Refitted Material and Consideration of Lithic Reduction Sequence among the Microblade Assemblages: A View from the Okushirataki-1 Site, Hokkaido, Northern Japan

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INTRODUCTION

It is widely acknowledged that microblade technology appeared at the Last Glacial Maximum (LGM; around 20,000 B.P.) and lasted until the terminal Pleistocene (around 12,000 B.P.) in the Japanese Islands. Through general surveys and a large number of excavations in most areas of Japan, microblade assemblages that contain a lot of temporally diagnostic lithic artifacts have been discovered at more than 1700 sites (Sato and Tsutsumi 2007). Such an abundant archaeological record may provide important insights into forager behaviors in the Japanese Islands during the late Upper Palaeolithic.

Many studies of microblade assemblages in Japan have undoubtedly seen the classification of specific core types and sequences of microblade core reduction as one of their major goals. The sequences of microblade core reduction defined by the form of microblade core blank and preparation of microblade core are generally called *gihō*. Such techno-typological approaches were pioneered by M. Yoshizaki (1961), who identified the Yubetsu *gihō* in Hokkaido, northern Japan, along with the basic definition of core reduction sequence. The techno-typological approach is based on the analysis of the morphological attributes reflected in the reduction sequences from core blanks to flaked tools, in contrast to the morpho-typological approach, which is merely based on the morphological attributes of artifacts (Chen 2007; Hayashi 1968).

After the identification of Yubetsu *gihō*, the type and *gihō* concepts have been used for describing and naming a number of different kinds of microblade reduction sequences as archaeological entities (Fig. 1) (e.g., Tsurumaru 1979). Quite soon after its development, application of such concepts for describing technological characteristics had spread from Japan to adjacent regions (e.g., Andrefsky 1987; Chen 2007; Doelman 2008; Lu 1998; Seong 1998; Tang and Gai 1986). Until now, the classification of microblade core types and the *gihō* reconstructions have directed Japanese archaeologists toward a focus on the techno-typological description, and provided a "chrono-

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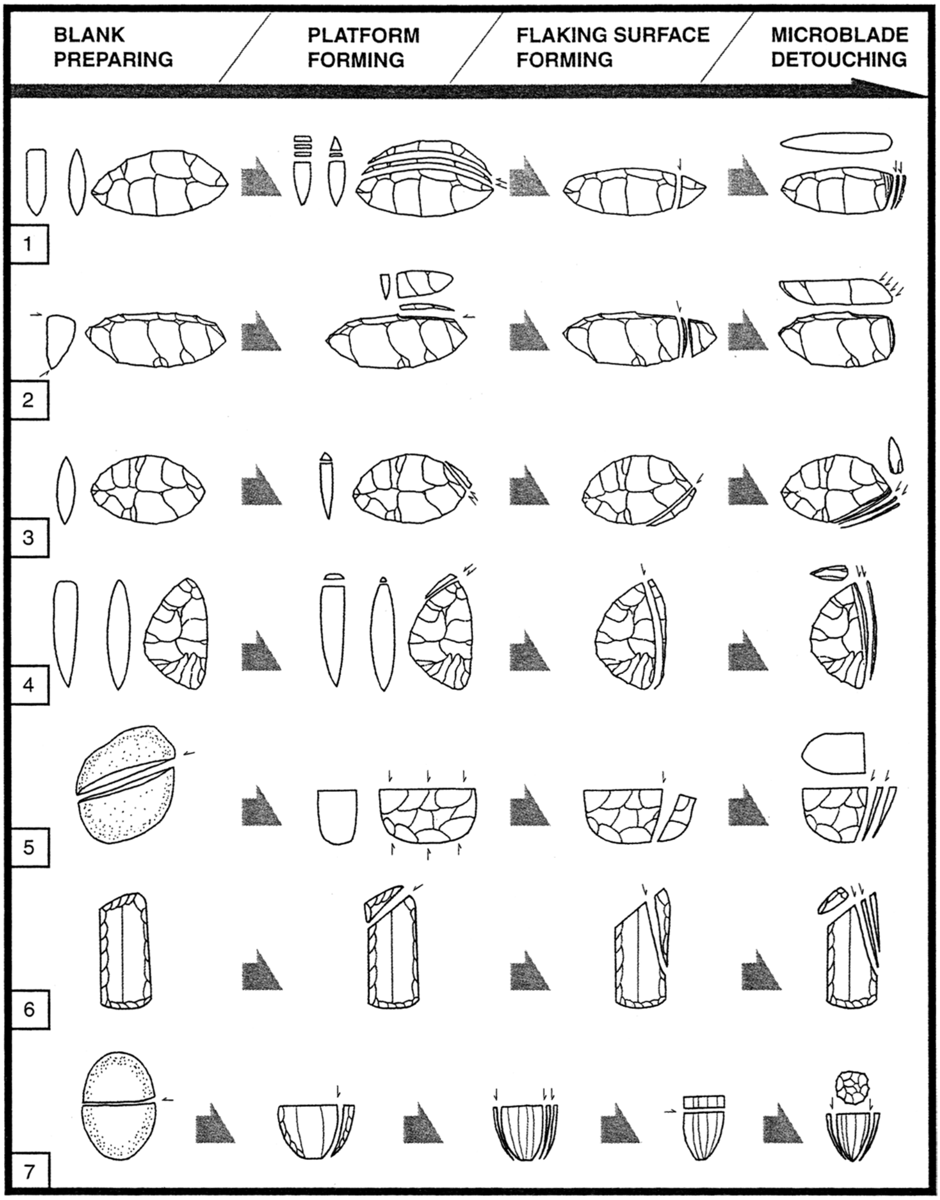

Fig. 1. Reconstructed *gihō* (1–4: modified from Tsurumaru 1979; 5–7: Nakazawa et al. 2005). 1: Yubetsu; 2: Togeshita; 3: Oshorokko; 4: Rankoshi; 5: Horoka; 6: Hirosato; 7: Oketo.

cultural" framework for the studies of microblade assemblages. Accordingly, it has allowed them to address significant issues in cultural-historical research.

However, in recent years, there has been increasing attention to criticisms concerning the ability of traditional morphological typologies and classification of *gihō* to convey meaningful interpretations for specific assemblages and to address issues that are not strictly chronological. These traditional approaches tend to hide variation within assemblages and similarities between techno-typologically "different" assemblages due to their "normative" essence (Bleed 2001, 2002*a*). In fact, as some researchers emphasized, the previous studies actually overlooked the possibility that lithic reduction sequences varied according to lithic raw material availability, abundance, shape, and quality (e.g., Kimura 1992; Nakazawa et al. 2005; Shiba 2007; Takakura 2007*a*, 2007*b*). Therefore, it is important that lithic reduction sequences be examined as a process reflecting the manner in which humans made behavioral choices and decisions within their daily lives, which were in turn often associated with environmental constraints and resource exploitation strategies. This suggests that we need to pay attention to situational variability in forager behaviors that shape choices in technological systems. That is, researchers should regard lithic reduction sequences as a series of human reactions to situations they face in their environments and societies. To be sure, this reorientation toward forager behavior triggered a reconsideration of the objectives and methods in archaeological studies of lithic reduction sequences.

Needless to say, refitting is an important analytical tool in lithic technological studies because the process of reduction itself can be clearly observed. It is apparent that refitting as well as experimental replication has performed an important role in the *chaîne opératoire* approach for Palaeolithic research (e.g., Aubry et al. 2008; Audouze 1999; Bar-Yosef and Van Peer 2009; Karlin et al. 1993; Pelegrin 2003, 2006; Takakura 2007*a*). Perhaps information gained from the lithic refitted materials can not only offer detailed descriptions of lithic life histories, but also increase our understanding of the technological choices and decisions made by foragers, who create situationally variable assemblages characterized by differences in the size and kind of lithic raw materials or core blanks, as a function of changing environmental and cultural factors. Fortunately, refitting efforts have been a persistent methodology at many Palaeolithic sites in Japan. Abundant refitted materials, providing a wealth of information on the reduction sequences of microblade assemblages, have been recovered and reported on in most areas of Japan. These materials include microblade cores fitted with many microblades, spalls for core preparation, blades, and waste flakes. Some of the refitted materials allow us to surmise the morphological features of gravel and lithic debris used as original raw material. Such evidence is extremely valuable for examining the life histories, from raw materials to removal of microblades, and may contribute significantly to our understanding of technological variability of microblade reduction sequences, through the identification of operations by ancient stoneworkers.

It is clear that we need to consider the rich information gained from the refitted materials of the microblade assemblages with regard to how ancient stoneworkers operated and organized their actions along with technological choices and decisions. To emphasize the situationally shifting behavioral choices and the forager decision making in the studies of the refitted materials may lead in productive directions because such an approach can provide important insights into the processes responsible for generating technological diversity.

In order to explore the significance of refitted materials in the studies of lithic reduction sequences, this article analyzes refitted materials obtained from the microblade assemblage at the Okushirataki-1 site, Hokkaido, northern Japan. Through diligent and consistent refitting efforts, the assemblage has yielded significant information concerning the process of knapping of blades, microblades, and the abundant flakes at the site. The main purpose of this article is to reconstruct the lithic reduction

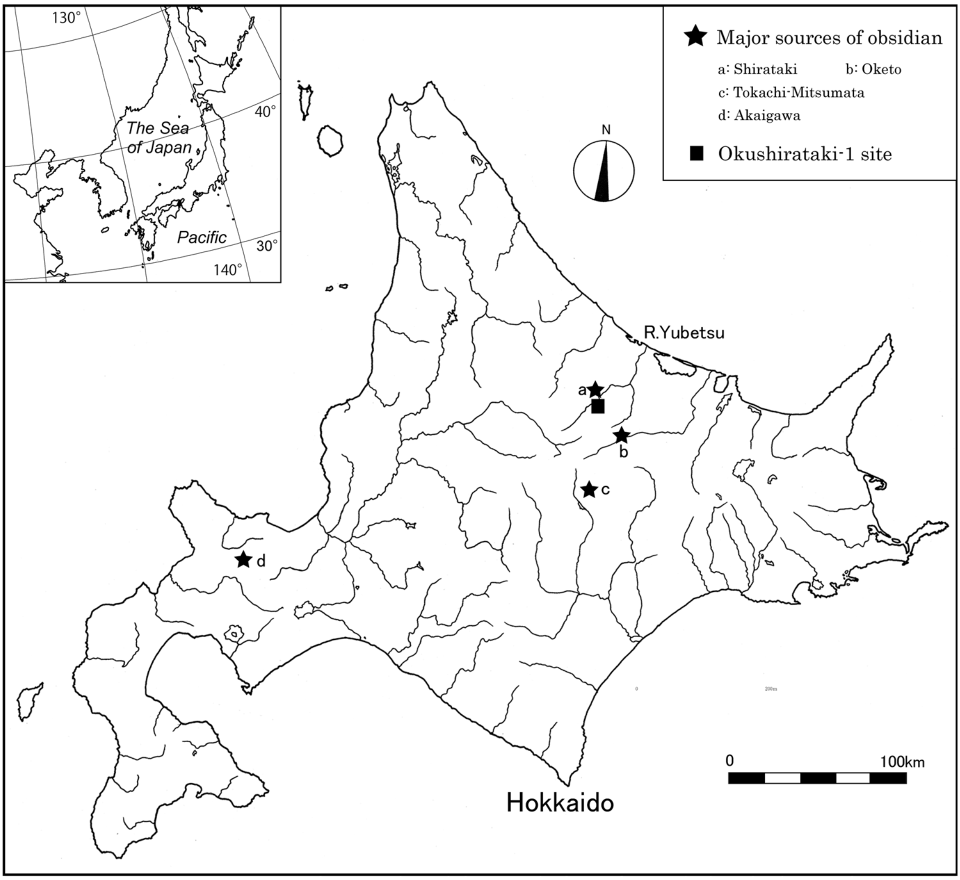

Fig. 2. Location of the Okushirataki-1 site.

sequence of this assemblage, and to assess the relationship between the technological variability of lithic reduction sequences and the morphological features of lithic raw materials, based on the numerous refitted materials.

REFITTED MATERIALS FROM THE OKUSHIRATAKI-1 SITE

The Okushirataki-1 site is an open site located in the Yubetsu River basin, eastern Hokkaido, northern Japan (Fig. 2). The Okushirataki-1 site was excavated in 1997–1998 by the Hokkaido Buried Cultural Property Center (Naganuma et al. 2002). The area of excavation covers approximately 7300 m^2. The Okushirataki-1 site is located nearby a huge outcrop of obsidian that is of good quality, with few interior inclusions. Since the source of obsidian was easily accessible for inhabitants at the Okushirataki-1 site, a large amount of lithic production was done at this site. It is clear that most of the lithic artifacts belong to the late Upper Palaeolithic (20,000–12,000 B.P.) from the techno-typological point of view. Although the spatial distribution of lithic artifacts within the site was probably modified by natural transformation processes, such as solifluction, numerous spatially separated concentrations of lithic artifacts can actually

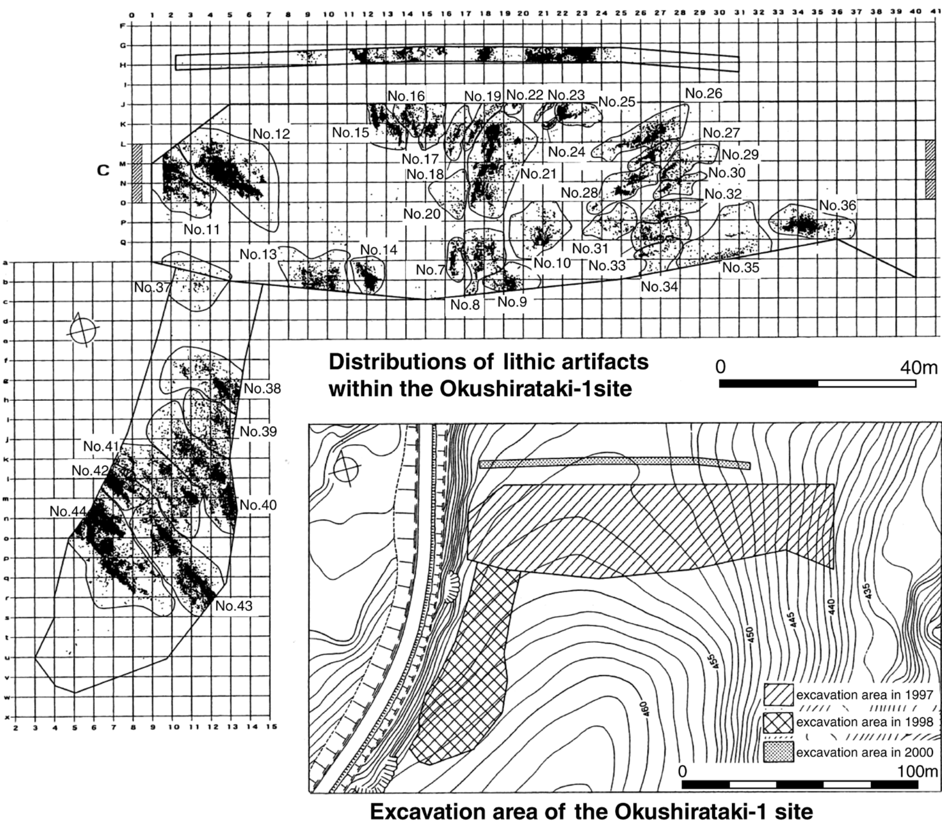

Fig. 3. Excavation area and distribution of lithic artifacts from the Okushirataki-1 site (Naganuma et al. 2002).

be observed. The Paleolithic material within this site has been segregated into four groups techno-typologically. In this paper, I focus on analysis of lithic material in one of these groups: the assemblage recovered from the lithic concentration No. 7–10 (Fig. 3).

The microblade cores of this group are mainly characterized by a conical form with a multifaceted platform, and are referred to type as "Momijiyama" (Naganuma et al. 2002). The "Momijiyama" type has been previously defined as a conical-shaped microblade core in Hokkaido, sometimes called "Oketo" type (e.g., Hayashi, 1968; Nakazawa et al. 2005; Takakura 2007*b*; Tsurumaru 1979). Several major techno-typological traits common to blade and microblade reduction sequences of this assemblage were recovered from the concentration Nos. 7–10. This concentration manifests little evidence for mixing with other assemblages at the site. Also, the fact that a lot of refitted materials are found in the lithic assemblage of these concentrations may support this assumption.

This assemblage comprises 2704 lithic artifacts, including microblades (246), blades (488), blade-like flakes (199), end scrapers (28), side scrapers (2), gravers (6), spalls of graver (2), drill (1), retouched flakes (8), microblade cores (16), blade cores (14), cores (2), and flakes (1692). All of them are made of obsidian exclusively. Blanks of end scrapers, side scrapers, gravers, and drill are derived from blades and blade-like flakes. Figure 4 shows the lithic artifacts, and Figures 5–7 exhibit the numerous refitted materials derived from this assemblage. These refitted materials are enough to reconsider the reduction sequences of this assemblage as a whole. Unfortunately, no chronometric dates indicating a reliable chronological position for this assemblage have been obtained. Therefore, debate on its chronological position still continues (Nakazawa et al. 2005; Takakura 2007*b*; Yamada 2006).

Raw Material Procurement

Inhabitants at the Okushirataki-1 site used exclusively obsidian that was locally abundant and accessible. Cortex is frequently present on the dorsal surface of flakes recovered from the concentration No. 7-10. Although we often tend to treat such phenomena as evidence indicating which initial stage of pebble testing and reduction took place on the site, most of the refitted materials from this assemblage, however, demonstrate that inhabitants did not import original raw obsidian itself. Instead, the reduction sequence began with the importation of relatively large, prefabricated percussion cores. Perhaps the initial processing of obsidian gravels was done before gravels were brought to this site.

The roundness of natural cortex observed on the dorsal surface of lithic artifacts shows that angular, sub-angular, sub-rounded, and rounded obsidian gravels were acquired and used to manufacture blades and microblades. The gravels are mainly comprised of both equant (ball-like) and oblate (disk-like) shapes, while the length of the gravels used for raw material is about 15–20 cm. Although the obsidian raw materials were almost all acquired nearby, it is interesting to note the diversity of their morphological features such as their general shape and dimensions.

Core Preparation and Rejuvenation

The main objective of the reduction sequence of this assemblage appears to be the manufacture of blades and microblades, with bifacial reduction sequences scarce. Despite this focus on blades and microblades, a range of blade cores and microblade cores are present, and it seems that such variability is mainly related to the presence and content of the core preparation (Takakura 2007*b*).

There are some refitted materials indicating elaborate ridge preparation on the core preforms, with multifaceted platforms (refitted specimens No. 1013: Fig. 5). The cortex type of specimens No. 1013 shows that large debris or angular gravel was used for the cores' raw material. A ridge exhibiting transverse flake scars emanating from the dorsal midpoint is commonly interpreted as an artificial salient to guide removal. Indeed, it establishes parallel ridges that can be used to remove subsequent blades with triangular cross section. This refitted material reveals that the subsequent removal of blades and the rejuvenation of platform by either faceting its surface, or trimming its perimeter, or both are alternately executed, so that the lengths of each subsequent decorticated blade are progressively shortened.

In addition, there are some specimens for which the core preparations, such as transverse flaking from the back of the core, are practiced on the side surface of the core in order to modify the core preforms. The specimen No. 1011 (Fig. 5) is such a case. The angular gravel is used for the raw material of the core. Initially, blades were

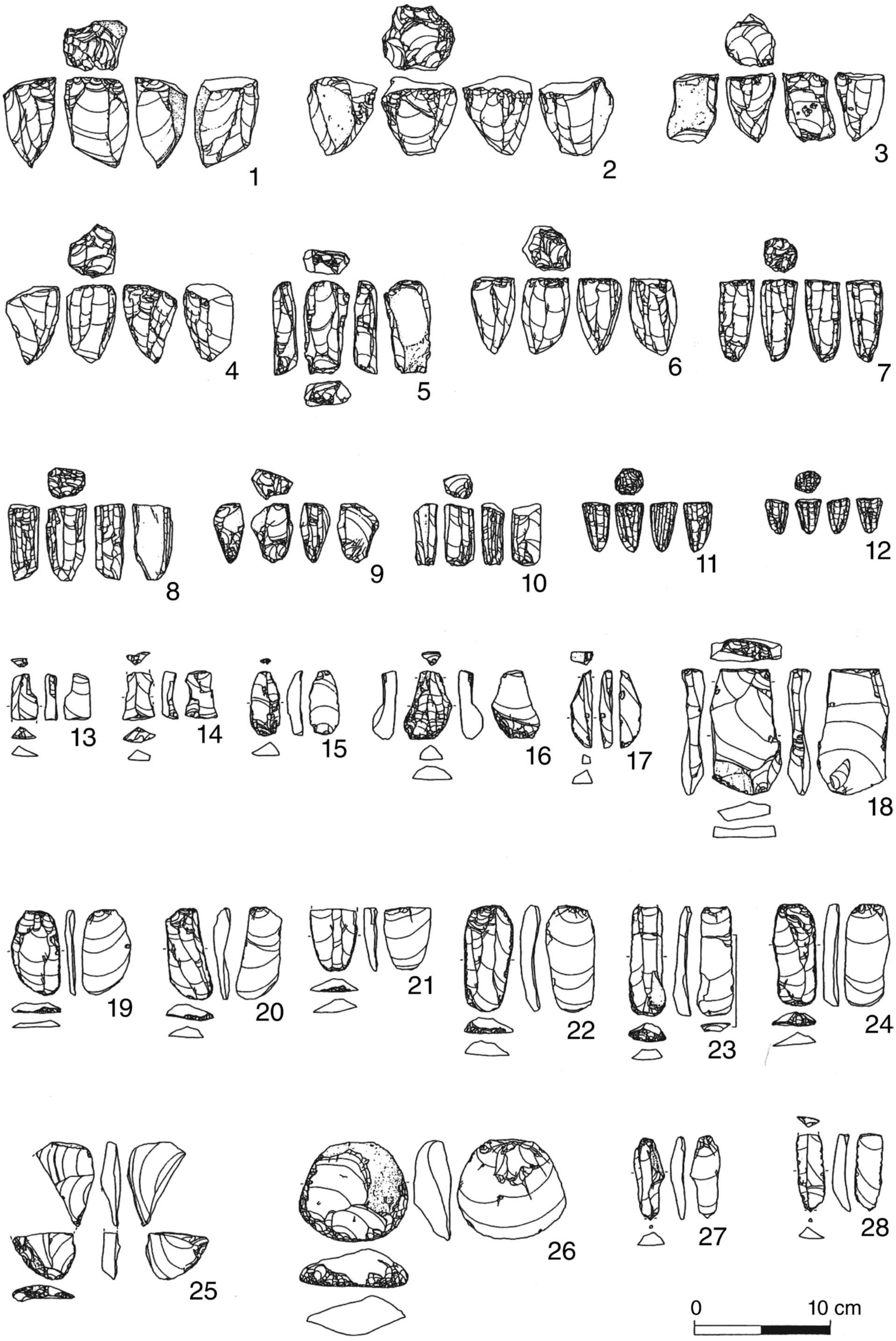

Fig. 4. Lithic artifacts from the Okushirataki-1 site (Naganuma et al. 2002). 1–7: blade cores; 8–12: microblade cores; 13–18: gravers; 19–26: end scrapers; 27–28: drills.

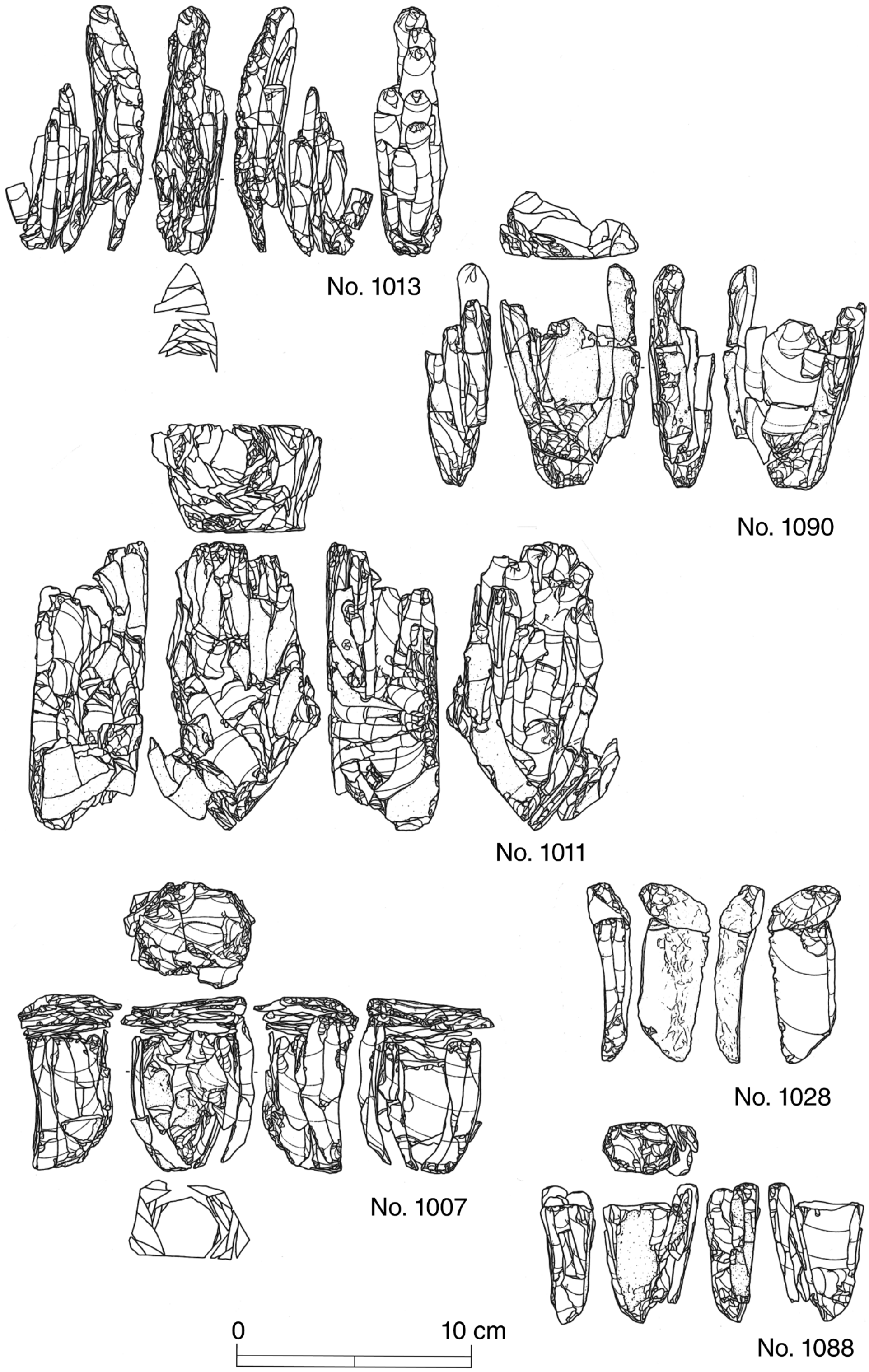

Fig. 5. Refitted materials from the Okushirataki-1 site (1).

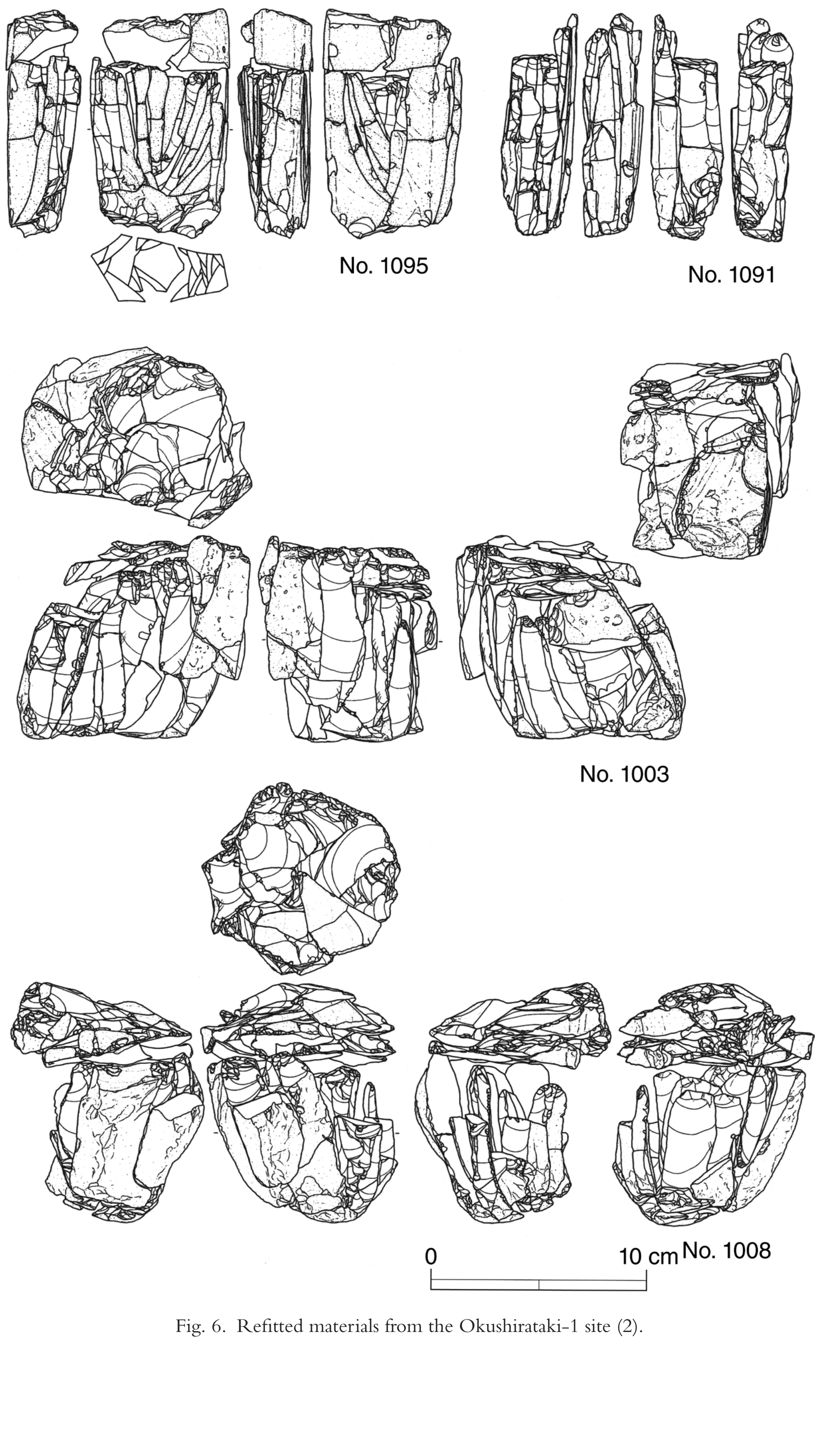

Fig. 6. Refitted materials from the Okushirataki-1 site (2).

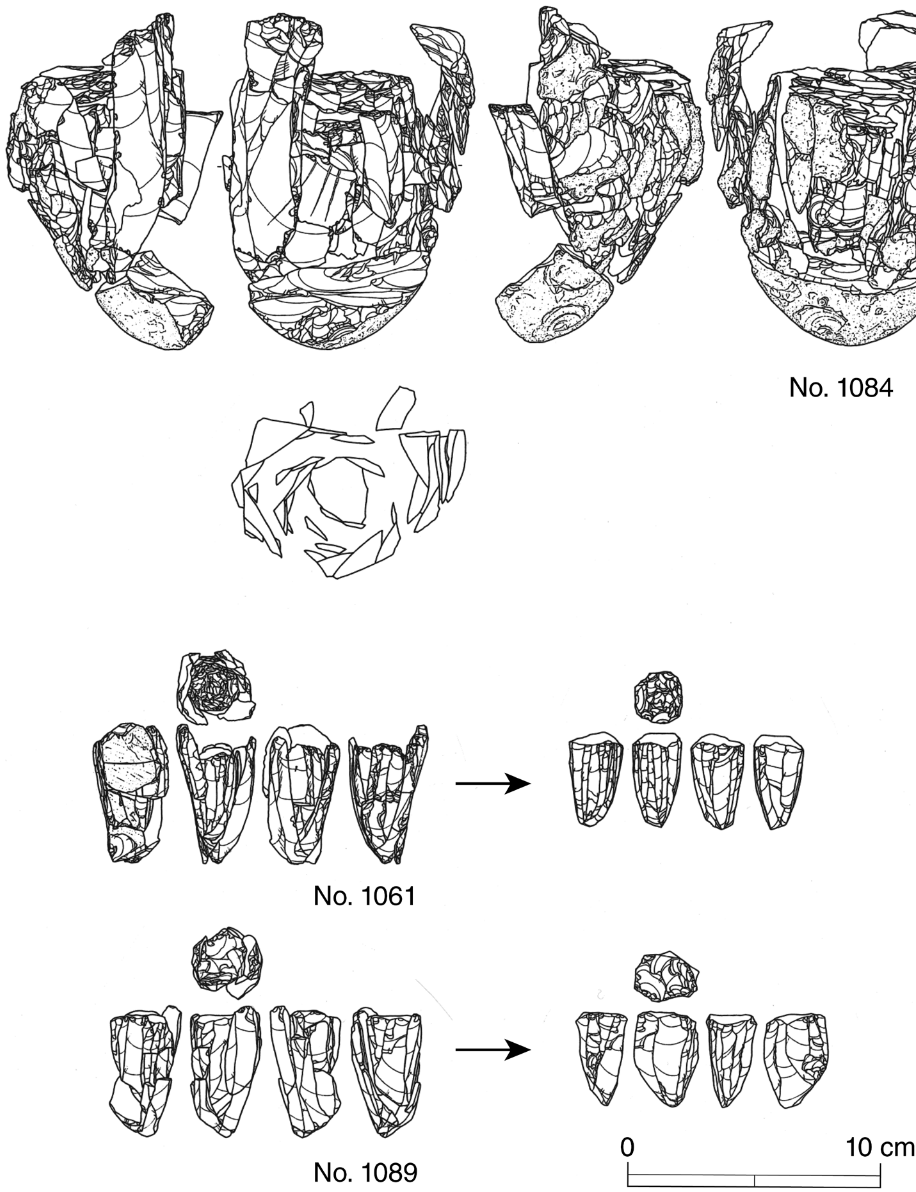

Fig. 7. Refitted materials from the Okushirataki-1 site (3).

mainly detached on the front of the core after the preparation of platform and flaked surface. After that, the removals of blades were also employed on the side surface of the core.

In this assemblage, however, the refitted materials with the elaborate ridge preparation occur in low frequencies. Among most of the refitted materials, the natural salient of raw material or edge of the flake was used for a crest or ridge from which the first blade was detached. The refitted specimens Nos. 1007, 1028, and 1088 (Fig. 5) show that the thick flakes are used for blanks of the core, which are produced by splitting the sub-rounded or rounded obsidian gravels. The flaked surfaces of blades are extended to the side surface of the core, resulting in a semi-prismatic core. It is likely that the rejuvenations of platforms by faceting their surfaces were repeatedly employed while the blades were detached.

In addition, there are some refitted materials in which the natural salient of raw materials is used for a crest or ridge, such as the specimens Nos. 1095 and 1091 (Fig. 6). Among these refitted materials, the oblate-shaped angular gravels are used for the raw materials of the core. Initially, removals of blades are employed on the side surface of the core after the preparation of the platform. Core preparation and rejuvenation are not practiced except for the repeated rejuvenated platform by faceting. Therefore, cortex tends to remain in the large portion of the core. On the contrary, among the specimens Nos. 1003 and 1008 (Fig. 6), and 1084 (Fig. 7), equant-shaped sub-angular gravels and rounded gravels are used for the raw materials of the core. Core preparation is substantially rare on these cores, except for the multi-faceted platform.

The refit data presented here offers a variety of blade reduction sequences in relation to the presence and kind of core preparations and rejuvenations. Although the manner in which the preparations and rejuvenations were employed on the platforms was common to most of the refitted materials, the executing of ridge preparations and the position of flaked surfaces of blades may vary according to the situational variability among the obsidian raw materials and core blanks. The elaborate ridge preparations appeared to be executed when the angular gravels or sub-angular gravels were used for the raw materials of blade cores, and these did not have naturally straight ridges to guide the subsequent removal of blades on the obsidian raw materials. These differences in manufacturing technique would be difficult to determine simply from the recovered cores themselves. In fact, it is only through consistent refitting efforts that we can discover the evidence of variability related to the course of the reduction sequence.

Blade and Microblade Knapping

Most of the recovered blade cores and microblade cores are unidirectional conical-shaped or prismatic ones with a single prepared platform. However, a few refitted materials, for example the specimen No. 1091, show that blade cores were sometimes rotated and some blades were detached from the bottom edge of the core in the course of the reduction sequence. It is likely that such bi-directional blade knapping was exclusively executed on the oblate-shaped core with the rectangular cross section.

One of the interesting features about this assemblage is that blades and microblades are detached from the same cores in the progress of reduction sequences (Fig. 7). Here, distinction of blade and microblade depends on the definition generally accepted, wherein a blade is assumed to be more than 12 mm in width, while a microblade is assumed to be less than that. Based on the removal of them from the same cores, many researchers may tend to interpret the detachments of blades and microblades as proceeding as a smooth continuum, and so the dimensions of productions were gradually reduced in the progress of lithic reduction sequences. However, histograms of the width of blades and microblades illustrate that they can be segregated into two groups divided at the boundary of about 12 mm (Fig. 8). Additionally, identification of the knapping techniques used for blades and microblades, which correlate

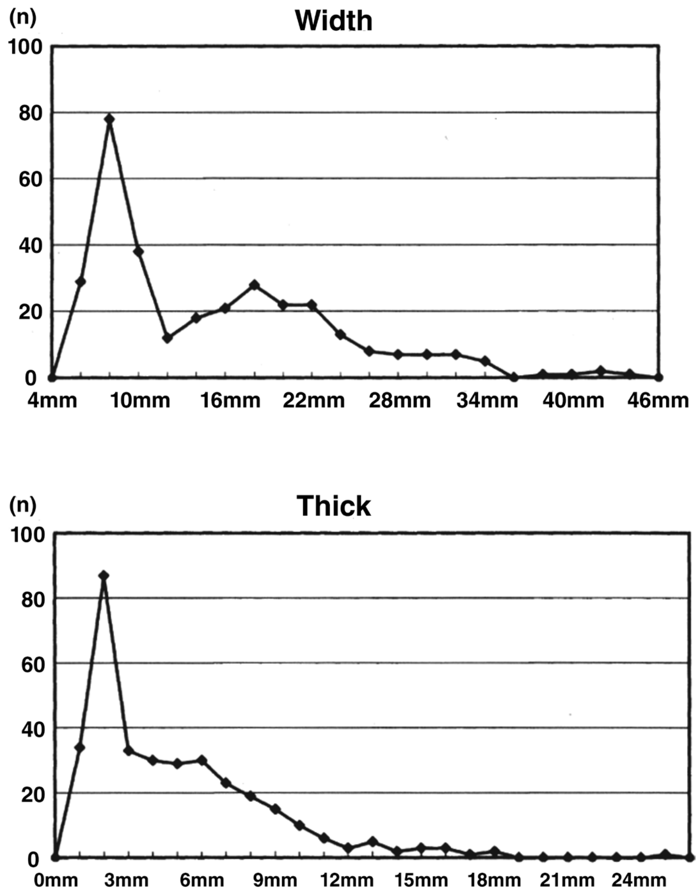

Fig. 8. Histograms of blades and microblades class numbers from the lithic concentration No. 7-10 at the Okushirataki-1 site (Takakura 2007*c*).

to the knapping tools and work postures at the moment of knapping activities, suggest that blade knapping was applied by indirect percussion or soft hammer (wood or antler) direct percussion, while microblade knapping was applied by pressure (Takakura 2007*c*, n.d.), as determined from the analysis of fracture wings (Hutchings 1999; Takakura and Izuho 2004) observed on the fracture surfaces. This indicates that knapping techniques of blades and microblades were apparently converted in the progress of lithic reduction sequences. Such conversion certainly required considerable changes in facility like clamps or core supports.

In this assemblage, blades have various shapes and dimensions within a certain range, wherein some are thick and have semi-parallel lateral margins. In contrast, microblades are highly regular, parallel-sided, and thin. Perhaps, the conversion of the knapping techniques employed by stoneworkers mainly resulted in this segregation in shape and dimension among the productions of the reduction sequence. As a result, the refit data presented here suggest that the operations of ancient stoneworkers were actually interrupted at least once in the course of the reduction sequence, which marked "logical" breaking points to divide the reduction sequence (Bleed 2002*b*).

CONCLUSION

This article primarily focuses on issues related to the reconstruction of blade and microblade reduction sequences through the analysis of refitted materials. My discussion presented here may offer potential avenues for further exploration with regard to our understanding of lithic reduction processes. Based on the assessment presented above, I drew the following three conclusions concerning the lithic reduction sequences among the assemblage at the Okushirataki-1 site.

First, the refitted materials from the Okushirataki-1 site show that the detaching of microblades inevitably connects with the removal of blades in the course of the reduction sequence. The condition of cores that make it possible to detach microblades adequately is not obtained as the result of blank production through the shaping of bifaces or detaching of blades themselves, such as generally observed among other microblade assemblages in Hokkaido (Kobayashi 1970; Nakazawa et al. 2005; Sato and Tsutsumi 2007; Tsurumaru 1979; Yamada 2006; Yoshizaki 1961), but are instead achieved as a result of the procedure of blade reduction. Therefore, this present analysis brings to light important evidence concerning the reduction sequence of assemblages with conical-shaped microblade cores in Hokkaido, which has been previously unclear.

It is well known that conical-shaped microblade cores are widely distributed in northeast Asia, such as Siberia, Mongolia, the Russian Far East, and North China, and that their spread began in the early Holocene. Some researchers have previously noted that the microblade cores of the "Momijiyama" type in Hokkaido could be placed within this widespread artifact category from the chrono-cultural point of view (e.g., Hayashi 1968). Indeed, it is very easy to recognize the morphological similarity of the recovered microblade cores among these regions. The nature of the reduction sequences, from procurement of variable raw materials to detachment of blades and microblades, however, may prompt us to reconsider the validity of such an interpretation since there are marked differences in the reduction sequences between the microblade cores in Hokkaido and elsewhere. If reliable dating on assemblages similar to the Okushirataki-1 site can be obtained in the future, our work on reduction sequences will be key to reexamining the relationships among lithic industries over this broad region of Eurasia in the Upper Palaeolithic.

Second, refitting efforts, examples of which were discussed earlier, revealed that the presence and content of the core preparations or rejuvenations on the flaked surfaces may play a significant role in the formation of variety among the blade reduction sequences. Importantly, it is clear that whether these were employed or not, depends upon the shape of obsidian raw materials or kind of core blanks, especially the conditions of their salient on the edge of them. In contrast, most of the refitted materials have similar characteristics in terms of the preparations and repeated rejuvenations on the platforms. It means that the variety of the raw materials or the core blanks has not significantly affected the formation and maintenance of platforms in the course of the reduction sequence. Thus, we can understand that ancient stoneworkers may have regarded the maintenance of prepared platforms and flaking angles as a critical process for appropriate knapping of blades and microblades, through the comparison of refitted materials.

As I have tried to show, the morphological attributes of cores, microblade cores, blades, and various flakes may vary according to situational variation. The result of successful refitting efforts suggests that it is not appropriate to compare the lithic assemblages and examine inter-site variability only through the analysis of morphological attributes reflecting reduction sequences, which has thus far been the focus of techno-typological approaches. It is apparent that we should pay more attention to the associations between the morphological attributes and contexts intimately related to them. Additionally, it is necessary to search for diagnostic and fundamental processes not subject to the situational variables from the reduction sequence, in order to develop meaningful criteria for comparison among the lithic assemblages.

Third, different types of knapping techniques were used to detach the object pieces, depending upon the progress of the reduction sequence. This is inferred from the identification of blade and microblade knapping techniques, based on the analysis of fracture wings observed on the obsidian lithic fracture surfaces, which shows that these are detached in different ways in terms of the knapping tool, facility, and work posture (Takakura 2007*c*). Generally speaking, the knapping of blades and microblades from the same cores may lead to the notion that the detachments of them proceeded in a smooth continuum. Yet, the data gained from this assemblage provides us with clear evidence that interruption occurred in the course of lithic reduction activities. As the types of knapping techniques change, the outcomes of each knapping techniques were different, resulting in the different morphological attributes.

As emphasized before, the ability to recognize the interruption points to divide the reduction sequence is a useful approach for understanding the cognitive basis of technological actions (Bleed 2002*b*). The assessment of the refitted materials from the Okushirataki-1 site presented here gives us an impressive case study for exploring this issue in terms of the application of different types of knapping techniques in the course of the reduction sequence.

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ABSTRACT

In this article, I attempt to reconstruct the lithic reduction sequence of the microblade assemblage from the Okushirataki-1 site, Hokkaido, northern Japan, and to discuss the relationship between the technological variability of lithic reduction sequences and the morphological features of lithic raw materials, through with the assessment of numerous refitted materials. In terms of results, the refitted materials from this assemblage show that the detaching of microblades inevitably connects with the removal of blades in the course of the reduction sequence. Additionally, the presence and content of core preparations or rejuvenations on the flaked surfaces may have a significant role in the formation of variety among the blade and microblade reduction sequences. Therefore, it is not appropriate to compare the lithic assemblages and examine inter-site variability only through the analysis of morphological attributes reflected in the reduction sequence, which has been the focus of previous techno-typological approaches. Keywords: Japan, Hokkaido, Palaeolithic, stone tools, lithic reduction sequence, microblade assemblage, refitted material.