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Experimental Study of Pomeranian Flint (Kugleflint) from Mesolithic Excavation Site in Jastrzębia Góra 4

INTRODUCTION

The experimental method has proven to be an effective tool for studying prehistoric flint materials. The use of experimental knapping was first noted in Poland at the beginning of the 20th century in the context of the late Paleolithic artifacts (Sawicki 1922). However, the method was abandoned for several decades and started to be used again in the 1980s. Among researchers who returned to applying this method in the research were Migal and Boguszewski. They analyzed the technology of Mesolithic flint-knapping for manufacturing of microblades from the Pomeranian flint in the Kaszuby Lakeland (Boguszewski, Migal 1991).

In this paper we present an experiment designed to verify the hypothesis of preparation and blade removal from the Pomeranian flint cores, the flint also commonly known as “swallow breads”, “Ballflint” or “Kugleflint” (Becker 1952, p. 111–113; Kabaciński 2001, p. 142).

We further propose a modification of Boguszewski’s and Migal’s (1991) method for striking platform preparation, which is referred in their article as “variant 2”. The method is based on direct percussion with hard hammer stone and soft anvil chosen to be a flat piece of wood. The performed experiments confirm that sandstone and other similar soft materials may have been used as anvil. We also demonstrate the effectiveness of using a bulge edge of sandstone, antler or wood as base point (as depicted on fig. 1).

The experimental blade debitage was performed using indirect percussion and pressure techniques. Both techniques are extensively documented in literature, including their detailed description of morphological features (Crabtree 1968; Bordes, Crabtree 1969; Pelegrin 1984a; l984b; 1984c; 2006; Sørensen 2006). To the best of our knowledge, the effects of debitage technique were not previously inspected on the Pomerian flint. Direct percussion was not considered applicable due to significant differences (Pelegrin 2000) in lithics morphology of Jastrzębia Góra 4 blades.

The experimental debitage is later compared with the refitting of the Mesolithic inventories from Jastrzębia Góra 4. The Jastrzębia Góra 4 site was excavated in the late 1970s by Lucyna Domańska. The entire excavated material was for a long time considered to have originated from the late Mesolithic period. This hypothesis was later confirmed by C^{14} dating, which estimated the material date to around 4755 BC (Domańska 1992; Ruta 1997) However, our research, shows that despite this C^{14} dating being accurate, there also may exist other, chronologically diverse materials on Jastrzębia Góra 4 site.

Raw Material

Pomeranian flint is a variant of the erratic moraine Baltic flint that was eroded and transported from northern Europe by glaciers during Pleistocene. In contrast to the Baltic flint deposited in the entire central, northern and north-western Poland, Pomeranian flint occurs randomly only in central and (more frequently) in northern Poland. The Pomeranian flint was a dominant raw material used along the north-western and middle Baltic shoreline during the Stone Age. Today, as illustrated on figure 2 (Becker 1952; Boguszewski, Migal 1991), outcrops of Pomeranian flint range from Gdańsk Bay area to mid-Baltic shoreline between Słupsk and Koszalin.

The shape and size of the Pomeranian nodules are unique. Their characteristic features strongly influence the way of preparation and blanks detachment. The round or oval flint nodules are very small. Our largest finding measured only 5–6 cm. We suppose that producers in the Stone Age had access to the outcrops of the Pomeranian flint that contained slightly bigger nodules, probably ranging from 6 to 9 cm in diameter. The lithic refitting material from Jastrzębia Góra is one of the factors that may support this hypothesis (Płaza 2005).

EXPERIMENT

Stage I. Opening flakes preparation

The experimental replication was made with nodules having at most 6 cm of diagonal length that were collected on the Baltic Sea coastline. We utilized various mineral hammers, hard and soft (wooden, antler or sandstone) anvils. During the experiment three alternative platform preparation methods were applied: direct percussion with hard hammer and no anvil, direct percussion with both hard and soft hammer on soft anvil and the splintered technique. The following is a brief description of the experimental results.

Method I: Direct percussion with mineral hard hammer and no anvil

The first experiment was an attempt to reproduce opening flakes by applying hard mineral hammer percussion to the nodules. The impact point (butt) on each flake was marked by cracks, a thick bulb and visible scars. The majority of flakes showed gently crushed edges on butts and clearly visible ripples. The signs of slight plunging of the flake were also observed. The flake's precore had a gently crushed edge and negatives of a bulb. On the side opposite to the point of percussion, plunging scars matching those on the flakes were visible. Striking platform had an angle of around 70°–80°. These morphological characteristics and technical stigmata (Pelegrin 2000) demonstrate the application of direct percussion (fig. 3).

The flaking angle is of uttermost importance since it influences the blade debitage technique. A higher angle (of about 90°) is more suitable for the indirect percussion and pressure techniques, but the angle of around 70°–80° proved to be the most effective for the direct percussion (Inizan, Ro che, Tixier 1992). The evidence of these flaking angle characteristics are presented among others, in the findings of Melsted or Ålyst (Becker 1952; Casati, Søerensen 2006).

Method II: Direct percussion with both hard and soft hammer on soft anvil

In the second experiment we applied direct percussion with both hard and soft mineral hammers to the nodules placed on a soft anvil made of wood, antler or sandstone. This technique is more complex as it requires a nodule to be immobilized on a soft anvil prior to striking it.

As a result, the morphological characteristics and the technical stigmata of the flakes were significantly different from the traces left by the direct percussion technique. Smaller cracks, crushed edges and more diffuse bulb – with reduced or absent bulb scares – were detected in the impact point area. However, the majority of flakes had no or but few delicate ripples. When ripples were detected, they were very smooth. The evidence of plunging was rarely found and the striking platform happened to be softly concaved. Flaking angle was always close to the right angle 85°–90° (fig. 4). Failure during striking the opening flake could result in the product similar to direct percussion. It usually happened when the applied blow was imprecise.

Both the orthogonal flaking angle and almost no plunging are the results of immobilizing the nodule on a soft anvil featuring a bulge edge (as graphically depicted in fig. 1). Due to the bulge surface on the opposite site, the applied striking force travels through the flint with great precision, resulting in an almost orthogonal platform and no plunging. This almost orthogonal flaking angle enables the pressure or indirect detachment techniques to be applied later in the blade production.

Method III: Splintered Technique

Splintered technique was performed by applying mineral hammers to the nodules placed on a hard mineral anvil (Balcer 1983, p. 27). Debitage left many bipolar negatives on flakes and cores as well as crushed edges near the butt. The nodules were often unintentionally split into more than two parts.

Stage II. Blade debitage

Indirect percussion and pressure techniques had a long history of being used in experimental case studies. The two techniques share a few important characteristics. In order to closely compare them they were both applied to micro blade technology from Jastrzębia Góra 4. Few series of blades were produced using antler punch and pressure tool. For the higher accuracy, the comparative analysis was performed on the sequence of detachment.

Method I: Indirect percussion using moose antler (fig. 5)

- Blades have regular edges and ridges.
- Angle between platform and flaking surface is most suitable for debitage when it is around 80°–90°. Right angle usually influences blade morphology with more curved distal portion of a blade than by detaching it at slightly sharper angle. M. Sørensen (2006) suggests that in such cases using support at the bottom of a core helps to straight blade profile.
- Bulb can be diffuse well pronounced and has a tendency to be more extensive in length (Pelegrin 2006). It is a characteristic mark of the application of indirect percussion. Deriving force by hitting with a punch is not as gentle as in the pressure technique (where the blade is pressed to the amount

of for suitable for detaching). The shapes of bulbs are also determined by the angle at which the force is applied.

Method II: Pressure technique using antler tine stick and vice (fig. 6)

- Blades have particularly regular edges and ridges, they are also relatively thin.
- Angle between platform and flaking surface for detaching a blade is always close to 90°. Blades produced by this technique have almost always a straight profile with a little curved distal part.
- Without the loss of precision, it may be assumed that the shapes of bulbs are consistent across the series of blades. They depend on the angle of debitage which is always close to 90° and on the amount of force applied while pressing. The bulbs are usually thick. They are also located higher and are shorter than the ones produced by indirect percussion (Pelegrin 2006).

Comparison with the Archaeological Findings

The knapping techniques used for production of archaeological findings are typically evaluated by analyzing the morphological characteristics of the debitage. In the same manner the products of performed experiments were used to assess the knapping techniques that may had been used to produce the Mesolithic materials excavated in Jastrzębia Góra 4 site.

A dozen of opening flakes and around 40 cores originating from the site were analyzed. Wherever possible, the cores were refitted with the opening flakes (Ruta 1997; Płaza 2005).

Some samples featured prominent bulbs, visible ripples, plunging marks and scars, or splintered negatives at ventral side. These characteristics match our experimental results obtained by the direct percussion technique with hard hammer stone and no anvil or as a result of mistakes occurring during the application of method II (fig. 7).

In contrast, other analyzed samples featured delicate bulbs, crushed points of impact, gentle convexities and no evidence of plunging. These characteristics match our experimental results obtained by applying direct percussion on a soft anvil (fig. 8).

However, we could not detect any samples of splintered materials, from the preparation phase that would match the experimentally obtained characteristics of the splintered technique.

Subsequently, we analyzed debitage related to blank production: mainly blades, cores and few microburins, most of which had a standard form. In the majority of cases, after detaching the blades, the cores had very regular negatives. Some cores were wasted due to the errors in knapping. These deformations frequently took a form of hinged fractures (fig. 8; 9: 5) or an outrepasse effect during blank production (fig. 8). The flaking angle was usually around 90°, blades were slightly curved in distal part (fig. 9: 1, 2). Their morphology was particularly straight and regular. The butts had been sometimes prepared by faceting. The bulbs were often thick with a little lip on the butt of blade. Most of them show that force applied on the core was driven orthogonally to the platform, evidence of a lip is probably effect of soft organic material (like antler or bone) used for blade detachment (fig. 8; 9). These features seem to be characteristic of experimental pressure blade debitage (fig. 6). Some blades were produced to eliminate the previously committed errors on flaking surface (mostly hinged fractures, visible e.g. on fig. 9: 3). Part of these blades could be also a result of applying direct percussion with a soft hammerstone.

CONCLUSIONS

When compared to the experimental results, the artifacts from Jastrzębia Góra 4 exhibit flint processing economy, which maximizes the effectiveness of blade production by utilization of raw material with low amount of flint wastes. The experiment design was focused on constructing operational sequences for blank production on the site (fig. 10) through preparation of platforms and blade removal process. The proposed method of blade detachment consists of two stages. The initial stage begins with detaching of cortex blades and blades forming proper flaking pattern. The subsequent stage puts emphasis on the debitage of blades. Rejuvenation flakes appear on the platform when correction of flaking angle is required. Debitage usually finishes with failure (hinge, outrepasse) or core's exhaustion. Most probably, pressure technique was used for obtaining blades. Blanks from the production were mostly used as ready tools or reshaped into microliths.

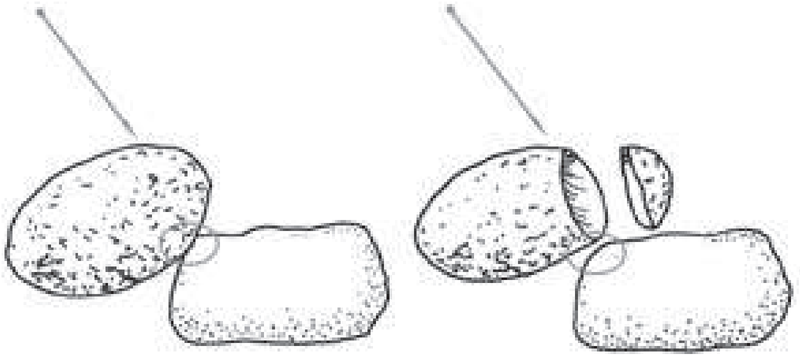

Fig. 1 “Bulge edge” of the soft anvil used as base point during striking the opening flake

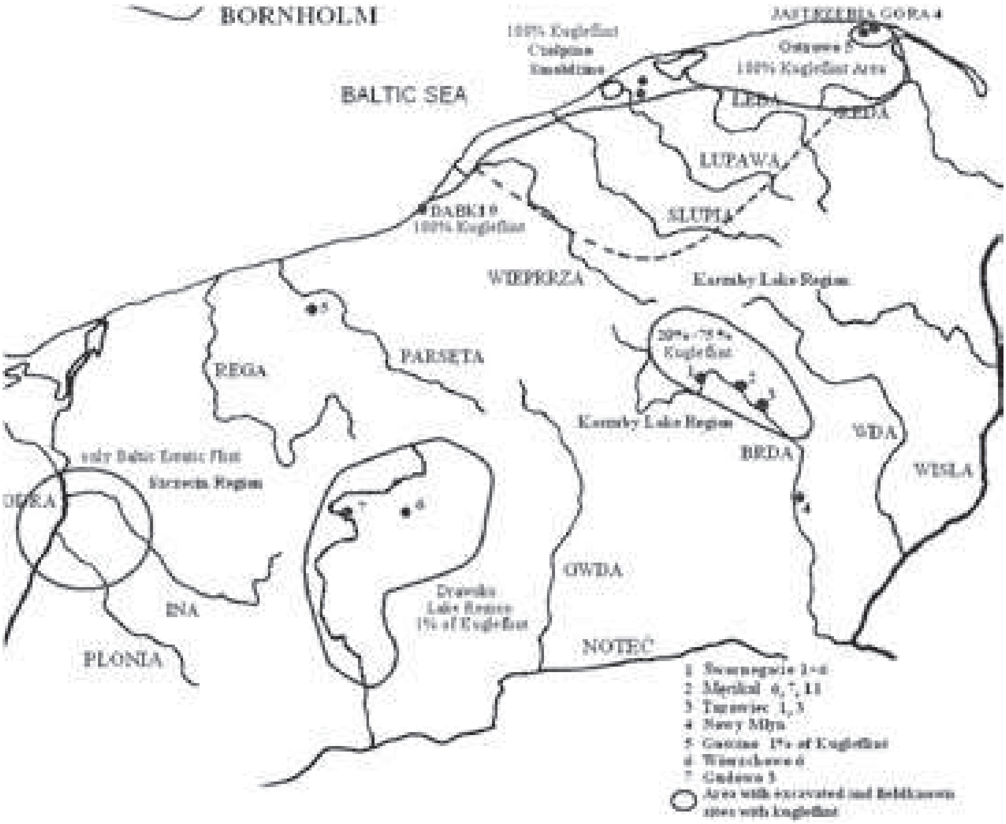

Fig. 2. Percentage of Pomeranian flint in particular regions and sites numbered 1–7 denote Mesolithic materials (Galiński 1992, Kobusiewicz 1999)

Fig. 3. Experimental replication of method I: direct percussion and no anvil (photo W. Pohorecki)

Fig. 4. Experimental replication of method II: direct percussion with both hard and soft hammer on soft anvil (photo W. Pohorecki)

Fig. 5. Experimental blades made by indirect percussion

Fig. 6. Experimental blades made by pressure technique

Fig. 7. Jastrzębia Góra 4: example of direct percussion with no anvil (photo W. Pohorecki)

Fig. 8. Jastrzębia Góra 4: example of direct percussion with both hard and soft hammer on soft anvil (photo W. Pohorecki)

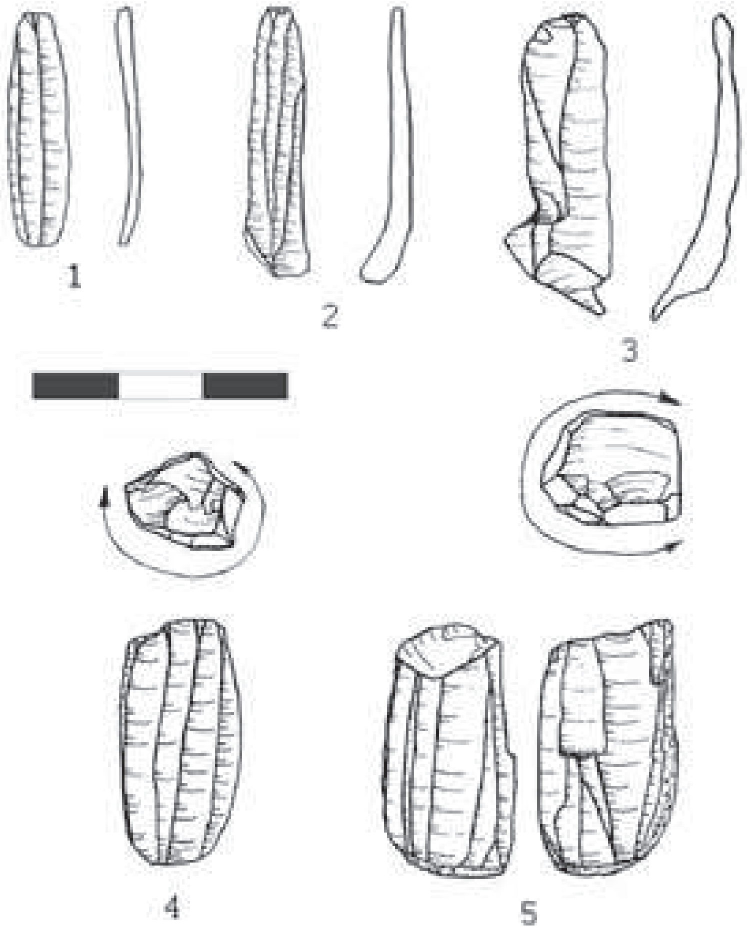

Fig. 9. Jastrzębia Góra 4: Blades (1–3) and cores (4, 5)

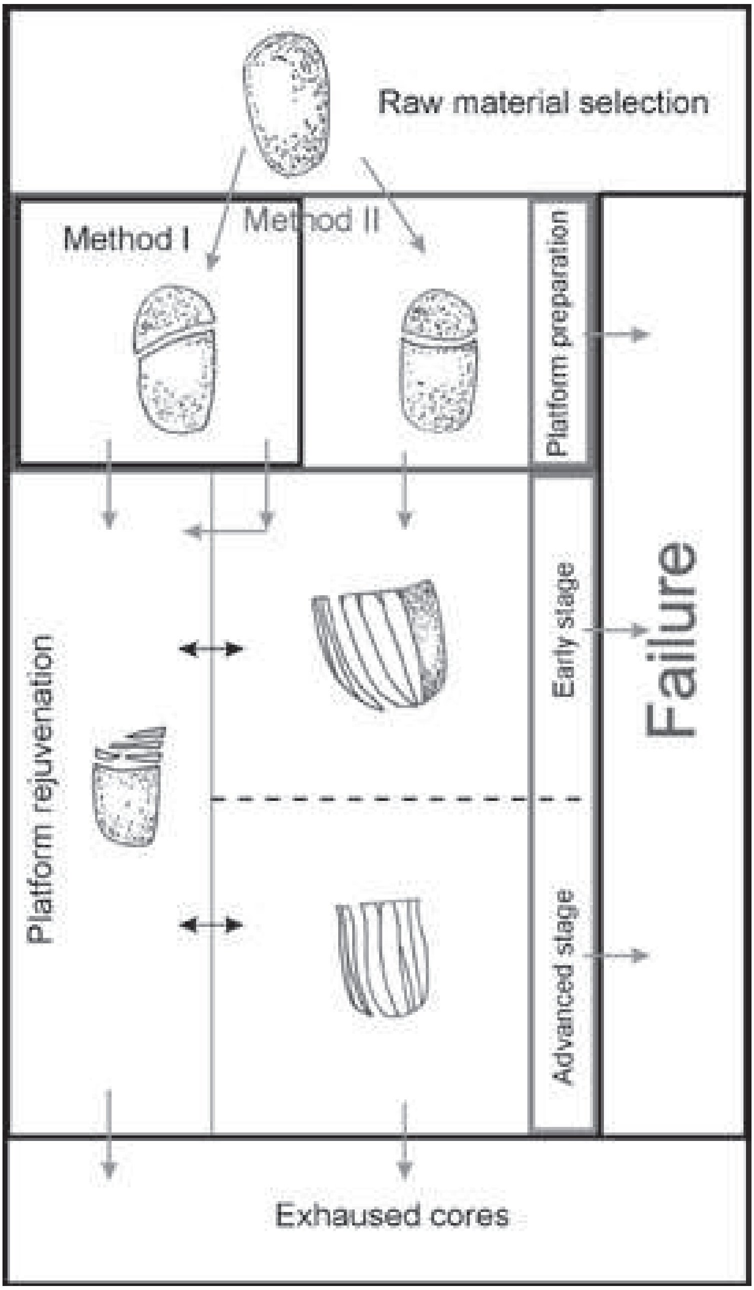

Fig. 10. Jastrzębia Góra 4: chaîne opératoire

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