	—	1 (?)	Keates (this volume); Kuzmin (this volume); Kimura (1997:244–245); Mochanov and Fedoseeva (1996)
	Str. 2a	N/A	11	2	18.2%	1 (?)	
Verkhne-Troitskaya	Layer 6 (Str. 3)	18,300±180	52	5	9.6%	2	
Russian Far East							
Ust-Ul'ma	Layer 3	N/A	209	?	?	2	Keates (this volume); Kuzmin (this volume)
	Layer 2b	19,350±65	9,249	?	?	2	
Ogonki 5	Hor. 3	From 19,320±145 to 17,860±120	11,450	339	3.0%	66	
Transbaikal							
Kamenka, complex B	Layer 6	From 28,815±150 to 24,625±190	70	13	18.8%	2 ("proto wedge-shaped" cores)	Keates (this volume); Kuzmin (this volume)
Mongolia							
Chikhen Agui	Stratum 3	27,432±872	1385	24	1.7%	1 (?)	Keates (this volume); Kuzmin (this volume)

Table 12.1 (continued)

Site	Stratum/ Horizon/ Layer	^{14}C Date, BP	Total lithic specimens reported	Microblades (backed or retouched)	Percentage of microblades in total lithics	"Wedge-shaped" microblade cores reported	Source
North China							
Shiyu	Layer 2	28,130±1370	>15,000	0	0	1 (?)	Chen (this volume); Chen and Wang (1989); Keates (this volume); Lu (1998); Tang (2000)
Chaisi		25,650±590	?	?	?	?	
Xiachuan	Layer 2	From 23,900±1000 to 16,400±900	1348	85	13%	15	
Japan							
Kashiwadai 1	Layer 4	From 20,70±160 to 19,840±70	3365	625	18.6%	5	Hokkaido Maizobunkazai Center (1999); Ono *et al.* (2002); Sano (this volume); Tsutsumi (2003a)
Pirika	Layer 1	20,100±335 20,900±260	109,498	1107	1.0%	30	
Araya		14,250±105 13690±80	7228	1183	16.4%	56	
Chaen	Layer 5	15,470±190	1907	422	22.1%	28	
	Layer 4	N/A	2531	738	29.2%	14	

"proto" this proto-type was. This may well have been where microblades of Northeast Asia and North America were born. Where, and when did the proto-type become a full-grown microblade industry?

MICROBLADES AND MICROBLADE INDUSTRIES

The microblades of Northeast Asia and northern North America are thought to have been used in a composite tool, set into a groove along the side of a point made of organic materials such as bone, antler, and ivory. Examples of such points are known from several sites, such as Lime Hills Cave 1 and Trail Creek Cave 2 in Alaska (Ackerman, this volume) and Afontova Gora 2, Kokorevo 1, and Oshurkovo in Siberia (Chard 1974; Kimura 1997). It has been argued that the combination of the sharp edge provided by the stone and the resilience of the organic material in low temperature produced a strong and lethal weapon, advantageous for human groups coping in the cold climate (Elston and Brantingham 2002). The organic element of this useful weapon, however, has not been recovered from China, Korea, or Japan. In the absence of clear evidence in the form of grooved points made of organic materials, the archaeological indications of the use of microblades in a composite tool may include: (1) the presence of microblades that are standardized in form and dimensions, (2) their presence in an assemblage in a substantial number, and (3) the absence of steep retouch that would interfere with insertion into the groove. After some frustrating attempts to discover where and when such archaeological indications occurred, by jiggling various figures in my head, I decided to arrange some key numbers in a table form (Table 12.1). To the assemblages out of Kuzmin's ^{14}C date list (this volume) on which Keates' detailed description (this volume) provides us with relevant data, I added, for comparative purposes, a few "obvious" microblade industry sites such as Kokorevo 1, Kashiwadai 1, Pirika, and Araya for which equivalent data are available.

The limited utility of such a table became apparent as soon as I began collecting numbers. The "total number of lithic specimens reported", against which the numerical significance of microblades was to be measured, varies wildly, from over 60,000 for the combined layers 2 and 3 of the Kokorevo 1 site to only six for Ikhine stratum 2b. The variation is due, in part, to the kinds of activities that took place at the sites in prehistoric times, but mostly, it seems, to the operational practice of the archaeological investigation concerned: the length and intensity of the excavation, inclusion of waste flakes and minute chips into the "total" count, the use and mesh size of the screen for recovery of small items, etc. A large discrepancy exists even between two "obvious" microblade industry assemblages in the same area of the same country, as we note that the proportion of microblades for the layer 4 assemblage of Kashiwadai 1 in southwestern Hokkaido is 18.6%, as against 1.0% for layer 1 of the nearby site of Pirika, where as many as 109,496 lithic items were recovered and recorded.

Nevertheless, Table 12.1 does show that during the c. 28,000–27,000 BP period, microblades or bladelets accounted for less than 1% of the lithic specimens recovered from strata 12 through 9 of the Anui 2 site in the Altai Mountains area. On the other hand, they constituted higher proportions of the "transitional" and "Initial Upper Palaeolithic" assemblages of Denisova Cave and Ust-Karakol 1, even though they are older. Most of the small blades of the Gorny Altai, including the ones from Anui 2, are retouched bladelets, which, as I mentioned above, show greater affinity to the microlithic industries of western Eurasia than to those in the area further east in Eurasia. I am also intrigued by Keates' observation (this volume) that microblades disappear from the Altai Mountains region after about 26,000 BP. Is the situation analogous to the "Proto-Aurignacian" of southern Europe, which flourished between 39,000 BP and 33,000 BP, to be abandoned in favour of "classic" Upper Palaeolithic industries (Kuhn and Elson 2002)? Microlithic industries re-appeared in southern Europe later in the Pleistocene, but they do not seem to be the results of *in situ* developments out of the "Proto-Aurignacian" of earlier times. Is there a similar temporal and cultural discontinuity between the pre-26,000 BP Gorny Altai assemblages and the numerous microblade assemblages that appear just before the LGM in the Yenisei, Angara, and Lena River basins as well as in North China, the Korean Peninsula, and the Japanese Archipelago? Even though there are several assemblages that appear to date to the critical interval of c. 26,000–22,000 BP, particularly in Transbaikal, Mongolia, and North China, the data available to us are insufficient even to formulate a speculative hypothesis.

In sum, I am unable to find when, where, and how the "proto" microblade technology of the Altai Mountains became what most of us would agree to call a "real" microblade industry, characterized by a substantial number of standardized microblades, suitable to be used as insets in a point made of organic material. Clearly, a simple tabulation of the numbers available to us is not the way to reach the answers.

COMPARATIVE STUDIES OF PRODUCTION PROCEDURE

We now turn to the techno-typological approach which Chun Chen (this volume) advocates as an "appropriate way to distinguish the attribute of microblade cores and trace .... prehistoric affinities in time and space." Magne and Fedje (this volume) also noted, in their concluding section, that a finer core typology and technological analysis of reduction procedure than those currently in use by New World archaeologists might help increase our understanding of age distribution patterns of microblade industries in the New World.

This indeed has been the approach used by the Japanese researchers, who, for various reasons as discussed elsewhere (Ikawa-Smith 1975; Ono *et al.* 2002), relied less on direct chronometric dating of archaeological assemblages than on relative stratigraphy and typological comparison for chronology building. For the microblades found in the Japanese Archipelago, Sato and Tsutsumi (this volume) distinguish no fewer than 12 different reduction procedures, and Sano (this volume) uses a very similar classificatory framework. The procedures, named after a type site, are divided into two categories: the Yubetsu method group in which the cores are first made into a biface prior to platform preparation and microblade detachment, and the non-Yubetsu methods that do not prepare the core blanks into a biface first. The critical attributes used in distinguishing the seven types in the first group and the five types in the second one are explained by Sato and Tsurumi (this volume), and are illustrated in Tables 4.1 and 4.2 and Figures 4.3 and 4.4. Some of the core types are associated with ^{14}C determinations (e.g., the Rankoshi and Pirika types at Kashiwadai 1, and the Pirika and Fukui types also at their type sites), while some others are found in clear stratigraphic relations to well-dated tephra horizons. Thus, the Togeshita, Rankoshi, and Pirika types are assigned ages earlier than c. 18,000 BP, an average of ^{14}C dates for the Eniwa-a Pumice that fell over a large part of Hokkaido, while the Oshorokko, Shirataki, and Sakkotsu types postdate c. 18,000 BP (Table 12.2). Using these key dates, and stratigraphic relations with each other, Japanese researchers have constructed a detailed chronology of microblade industries.

The Japanese method of reconstructing reduction sequences is based on painstaking refitting of remnant cores, microblades, spalls, and all the other residues collected at the site, which Masakazu Yoshizaki pioneered during the 1950s with the materials from the Shirataki site group. He named the procedure “Yubetsu technique” after the river along which the numerous Palaeolithic sites were located in Shirataki Village, Hokkaido (Yoshizaki 1961). Following the identification a few years later by Morlan (1967) of the Horoka technique, named after one of the Shirataki localities, a number of new microblade reduction procedures and core types have been defined and redefined, and various classificatory systems have been proposed. Although, as Sano reports in this volume, some authors have suggested that the different core types are the results of adapting to the form and quality of lithic materials available, the underlying assumption in reconstructing the reduction procedure is that the flint knapper proceeds according to a mental template and that the remnant cores and spalls recovered from the sites are a collective reflection of this norm, rather than the residue of a dynamic process in which the knapper makes a series of decisions to meet various contingencies, including the nature of the lithic material and his/her errors.

Starting from China, Chun Chen discusses microblade industries of East Asia and northwestern North America in terms of the 6-type system which he developed for the microblade cores from Xiachuan, on which he began working in the early 1980s (Chen 1984, 1992, this volume; Chen and Wang 1989). Although I am aware that he has experimented with microblade replication while he was a graduate student at McGill University, his six types have been constructed largely on the basis of detailed examination of cores recovered from the sites.

The link between the 12-type Japanese system and Chen’s 6-type system is provided by Tang and Gai (1986), both of whom spent some time in Japan. C. Tang in particular is quite familiar

Table 12.2. Comparison of techno-typological classifications.

<table>
<tr><th colspan="2">Japan
(Sato and Tsutsumi, this volume; Sano, this volume)</th><th colspan="2">China
(Chen, this volume; Shen, this volume; Tang and Gai 1986)</th><th>North America
(Ackerman, this volume; Magne and Fedje, this volume)</th><th>Siberia
(Mochanov 1980)</th><th>Korea
(Seong, this volume)</th></tr>
<tr><td rowspan="7">Yubetsu Method</td><td>Togeshita (>18,000 BP)</td><td>Yangyuan</td><td rowspan="7">Wedge-shaped</td><td rowspan="7">Denali</td><td rowspan="7">Dyuktai</td><td rowspan="7">Type 1</td></tr>
<tr><td>Rankoshi (>18,000 BP)</td><td></td></tr>
<tr><td>Pirika (<18,000 BP)</td><td></td></tr>
<tr><td>Oshorokko (<18,000 BP)</td><td>Sanggan</td></tr>
<tr><td>Shirataki (<18,000BP)</td><td>Hetao</td></tr>
<tr><td>Sakkotsu (<18,000 BP)</td><td></td></tr>
<tr><td>Fukui (Saikai technique)</td><td>Xiachuan</td></tr>
<tr><td rowspan="5">Non-Yubetsu Method</td><td>Horoka/Funano</td><td colspan="2">Boat-shaped</td><td>Northwest Coast</td><td></td><td rowspan="5">Type 2
Type 3
Type 4</td></tr>
<tr><td>Hirosato</td><td colspan="2"></td><td></td><td></td></tr>
<tr><td>Momijiyama</td><td colspan="2" rowspan="2">Cylindrical
Conical
Semi-conical
Funnel-shaped</td><td></td><td></td></tr>
<tr><td>Nodake/Yasumiba (Yadegawa method)</td><td>Late Tundra</td><td>Sumnagin</td></tr>
<tr><td>Unewara/Kajiyazono</td><td colspan="2"></td><td></td><td></td></tr>
</table>

with the Japanese approach to the reconstruction of microblade reduction procedure from his graduate work at Japanese universities (Tang 1996). Table 12.2 is my attempt to juxtapose the frameworks for techno-typological comparison used in Japan and China.

Fitting Korea into this comparative chart was rather difficult. Seong (this volume) comments, quite rightly, I think, that the technological typologies currently used by Japanese and Chinese scholars "are often overly specific and do not effectively represent the full range of variation." As to the four core types Seong proposes for Korea, his Type 1 seems to have the attributes of the Yubetsu-Denali-Dyuktai group of wedge-shaped cores, but I could not be any more specific than to place all of his types 2, 3, and 4 in the non-Yubetsu type group.

Adding the classifications used in Siberia and North America to Table 12.2 was relatively simple, due, probably, to my own ignorance. Other than those which occur in Dorset and Pre-Dorset contexts, North American microblade cores are discussed in terms of three categories (Ackerman, this volume; Magne and Fedje, this volume): Denali, which corresponds to the generalized "wedge-shaped" category; the Northwest Coast variant, which often takes a "tongue-shaped" or "boat-shaped" form, like Horoka/Funano of Japan; and the conical-cylindrical variety, referred to as the Late Tundra tradition by Ackerman, who links it to the Sumnagin complex of Siberia. For Siberia, I follow here the Dyuktai-Sumnagin dichotomy proposed by Mochanov (1980) a quarter of a century ago. I read in Japanese sources that various microcore types have been proposed by Russian scholars and that some Japanese scholars identify most of the named Japanese core types in Russian collections (e.g., Kato 2003; Kimura 1997; Sato 2003b), but details are not available to me at this time to incorporate the information into Table 12.2. When such information is placed before a gathering of regional experts who can evaluate it with the knowledge of the microblade technologies in respective regions, we may be in the position to better understand the patterns of the dispersal of microblade industries and the movements and interactions of humans which the patterns may represent. We might even point to the general direction, at least, of the places where the various techniques/methods/types originated.

In the meantime, Table 12.2 is what I could glean from the papers in this collection. I should be very much surprised if I did not commit grave errors of misunderstanding and misrepresentation. If this generates comments and further discussion, it would have served its purpose very well. It is quite obvious from the foregoing that we need to pool our knowledge and merge our research skills, with the view to coordinating our terminology and analytical frameworks, if we are to have effective inter-regional comparisons of microblade technologies.

WHERE DO WE GO FROM HERE?

A comprehensive collection such as this always points up the gaps in our knowledge. As Binford (1991) said at the end of another collection of papers, "There is Always More We Need to Know." In our case, some of the gaps are the products of the past and present geopolitical environments, that are beyond our control. The most obvious one continuing today is the lack of information about the current state of microblade research in North Korea. In other cases, cross-border access to information is becoming easier in recent decades, and collaborative research by international teams has been launched at several locations covered in this book. Nevertheless, perusal of the papers in this collection makes it clear that many of us have limited knowledge of what is going on beyond our respective borders, or, more precisely, beyond the linguistic barriers. It is hoped that the growing trends towards international cooperation and interaction will continue, and that we will have another opportunity for a face-to-face exchange of opinions.

Before such an opportunity arises, we might explore new horizons. One of the ways is to expand our scope and examine those microblade assemblages of northern China and Mongolia that also contain pottery and ground stone tools. These assemblages, assigned to the "Neolithic" age in Chinese archaeology, have often been excluded from comparative studies of microblade industries. Yet, the wedge-shaped microblades of the Fukui Cave, that are associated with linear relief pottery and ^{14}C dates of 12,400 ± 350 BP (GaK–949) and 12,700 ± 500 BP (GaK–950), have always been an integral part of the interregional comparison of microblade technologies. Pottery also occurs in association with microblades at a number of sites in the Russian Far East (e.g., Kononenko and Tabarev 1995), and Norton *et al.* (this volume) mention that 900 Chulmum pottery sherds were found in association with 470 microblades at the Kosanni site on Cheju Island, indirectly dated to c. 10,400–10,200 BP. Seong (this volume), on the other hand, reports that ground stone axes have been recovered from the Sinbuk and Jiphyeon sites in association with numerous microblade cores, and Keates (this volume) tells us that "an incompletely polished adze" was found at the Ogonki 5 site in Sakhalin. Sinbuk, one of the southernmost sites on the Korean Peninsula, is dated to about 25,000–18,500 BP, and Ogonki 5 to about 19,000–18,000 BP. Presence of partially polished or ground stone tools does not signify the "Neolithic" status of an assemblage, as over 300 examples have been recovered from unmistakable Pleistocene contexts at more than 30 Palaeolithic sites in the southern part of the Japanese Archipelago (Ikawa-Smith 2004:294–296). While many of the "microliths" in the "Neolithic" assemblages of northern China are literally small stone tools, not the microblades we are concerned with here (Lu 1998), there surely must be some genuine microblade assemblages that have been assigned to the "Neolithic" period, solely on the basis of association with ground stone artifacts and/or pottery. Stratigraphic contexts of these should be examined, and ^{14}C dates obtained, if possible, and the assemblages should be added to our corpus of data for comparative studies.

Admittedly, these assemblages, like the Fukui and Senpukuji assemblages of Japan, the Kosanni of Korea, and Gromatukha, Osipovka, and Ustinovka of the Russian Far East, would be relatively late, and have no direct relevance to the 'origins' question which is the central issue here. Nevertheless, inclusion of these assemblages into our consideration could help us to go beyond the current emphasis on techno-typologies and chronology building. It would broaden our perspective regarding the questions of **What were microblades used for?** and **Why did they spread so fast and wide?**

From the distribution of microblade sites across Northeast Asia and northern North America, it has generally been assumed that microblades gave some advantages to the humans living in cold climates, where plant resources would be scarce and hunting would be the major subsistence activity. This idea has been enhanced with the persuasive arguments advanced by such authors as Elston and Brantingham (2002) and Goebel (2002). Many of the papers in this volume referred to the environmental deterioration, cooling temperature, uneven distribution of animals, shrinkage of habitable space, and need for high mobility, all of which would have been true much of the time, but one wonders "*Was it always that cold*?" and "*Did they live on hunting alone*?" Kuzmin (this volume), who presents succinct summaries of the environmental conditions for the first appearance of microblades in each of the major areas covered in this volume, also remarks that microblades spread through a vast area with different terrains, climate, vegetation, and animals, but that we lack detailed information about the nature of the environments.

Indeed, we need to know more about the environments in which the microblade users lived, and what they lived on. Extracting fine-grained environmental information would be a challenging task in much of the area under consideration, because of the conditions unfavourable to preservation of organic materials. The locations of the Yubetsu method microblade sites at the confluence of major rivers led Japanese researchers to hypothesize a possible dependence on anadromous fish as a seasonably predictable and abundant resource (Sato and Tsutsumi, this volume). Good evidence for inland fishing apparently exists for some of the microblade assemblages in the Russian Far East, while the distribution of microblade sites in northern China along rivers and lake shores (Lu 1998) may indicate the use of aquatic resources there as well. Lu (1998:104, 107) also mentions the occurrence of microblades in central and northern China with evidence of cereal cultivation, suggesting possible use of microblades in plant harvesting activity. Hard corroborative evidence either of fishing or plant processing is yet to be presented, but neither is there any concrete evidence of mammal hunting, at least from Korea and Japan, because of the poor preservation conditions. Someday we might get extremely fortunate and recover some tell-tale ecofacts. Or, perhaps, sufficient amounts of residues, be they blood, lipids, phytoliths, or starch grains, might be retrieved from the surface of the stone tools, leading to the identification of species to which the tools were exposed. We might then find that microblades were used in far more diversified contexts than we had imagined, and that their versatility and flexibility would have been particularly useful for humans coping in the rapidly changing environments of the final Pleistocene and Early Holocene. With unpredictable resource availability, possession of adaptable tool-kits, which made quick diversification of subsistence activities possible, could have been of decided advantage.