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Lincombian-Ranisian-Jerzmanowician Industry and South Moravian Sites: a *Homo sapiens* Late Initial Upper Paleolithic with Bohunician Industrial Generic Roots in Europe

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Abstract
This article re-examines the Lincombian-Ranisian-Jerzmanowician (LRJ) industry, a well-known Early Upper Paleolithic complex in northern Europe. It is widely thought that the LRJ was produced by late Neanderthals and that its industrial roots are in late Middle Paleolithic industries with bifacial leaf points in northwestern Europe. On the basis of evidence from four recently excavated open-air sites in southern Moravia (Czech Republic) (Líšeň/Podolí I, Želešice III/Želešice-Hoynerhügel, Líšeň I/Líšeň-Čtvrtě, and Tvarožná X/Tvarožná, "Za školou"), combined with findings from two cave sites in Bohemia (Nad Kačákem Cave) and southern Moravia (Pekárna Cave) and critical re-examination of the LRJ sites and materials from other areas, we propose that the LRJ should actually be considered a late Initial Upper Paleolithic industry. Its initial dates are just before Heinrich Event 4 (HE-4) and the Campanian Ignimbrite (CI) super-eruption, c. 42–40 ka cal BP. We further propose that LRJ assemblages were produced by *Homo sapiens*, and that its roots are in the Bohunician industry. The LRJ originated as a result of a gradual technological transition, centering on the development of Levallois points into Jerzmanowice-type blade-points. It is also suggested that the LRJ industry first appeared in Moravia, in central Europe, and spread along with its makers (*Homo sapiens*) across the northern latitudes of central and western Europe. Accordingly, the IUP "Bohunician package" did not disappear in Europe but gave rise to another IUP industry successfully adapted for the then steppe-tundra belts in northern Europe.

Keywords Initial Upper Paleolithic · Bohunician · Lincombian-Ranisian-Jerzmanowician

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Introduction

In the context of the Initial Upper Paleolithic (IUP) phenomenon in Eurasia, the Bohunician of central Europe occupies a special role, being the only direct industrial analogue in Europe with the eastern Mediterranean Levantine IUP/Early Emiran. The Bohunician and IUP share methods of core exploitation characterized by bidirectional, pointed, bladey opposed-platform core technology starting with a central *lame à crête*, with preparatory blade detachment end products which include true Levallois points, but lacking bifacial tool production (e.g., Demidenko & Usik 1993a; 1993b; 1993c; Škrdla, 1996, 2003a; 2003b; 2017). Currently (Škrdla, 2017), the Bohunician is dated to a large chronological interval, c. 48–40 ka cal BP, between Greenland Interstadials (GI) 13/12 and 9, and preceding the pronounced geochronological markers of both Heinrich Event 4 (HE-4) and the Campanian Ignimbrite (CI) super-eruption at the beginning of Greenland Stadial (GS) 9, c. 39.85 ka cal BP (Giaccio et al., 2017). This wide date range for the Bohunician is based upon a statistical overlap of thermoluminescence (TL), optically stimulated luminescence (OSL), and radiocarbon dates for stratified sites in southern Moravia, Czech Republic (Škrdla, 2017, pp. 92–94, 129–130). Hopefully, future dating efforts at Moravian sites will provide a narrower chronological range for the Bohunician. We think that the Bohunician is a unique European representative of the broader IUP phenomenon, and that it represents the earliest immigration of Levantine IUP Afro-Arabian *Homo sapiens* into central Europe. Some other authors consider it instead as part of a "*Szeletian paradox*," a highly variable single techno-complex with both Levallois points and bifacial leaf points local to central Europe (Oliva, 2016). This view resembles the initial interpretation of the Brno-Bohunice type-site lithics as a "*Szeletian of Levallois facies*" (Valoch, 1962, 1976a). However, our view, that the Bohunician is a European version of the IUP, is shared by the majority of researchers (e.g., Hublin, 2015).

One of the anomalous and notable features of the Bohunician industry is its apparent disappearance from the European UP archaeological record, with no subsequent continuity with later Upper Paleolithic (UP) industries and techno-complexes. The Levantine IUP/Early Emiran (represented by find complexes such as Boker Tachtit, layers 1–3, Ain Difla, and Yabrud II rockshelter, layers 8–7—sensu Demidenko, 2013) had a "happier destiny," with clear industrial and chronological continuity into Late Emiran IUP industries (such as Boker Tachtit, layer 4; Ksar Akil rockshelter, levels XXIII-XXI; Antelias cave, layers VII–V; Abu Halka rockshelter, layers IVf–IVe; Üçağizli cave, layers I–F; Umm El Tlel site, level II base—sensu Demidenko, 2013) that subsequently developed into the Early Ahmarian Early Upper Paleolithic (EUP) (see Marks & Ferring, 1988; Ohnuma & Bergman, 1990; Gilead, 1991; Marks, 1993, 2003; Bar-Yosef, 2000; Belfer-Cohen & Goring-Morris, 2003, 2014; Kuhn, 2004; Williams & Bergman, 2010; Marks & Rose, 2014). Ongoing research indicates a similar development of the IUP into various EUP industries in southern Siberia (Russia) and northern Mongolia (e.g., Derevianko, et al., 2013; Khatsenovich, 2018; Rybin et al., 2017). Here, however, it is worth noting that some Russian researchers (see for the latest updates Rybin (2020)) view the appearance of the IUP in central and eastern Asia as a local development, not associating it with long-distance dispersal of *Homo sapiens*.

In sum, in all other regions of Eurasia where IUP industries occur; they developed into some succeeding EUP industry. In contrast, the central European IUP/Bohunician seems to have just disappeared. The fate of the Bohunician seems even more inexplicable considering the highly developed lithic technologies and skills of Bohunician *Homo sapiens* (Svoboda & Bar-Yosef, 2003; Škrdla, 2017).

In this paper, we propose an alternative view that the Bohunician did not disappear without a connection to later industries. We argue that the Bohunician actually developed into the so-called Lincombian-Ranisian-Jerzmanowician industry (LRJ). Findings from recently excavated sites in southern Moravia, as well as a re-appraisal of evidence from other LRJ sites and assemblages support our hypothesis.

A Review and Re-appraisal of the Lincombian-Ranisian-Jerzmanowician

Research History

The history of research on the Lincombian-Ranisian-Jerzmanowician EUP began nearly 200 years ago with the discovery in England of its most distinctive artifact forms, leaf points on blades, bearing partial dorsal and ventral retouch. "*The first blade-point to be preserved from a British find-spot comes from Kent's Cavern* (*S. Devon*). *It was found by Mac Enery in 1825 or 1826*" (Jacobi, 1990, p. 272). At some sites/find spots, unifacial and partially bifacial blade-points were accompanied by bifacial thin "bi-convex" leaf points. During the nineteenth century, several more sites and/or find spots with the same blade-points were identified in Great Britain, Belgium, Germany, and Poland, leading to industrial definitions and chronological attributions. A range of definitions and names have been subsequently proposed. In the early twentieth century, these materials were referred to as Protosolutrean (Breuil, 1912; Garrod, 1926). An Early Upper Paleolithic time frame (Freund, 1952) was solidified in the 1960s–1970s with stratigraphic evidence an absolute dates from the cave sites of Ilsenhöhle Ranis (Germany) and Nietoperzowa (Poland) (Chmielewski, 1961; Hülle, 1977) and re-studies of the related materials in Great Britain and Belgium (Campbell, 1977, 1980; Otte, 1979, 1981). After Chmielewski's book was published in 1961, many researchers began referring to the distinct points as "Jerzmanowice-type points" or "J-types point" using as the reference site Nietoperzowa Cave. As R.M. Jacobi noted about the points from the Beedings site:

All of the leaf-points from Beedings take the form of what I have elsewhere (1990) termed simply 'blade-points' (cf, pointes lamellaires: Chmielewski, 1961). These are what other workers have called partially bifacial leaf-points (pointes foliacées partiellement bifaciales: Bordes, 1961, pl. 49), 'Jerzmanowice points' (Bordes, 1968, 183), unifacial leaf-points (Campbell, 1971, 1977), points with partial inverse flat retouch (*pointes à retouches plates inverses partielles*) or points with flat retouch, group B (*pointes à retouches plates*, groupe B: Otte, 1974), 'pointes de

Spy'(Otte, 1979, 275), 'Lincombe points' (Campbell, 1986, 13), unifacial leafpoints (Allsworth-Jones, 1986), unifacial blade-points (*pointes laminaires à face plane*: Desbrosse & Kozlowski, 1988, 35), incompletely retouched leaf points (Debénath & Dibble, 1994, 120) or blade leaf-points with partial flat bifacial retouch (*pointes foliacées laminaires à retouches plates bifaciales partielles*: Flas, 2000-2001, 167) (Jacobi, 2007, p. 245).

The above-mentioned regional studies, especially the work of Jacobi, have led to recognition of three similar local EUP industry types or "cultures." In England, J.B. Campbell proposed the name "Lincombian" after Lincombe Hill, in south-western England where Kent's Cavern is located. In Germany, the "Ranis-Mauern" and later "Ranisian" originated from the town of Ranis, eastern Germany, where Ilsenhöhle Ranis is located (Kozłowski & Kozłowski 1979; Kozłowski, 1983; Desbrosse & Kozłowski, 1988). In Poland, the "Jerzmanowician" was introduced by W. Chmielewski after the Jerzmanowice village where Nietoperzowa Cave is situated. Related finds from Spy Cave in Belgium were not assigned a specific industrial name but were referred to as a "*blade leaf-points industry*" comparable to Lincombian and Jerzmanowician (Otte, 1979, 1981). As more work was done on the sites and lithic assemblages (e.g., Jacobi, 1999, 2007; Otte, 1990, 2000), it became clear that these assemblages scattered across the so-called northern belt of Europe (the European Northern Lowland) from Great Britain in the west to Poland in the east indeed composed a single cultural unit now known as the "Lincombian-Ranisian-Jerzmanowician" (after Desbrosse & Kozłowski, 1988; Kozłowski, 1983). As J. Richter noted of the Ilsenhöhle Ranis materials: "*The term* '*Ranisian*' *should be rejected because the finds from Ranis 2 are well comparable to what was earlier named Jerzmanovician*" (Richter, 2008, 2009, p. 113).

Recently, D. Flas conducted an exhaustive study of all available data on the Lincombian-Ranisian-Jerzmanowician industry, which he usually shortens to LRJ (a term we also employ here) (Flas, 2006, 2008, 2011, 2012, 2014, 2015). Today, Flas' data and analyses are the essential reference materials for the LRJ industry. We also use the Flas publications as one of the basic reference datasets for our research.

Despite the long history of research and numerous published data for many loci and their finds, there remains a great deal of uncertainty about aspects of the LRJ industry. The main problems relate to the following three subjects. First of all, most LRJ sites were excavated before any modern field research and curatorial standards were in place, some in the nineteenth century. Second, many of the early excavated sites have multiple Paleolithic cultural components. Given past field methods, it is not surprising that the LRJ assemblages from these sites are usually archaeologically mixed. Third, even for unmixed and accessible assemblages, the LRJ industry's techno-typological characteristics are based upon a limited set of artifact classes and types, most importantly the leaf blade-points themselves, as for example, finds from recently published materials from Kirchberghöhle in Bavaria, Germany (Uthmeier et al., 2018). This "artifact type lacuna" problem is connected to the nature of most LRJ occupations. Documented sites are usually ephemeral hunting camps, mostly in caves and rock-shelters, but also some open-air localities (Cooper et al., 2012). The only known LRJ thought to represent a regular "occupation site" is the Beedings locality in England, which is situated on a hilltop with a commanding view of the surrounding region (Jacobi, 2007; Pope et al., 2013). However, knowledge of the site is largely limited to artifacts "*…collected in 1900 during construction of* '*Beedings*'*—a house built atop Beedings Hill…*" Moreover "*…the assemblage apparently originally comprised 2300 flints…*", from which "*…fewer than 200 lithics survive today*, *and the prevalence amongst these of retouched pieces shows that they have*, *at some point, been preferentially selected out of the assemblage and retained*" (Pope et al., 2013, p. 16). Fieldwork in 2007–2008 confirmed that there were multiple Paleolithic components at Beedings, led to discovery of more LRJ artifacts, and allowed dating of the site by OSL (Pope et al., 2013). Unfortunately, this recent research added only 17 additional artifacts that could help further define the techno-typological characteristics of the industry.

All in all, LRJ lithic assemblages are characterized by limited evidence for on-site manufacture and shaping activities. These include mainly rejuvenation/re-shaping and limited production of the points using imported blade-blanks, along with some modification of blades by irregular retouch, probably used for ungulate butchery. Both core and debitage data are scarce: evidence for on-site primary flaking processes is mostly limited to a few knapped cores, usually brought to the site already prepared. As a result, the LRJ industry's primary flaking processes are still rather enigmatic. The LRJ industry appears to be the only known UP industry in Europe, and probably in the entire world, defined on the basis of only ephemeral/short-termed hunting camps, with no workshops or "regular" campsites. On the other hand, the presence of large numbers of morphologically and typologically distinct points, usually on elongated and large blades, has allowed the broad acceptance of a discrete taxonomic status for LRJ within the European EUP.

All the difficulties with LRJ lithic data notwithstanding, a reasonable corpus of information on stone artifacts is available, in large part synthesized by Flas. Below, we summarize and critically discuss the available evidence. We use the Beedings site lithics as a reference assemblage for the entire LRJ industry because it is the largest know LRJ assemblage and contains the widest variety of cores, debitage, and other artifact classes in addition to Jerzmanowice-type (J-type) points.

LRJ Primary Flaking Processes

Few morphologically clear cores have been recovered from LRJ sites. The largest sample is from the Beedings site (Jacobi, 2007). Data regarding core reduction come mainly from both unretouched and retouched blades and the blade-blanks of J-type points. Consequently, data on flaking methods are usually restricted to blade production. Moreover, given that J-type points are mostly manufactured on long blades (≥ 10 cm), LRJ blade production may appear to have been directed almost exclusively to making long blades. However, a more likely explanation here is that there was deliberate selection of the longest blades to make J-type points, and that many smaller blades, elongated flakes and other flakes originally produced by LRJ knappers are missing from samples available for analysis. The same also probably applies to blade dorsal scar pattern types. Most J-type points have bidirectional scar patterns. However, free-hand manufacture of long straight blades, bidirectional of the type used for J-type point production, often results in the removal of smaller blades and flakes with different dorsal scar patterns, particularly when shaping the core and correcting mistakes (also see here: "*such cores represent a highly efficient method of obtaining blades since, by working from both ends of a core, a knapper could by-pass or correct faults and previous failures*" [Jacobi, 2007, p. 235]). But this is again a one-sided view. Therefore, restricting our technological observations of the LRJ to just the long blades used as blanks for J-type points would be equivalent to characterizing a Middle Paleolithic assemblage Levallois points using data from Levallois points only.

Nonetheless, it is still possible to arrive at a basic view of long blade production in the LRJ. Flas's work is the best starting point.

Blade knapping is done most of the time with an organic soft hammer, based on the relative thinness of blade platforms (less than 5 mm, with an average around 3 mm) and the frequent presence of a lip. Blade production is volumetric, involving preparation of the cores by different crests (central crest to initiate blade production and lateral crest to shape the back of the cores and enable management of the transverse curvature of the knapping surface during the reduction process). The knapping surface is relatively broad with alternating use of the two opposed striking platforms, yielding mostly straight and relatively sturdy blades, sometimes naturally pointed. These blade blanks are perfectly suitable to be transformed into Jerzmanowice points (Flas, 2011, pp. 611–612).

Two additional morphological features of the LRJ long blades made them good blanks for J-type points. Because they are "*….distally pointed and feather terminating…the blades from Beedings would have needed a minimum of distal modification if the intention had been to make leaf-points.*" (Jacobi, 2007, pp. 235–236). However, while the blanks selected for J-type points could indeed have been flaked with a soft hammer, this was not the only kind of hammer used. Core preparation processes, which produce many flakes and elongated pieces, could be well have been done with a hard hammer.

The long blade data, as well as some cores, provide some understanding of core striking platform preparation and rejuvenation processes. J-type points are usually well retouched at on the base, so evidence for platform preparation is usually missing. However, many unretouched long and bidirectional blades do bear facetted butts. This makes some of them morphologically similar to Middle Paleolithic (MP) or Middle Stone Age (MSA) Levallois blades, although neither true Levallois points nor *chapeau de gendarme* butts occur (e.g., Jacobi, 2007: Fig. 3; 4, 1–4; 5, 1–2; 6, 1). Overall, the presence of platform faceting gives a kind of superficial "Levallois veil" to LRJ blade technology. Faceting is also observed on striking platforms of the few examples of LRJ opposed-platform cores (e.g., Jacobi, 2007: Fig. 10, 1–3) (Fig. 1A: 1–3), though it is normally not fine faceting with more than 3–4 faceting scars. The faceting on both cores and blades and the absence of core tablets in known LRJ assemblages are signs that rejuvenation of plain striking platforms on cores was not accomplished by removing of core tablets. Accordingly, the LRJ blade core platform preparation and rejuvenation were more similar to MP and IUP lithic technologies in Europe, predating the appearance of the first Aurignacian, meaning namely the Proto-Aurignacian.

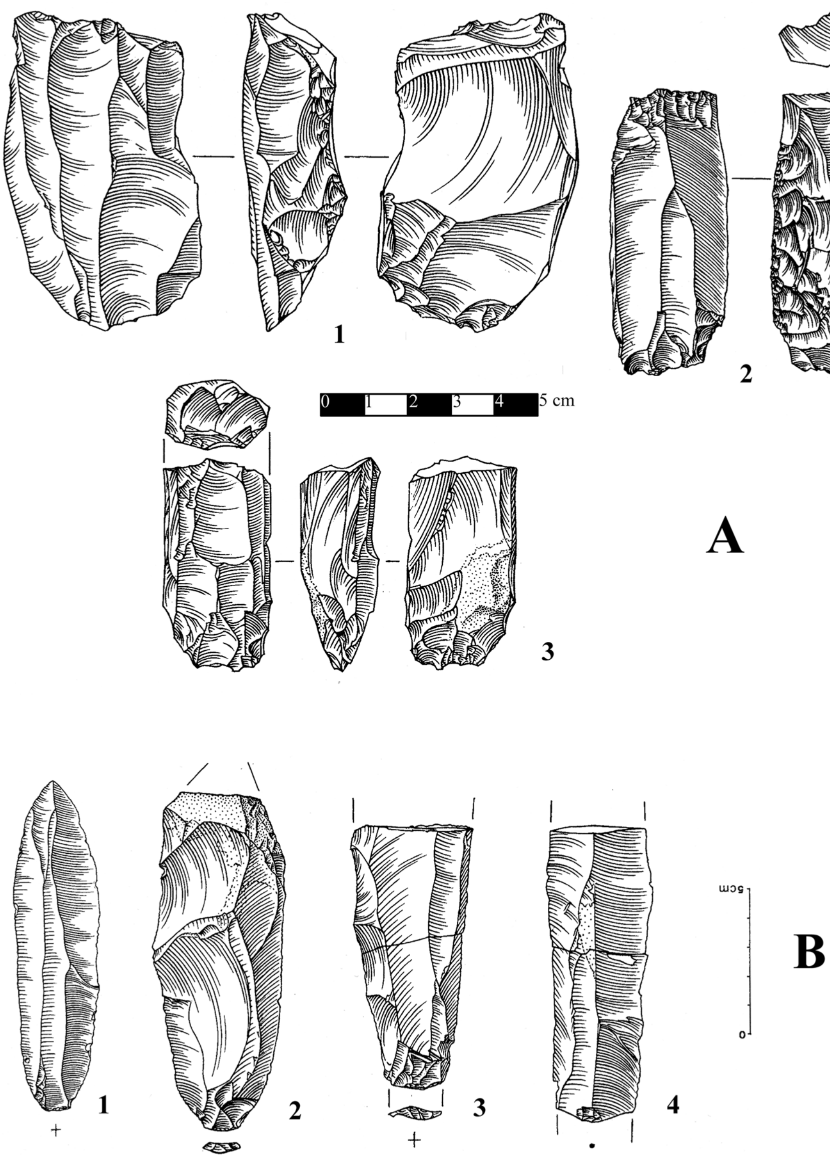

Fig. 1 Beedings site, Great Britain: **A** 1–3—opposed-platform bidirectional cores; **B** 1–4—unretouched blades (modified after Jacobi (2007))

There is one additional feature of blade core reduction that makes the LRJ more similar to MP, MSA, or IUP technologies. The striking platforms of some cores (Jacobi, 2007: Fig. 10, 1) and blades (Jacobi, 2007: Fig. 4, 3; 5, 1–3) from Beedings were prepared by abrasion (Fig. 1B: 1–4). It is especially noteworthy to see the occurrence of such abrasion on facetted butts on some LRJ blades (Jacobi, 2007:

Fig. 5, 1–2) (Fig. 1B: 2–3). Abrasion of facetted striking platform edges is nearly unknown in Early Upper Paleolithic contexts, although it is well-documented in some Early MP long blade production, where it provided better technological control over detachment of elongated debitage pieces (e.g., Hummalian industry in the Levant—Wojtczak et al., 2014). The use of platform abrasion, along with the systematic application of central *lame à crête technique* for core preparation, a technique first appearing in the IUP (see Demidenko & Usik, 1993c), suggests that LRJ blade technology should be regarded being no later than the IUP.

Flas also suggested the presence of bladelet core reduction in the LRJ: "*bladelet production is likely if we consider some of the cores from Beedings* (Jacobi, 2007)", while also observing that "*however*, *because of imprecision during excavation at this site*, *no complete description of this potential bladelet production can be given.*" (Flas, 2011, p. 612). Flas was referring to the absence of any bladelets that could correspond to the Beedings cores. In fact, true bladelet cores on nodules or chunks are not present in the Beedings assemblage and have not been reported yet from any other LRJ assemblage in Europe. However, many artifacts from Beedings would have produced bladelets or bladelet-sized blanks. One of the three cores identified by Flas could be called a burin-core (Jacobi, 2007: Fig. 11, 1; p. 237) (Fig. 2: 1). Two other suggested bladelet cores are not in fact "dedicated" cores but are instead tool fragments (J-type blade-points?) re-utilized for some ad hoc blade/bladelet production (Jacobi, 2007: Fig. 11, 2–3; p. 239) (Fig. 3: 1–2). From our point of view, it is possible to add three so-called "Kostenki knives" illustrated by Jacobi (Jacobi, 2007: Fig. 32, 1–3) (Fig. 3: 3–4) and six "composite tools" (variations of "Kostenki knives" with burins, bilateral retouched, and/or truncations) (Jacobi, 2007: Fig. 33, 2–3; 34, 1–4) (Fig. 2: 2–3; 3: 5–8). We should emphasize that the so-called Kostenki knives, originally defined in eastern European Late Gravettian assemblages with shouldered points c. 100 years ago, are functionally knives with a specific form of lateral rejuvenation of their cutting edges (e.g., Klaric et al., 2015), whereas the artifacts from Beedings are better interpreted as cores. Nine artifacts from Beedings resemble so-called cores on flakes or truncated-faceted pieces from Levantine Mousterian and some IUP assemblages (e.g., Demidenko & Usik, 2003: Fig. 6.17, n 27; 6.18: n 29; 6.19: n 31; 6.20: n 32–34; 6.22: n 35–37; 6.26: a–b, f–g; Wojtczak et al., 2014: Fig. 3, c; 5, a–e; 13, d; Demidenko et al., 2020, pp. 23–25; Marks & Kaufman, 1983: Fig. 5.3, c–d) (Fig. 3: 1–8). Such pieces usually appear in Paleolithic assemblages when people either faced a deficit of high-quality rock or were using very intensively all available raw materials during on-site primary and secondary manufacture of lithics. Under these conditions, some debitage pieces were additionally exploited as ad hoc cores on one of their two surfaces (more often the dorsal one). Besides the single possible burin-core noted by Jacobi, other burins from Beedings (Jacobi, 2007: Fig. 13, 2–3; 15, 1–2) could be indeed considered technologically burin-cores from our point of view (Fig. 2: 4–7). These burin-cores are again the well-known for both early MP and IUP assemblages (Wojtczak et al., 2014: Figs. 20–21; p. 45–46; Zwyns et al., 2012: Fig. 9, 1–10; Demidenko et al., 2020: 23–25; Marks & Kaufman, 1983: Fig. 5.3, c–d).

The presence of cores on flakes/truncated-faceted pieces with some blade and bladelet removals, as well as burin-cores that also served for bladelet detachment,

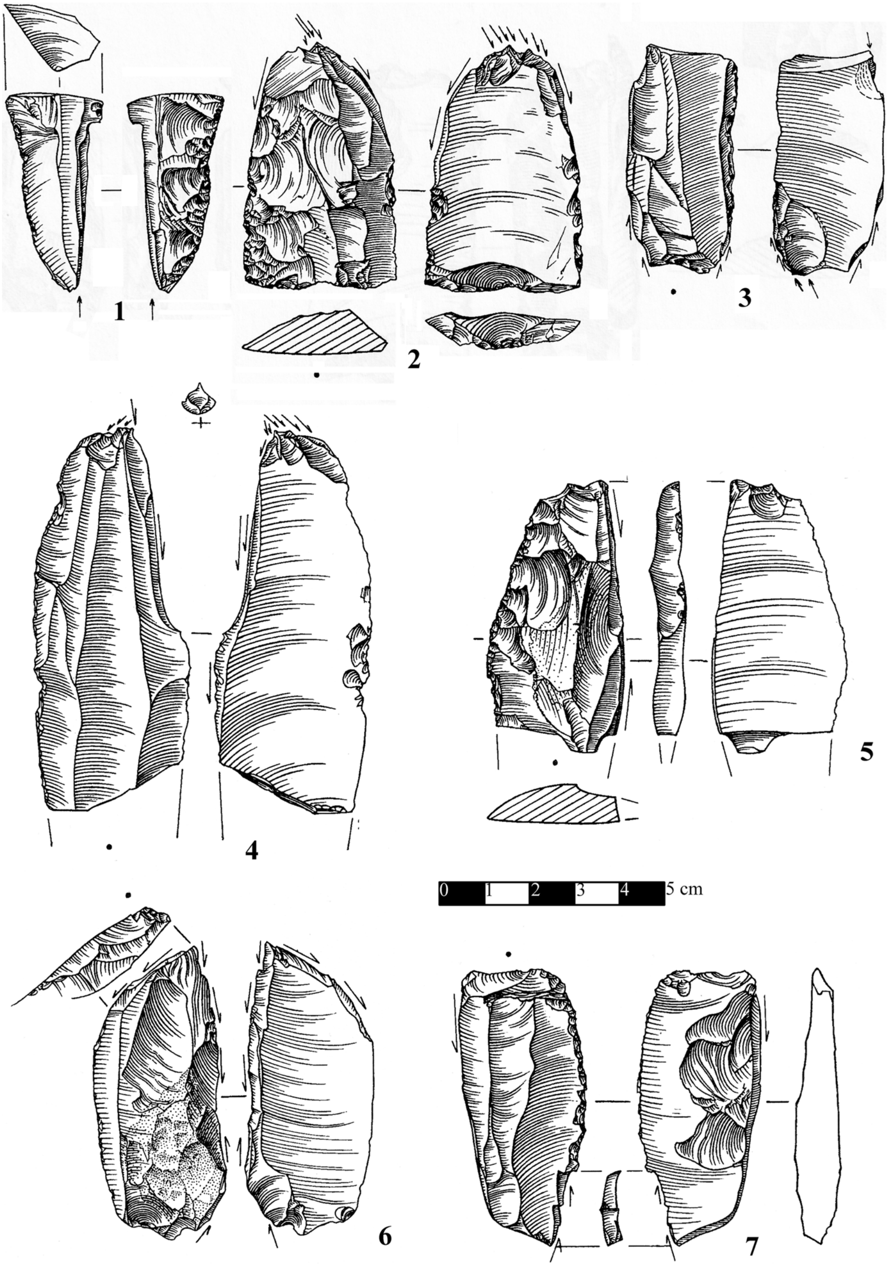

Fig. 2 Beedings site, Great Britain: 1–7—burin-cores (modified after Jacobi (2007))

indicate a kind of situational bladelet production that is characteristic for some MP, MSA, and IUP assemblages but not of "true" EUP or later UP assemblages. In the case of ad hoc bladelet production before the EUP, the bladelets themselves were

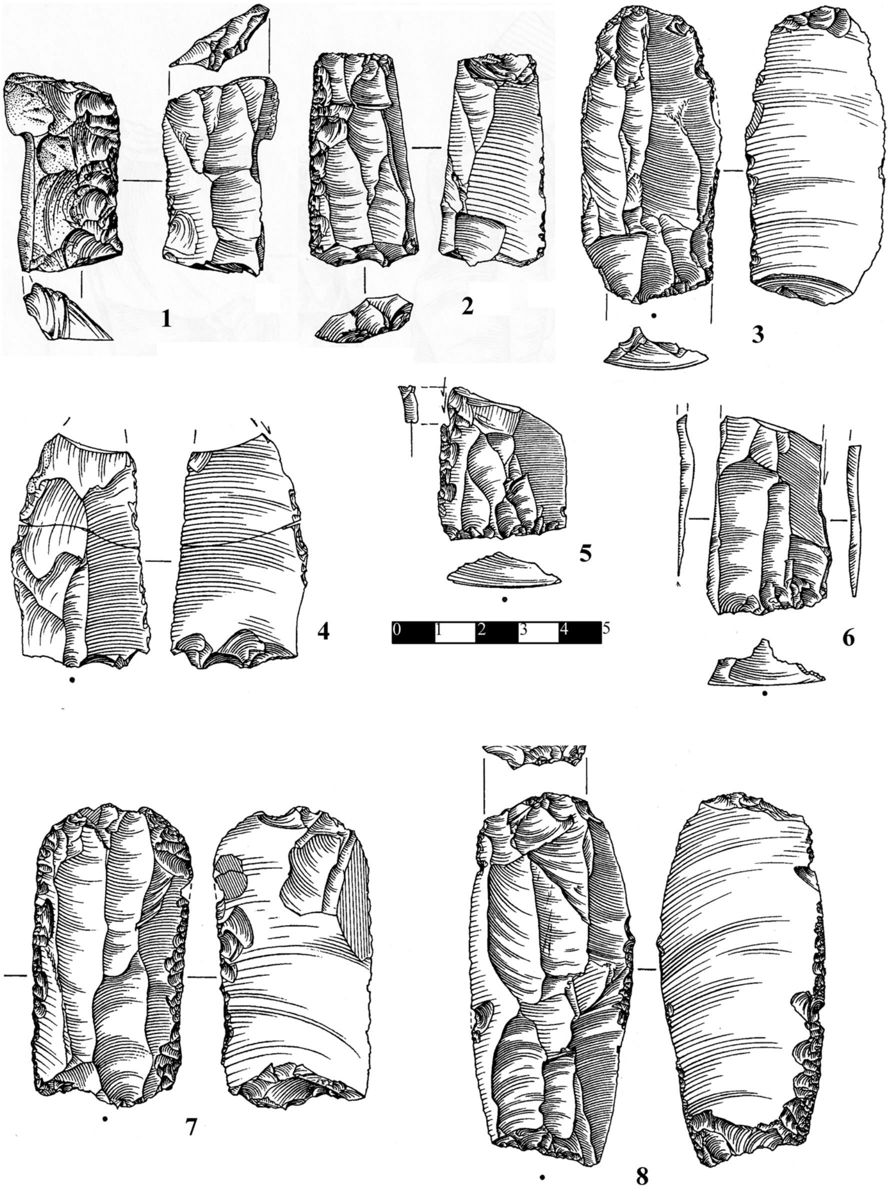

Fig. 3 Beedings site, Great Britain: 1–8—cores on flakes/truncated-faceted pieces (modified after Jacobi (2007))

used without systematic retouch and were most likely used for butchery or other cutting tasks (Wojtczak et al., 2014, pp. 41–46). Retouched and especially backed bladelets have not been recovered from LRJ assemblages, even when modern recovery techniques are used. Because of the absence of retouched and backed bladelets, previous attempts to connect the LRJ with the Gravettian (Jacobi, 1986; also see

Flas, 2000–2001) were abandoned (Jacobi, 2007, pp. 262, 266; also see Flas, 2014). In fact, the Beedings cores on flakes/truncated-faceted pieces and burin-cores could demonstrate technological connections between the LRJ and the MP or IUP, rather than with the mid-UP Gravettian.

Finally, we agree with Flas who argues "*…no flake production method has been recognized in the LRJ. The few flakes found in some of the assemblages may simply correspond to by-products of blade production or to flakes knapped from exhausted blade cores*" (Flas, 2011, p. 612).

In sum, there are clear limits on our knowledge of core reduction/blank production in the LRJ. We have a reasonably good picture only for the method(s) of core reduction that produced the long blades. Ad hoc bladelet production using debitage elements or tool fragments also sometimes occurs in LRJ assemblages. These observations consistently point to flaking processes for blades and bladelets in the LRJ which more closely resemble known MP/MSA or IUP technologies, and which differ substantially from EUP and especially middle UP/Gravettian technologies.

LRJ Retouched Tools

J-type points are the most typical and most easily recognized LRJ tool type (Jacobi, 2007: Fig. 20, 1; 43, 1–2; 50, 1–3) (Fig. 4: 1–6). They are almost exclusively produced on long blades (on average 9–10 cm long, 3 cm wide, 1 cm thick [Flas, 2011, p. 610]). For the Beedings site, all 36 J-type points (not including re-used and recycled examples) are manufactured on blades (Jacobi, 2007, p. 245). Going beyond the basic type name, Flas' 2001 term "*blade leaf-points with partial flat bifacial retouch*" is the best summary description of this class of artifacts. Complete examples are pointed and symmetrical. As a rule, the points have partial retouch on both dorsal (flat / semi-steep retouch) and ventral (flat retouch) surfaces, and the ventral surface often shows heavier retouch. At the same time, the amount, nature, and distribution of retouch on the blade-points depends on morphology, especially the overall shape of blade blanks. No detailed use-wear analyses have been carried out for J-type points, but the general opinion is that they were used as points of spears. This view is due, first and foremost, to the clear occurrence of projectile damage traces on many fragmented items (e.g., Jacobi, 2007: Fig. 21, 1; 26, 4; 28, 1–2; 29, 1) (Fig. 5: 1–4; 6: 1), consistent with the observation that they come from hunting stations. Jacobi (2007: Fig. 25, 1–2) (Fig. 6: 2) considered two points from Beedings "*unachieved blade-points*" (semi-products in our terminology) indicating that some of the points "*were being made at Beedings*" (Jacobi, 2007, p. 247).

The J-type points have often been compared to later UP and particularly middle UP Gravettian points on blades. Given the lack of affinity of LRJ cores, blades and bladelets with later UP industries, it is also possible that J-type points might be somehow typologically relate to IUP inversely retouched blade-points, being basically a variant of the Emireh Levallois point type made on a blade (Demidenko, 2013).

Bifacial leaf points also occur in LRJ assemblages but in contrast to the J-type points, which occur in every LRJ assemblage, the bifacial specimens are known

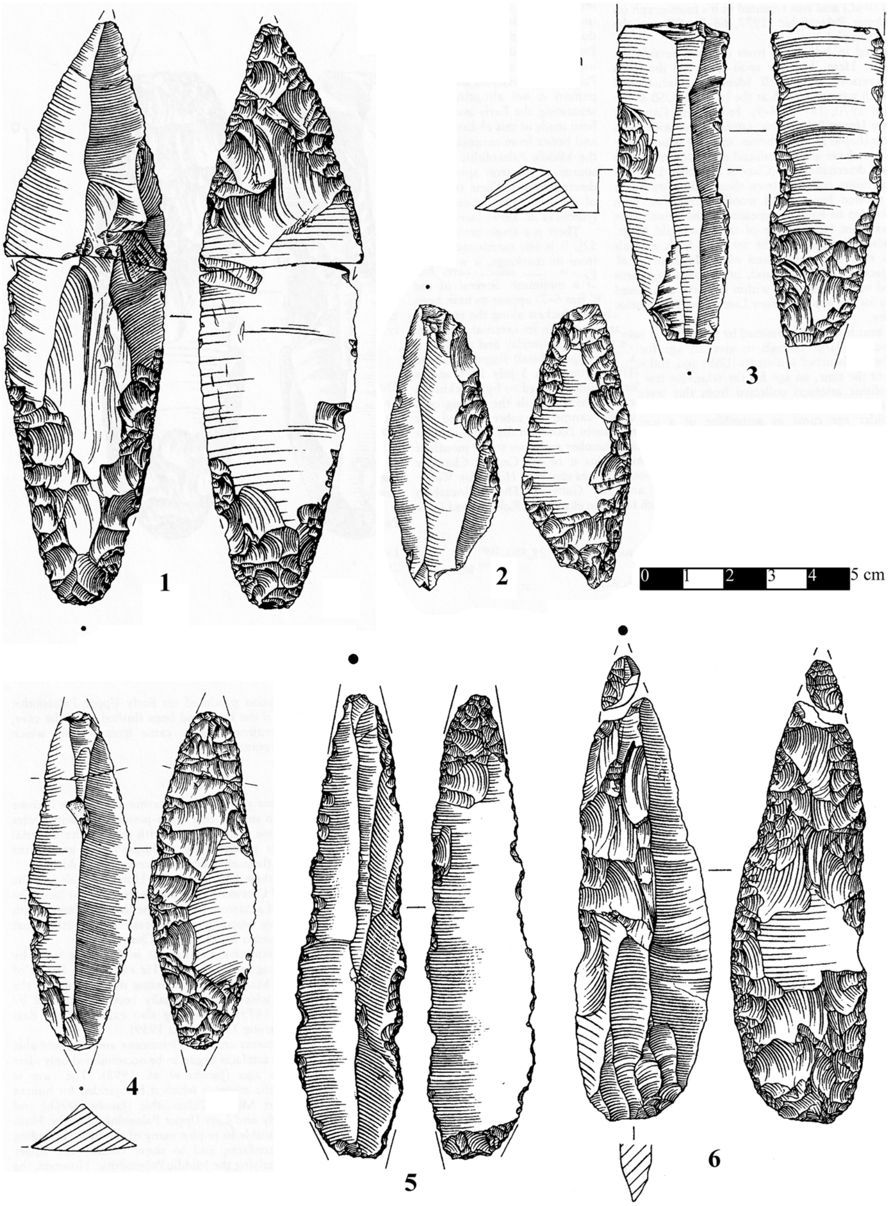

Fig. 4 Beedings site, Great Britain:1—J-type blade-point; Robin Hood Cave, Great Britain: 2–4—J-type blade-points; Kent's Cavern, Great Britain: 5–6—J-type blade-points (modified after Jacobi (2007))

from just a few sites. As Flas writes (2011, p. 611), "*they are far less numerous than the former* (J-type points), *except in the Ranis 2 assemblage* (Hülle, 1977), *and are found at only a few sites* (*Paviland Cave*, *Kent's Cavern*, *Soldier's Hole*, *Robin Hood Cave*, *Bramford Road*, *Nietoperzowa Cave*)". The seven sites with bifacial

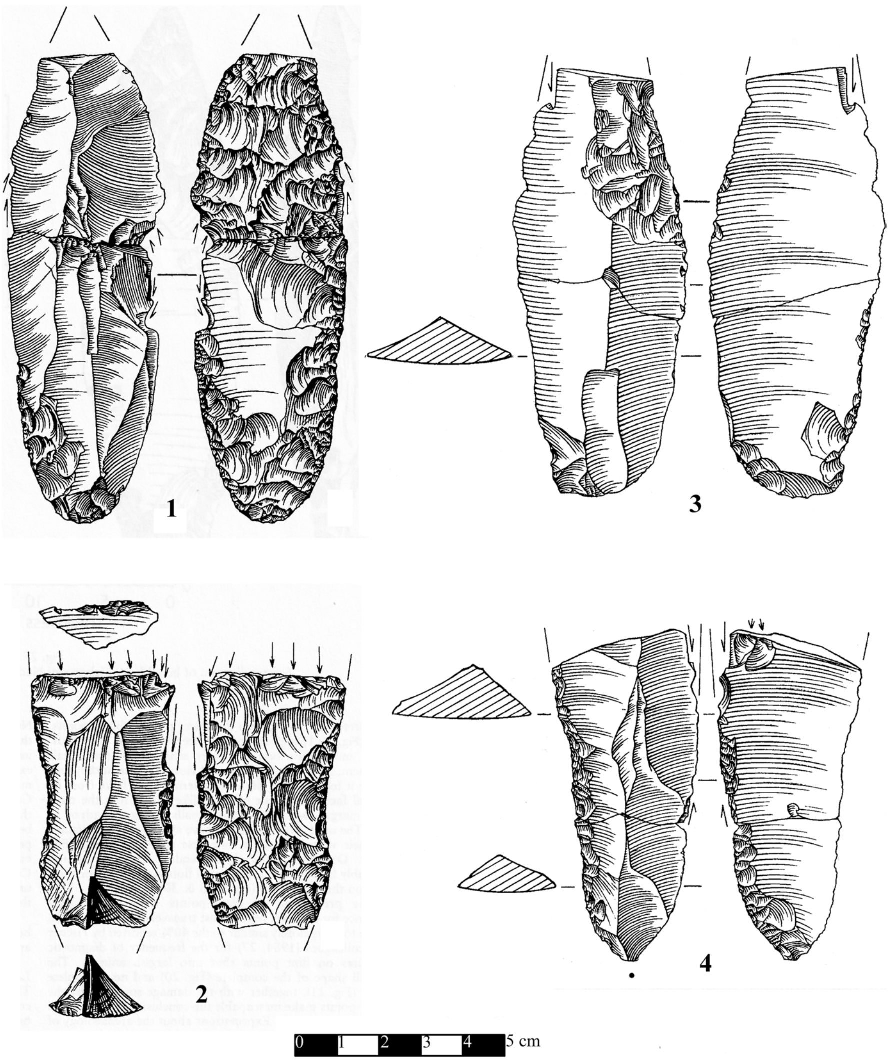

Fig. 5 Beedings site, Great Britain: 1–4—J-type blade-points with projectile damage traces (modified after Jacobi (2007))

points compose only 17.5% of the 40 known LRJ loci in Europe identified by Flas (2011; Fig. 1). Because of their scattered occurrence, bifacial points should not be considered typical of LRJ assemblages. Flas (2011, p. 611) also noted production of the bifacial points "*on blocks or large flakes*" with no detailed discussions on their manufacture. Very recently, a study using 3D geometric morphometrics and infrared spectroscopy was conducted on LRJ bifacial points from Ilsenhöhle Ranis (Weiss et al., 2019). The first preliminary results indicate several features of the LRJ bifacial points: (1) they are thinner than late MP bifacial points and closer in thickness

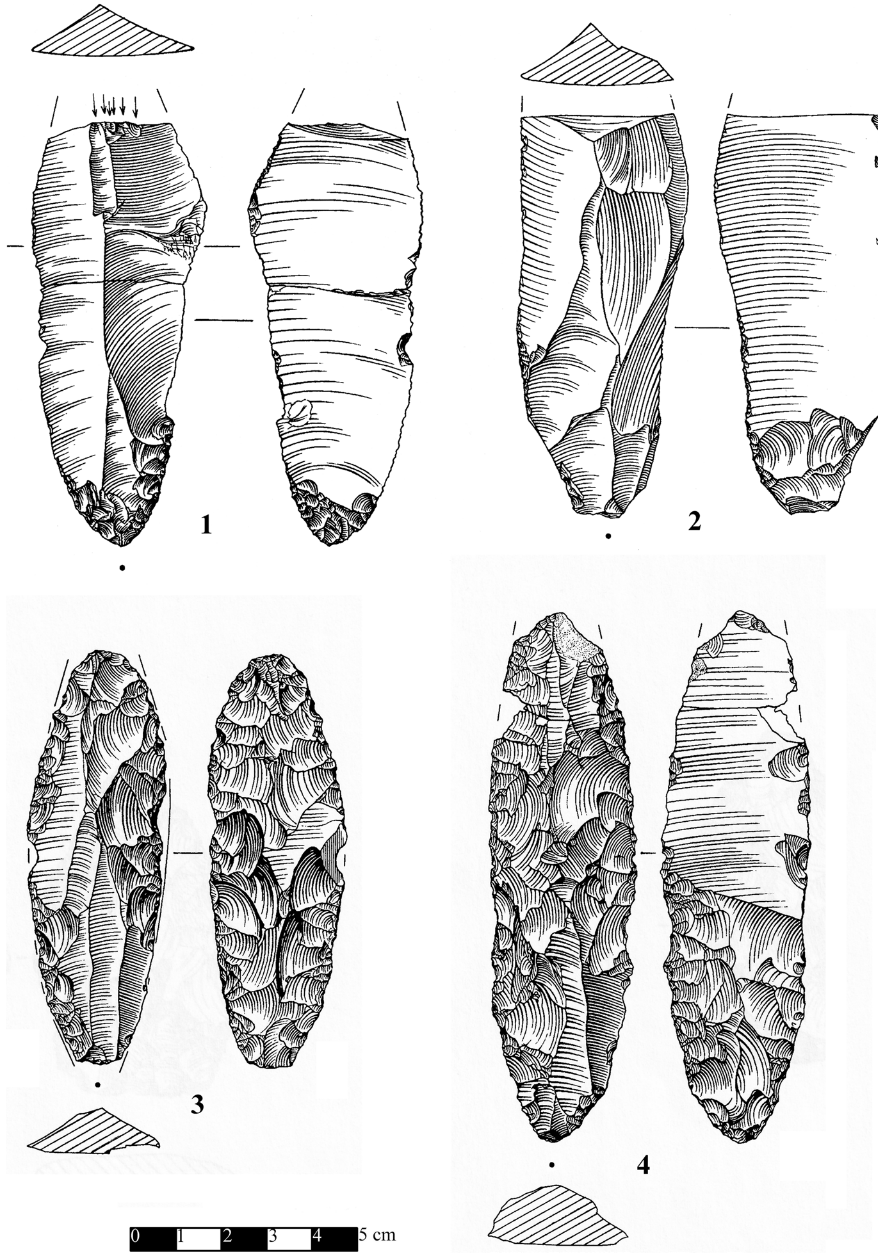

Fig. 6 Beedings site, Great Britain: 1—J-type blade-point with projectile damage traces; 2—a semi-product of a J-type blade-point; Kent's Cavern, Great Britain: 3–4—almost fully bifacial J-type blade-points (modified after Jacobi (2007))

to much later Solutrean points; (2) they were shaped by secondary treatment with a soft hammer, but; (3) there is no evidence of heat treatment or pressure technique. It is not clear yet that the bifacial pieces represent an entirely separate production process from the J-type points. Partially bifacial J-type points are numerous and so we cannot exclude the possibility that more extensive secondary treatment of these blade-points could have led to the creation of bifacial-like points at a few LRJ sites (e.g., Chmielewski, 1961: Pl. XVI, 1; Flas, 2012: Fig. 5, 2; Jacobi, 2007: Fig. 44, 1–2) (Fig. 6: 3–4). This would be especially likely at sites where high-quality lithic raw material was scarce. The latter suggestion is bolstered by the similar pointed and symmetrical forms of both bifacial points and blade-points in the LRJ (e.g., Richter, 2008, 2009: Fig. 9, 1–6).

In sum, it is hypothesized here that LRJ bifacial leaf points might not represent the result of genuine bifacial *façonnage*, as, for example, is the cases with MP Micoquian or EUP Szeletian assemblages in central Europe. Instead, they could be a fully-bifacially retouched variant of the normally partially-bifacial J-type blade-points. If this is the case, then the bifacial points in the LRJ do not demonstrate a cultural link to late MP/EUP industries with bifacial production, and we may search for the "roots" of the LRJ in industries having only unifacial tool shaping traditions.

Due to the specific hunting-oriented characteristics of most sites, we do not observe a wide range of so-called *domestic tool classes* and types within the LRJ assemblages. This situation is well-illustrated by the recently excavated Glaston site in England, where the shaped tools are limited to a single complete leaf blade-point and two "notched flakes." What is identified as a fragmented leaf blade-point is in fact a re-shaping or projectile damage flake from a point (Cooper et al., 2012: Fig. 8, p. 79–80).

The Beedings site provides the only possible domestic tool-kit for the LRJ (see also Flas, 2008, pp. 33–35; 2011, p. 611), although even here the situation is not really convincing. The seven endscrapers recognized at Beedings, at first glance, appear to be typologically simple ones with thin, non-carinated working edges, produced mostly on bidirectional blades (Jacobi, 2007: Figs. 16–18; pp. 244–245). However, from our point of view, the four illustrated pieces (Fig. 7: 1–2) may well be semi-products (unfinished versions) of leaf blade-points, with completely shaped, sub-rounded basal margins at the proximal ends and some partial and irregular retouch at the distal ends of the blade blanks. The rather light retouch treatment on most of the pieces (Jacobi, 2007: Figs. 16, 1; 17, 1; 18, 2) is likely connected to LRJ opposed-platform core reduction processes, which produced blanks with converging distal ends needing little secondary treatment. It also explains why pieces with sufficiently well retouched basal parts sometimes look morphologically like endscrapers. If our suggestion that four specimens are actually unfinished blade points is correct, then endscrapers are nearly eliminated from LRJ tool-kits.

As discussed above, many of the 11 Beedings burins, aside of a single dihedral burin (Jacobi, 2007: Figs. 13, 1), might in fact represent various burin-cores and cores on flakes/truncated-faceted pieces. This is also the case with five Kostenki knives and seven composite tools.

Leaving aside the 36 blade-points and a single typologically uncertain "chamfered blade," there are only 13 shaped tools left in the assemblage studied by Jacobi

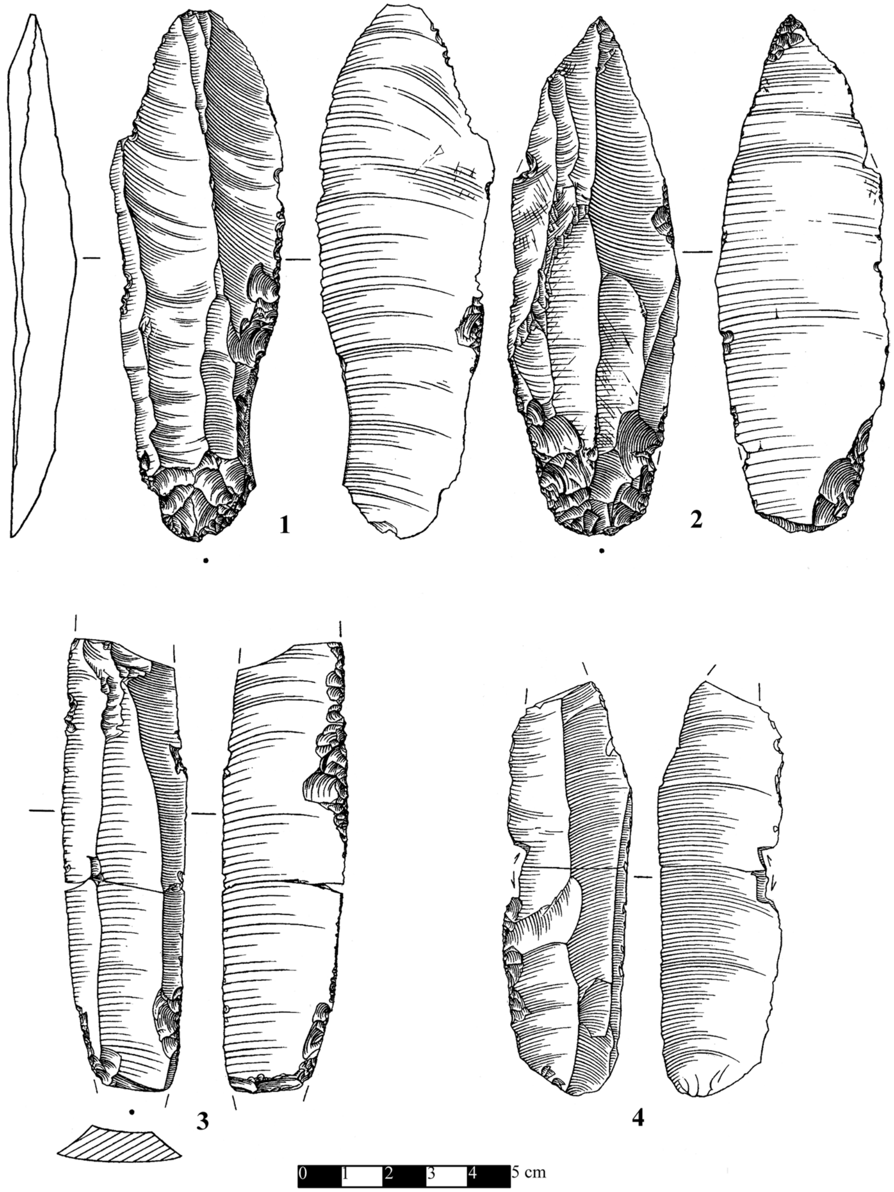

Fig. 7 Beedings site, Great Britain: 1–2—probably semi-products of J-type blade-points instead of "end-scrapers"; 3–4—probably semi-products of J-type blade-points instead of "laterally retouched pieces" (modified after Jacobi (2007))

(Jacobi, 2007: Tabl. 4). Some of these tools may also be associated with blade-points. These are five "laterally retouched pieces" (Jacobi, 2007, pp. 260, 262). All four of the specimens illustrated by Jacobi (Jacobi, 2007: Fig. 31, 1–4) (Fig. 7: 3–4) are fragments of bidirectional blades, c. 3 cm wide, and probably no less than 10 cm long when complete, with light and irregular partial dorsal and ventral retouch. These particular pieces could well be, like the above-discussed endscrapers, semi-products of blade-points. Not having an illustration for the last "*laterally retouched piece*" being said "*a very small proximal fragment*' (Jacobi, 2007, p. 260), it is not clear at all what it is. Four more "*possible examples of laterally retouched pieces*" are small blade fragments, three having a bidirectional scar pattern, but "*it is difficult to be sure if retouch rather than natural damage or a result of utilization*" (Jacobi, 2007, p. 262). Consequently, the "laterally retouched pieces" cannot firmly be assigned to the category of domestic. Aside from that, two "*retouched truncations*" may not be real truncations either, given that one "*may be an example of* '*spontaneous retouch*'," and the modification of the second piece "*may be ancient damage*" (Jacobi, 2007, p. 245). The only borer or piercer in the tool-kit is also of a dubious character due to the remark "*there is no reason why it should not be of some more recent date*" (Jacobi, 2007, p. 245), e.g., a Mesolithic artifact. The un-illustrated piece with "six contiguous notches on its proximal left hand margin" (Jacobi, 2007, p. 266) appears to be the only other potential domestic implement in the LRJ tool-kit from Beedings.

The preceding discussion of the Beedings cores and tools calls for a re-consideration of the view of the site as an LRJ living site. First, a limited range of knapping activities occurred at the site. The absence of any pre-cores and large, opposed-platform cores for serial detachment of long blades indicate that much of the blade core production occurred off-site, perhaps at a workshop. LRJ people mainly brought completed leaf blade-points and long blade-blanks for further manufacture to the site. Aside from five rather small and exhausted opposed-platform blade cores showing that some blade bidirectional reduction occurred at the site, the most clearly visible on-site blank production is represented by burin-cores and cores on flakes or truncated-faceted pieces. The surviving lithic assemblage, collected long ago and much reduced due to loss over time, contains no products of the small cores, such as bladelets and small flakes or chips, although the core-like piece types themselves certainly indicate that such artifacts were produced on site. As for shaped tools, aside from the often fragmented but morphologically clear and numerous leaf blade-points, the majority of specimens identified as "domestic" tools are actually damaged projectiles or semi-products of the blade-points. This reconsideration of the Beedings assemblage leads us to suggest that it was actually a short-term hunting site used, like other LRJ sites, for butchering or consumption of hunted prey. On-site reduction of burin-cores and cores on flake/truncated-faceted pieces was likely due to a scarcity of large-sized flint packages around the site. The small bladelets and flakes were probably used as cutting tools with no additional retouch. Taking into consideration the site's location high on Beedings Hill, with a view over vast areas around the site, it is additionally possible to suggest that the site was periodically and repeatedly visited by LRJ hunters to track ungulate herds in preparation for hunting them.

The newly proposed interpretation for Beedings site and its lithic artifacts drives us to the concluding paragraph of the article on the recent investigations:

To conclude, one question remains. The LRJ is currently represented across Europe by poorly stratified cave assemblages and isolated finds, mostly from surface contexts. Beedings appears exceptional in that it comprises a technologically diverse and rich LRJ assemblage in an open air context. Should we now consider the possibility that cave contexts are only showing a restrictive part of the technology and may have occupied a marginal position in LRJ landscape use and ecology? Conversely should we start to conclude that a site such as Beedings does not represent a specialized hunting camp but something more central in EUP settlement patterns of the northern European Plain? (Pope et al., 2013, p. 25).

From our perspective, the Beedings LRJ site, as well as the Gladston site and possibly some other known open-air surface find spots, could be different from LRJ cave occupations, although the latter loci usually do not have enough material to determine their potential functions. At the same time, the open-air sites also appear to fall on a spectrum of different kinds of hunting camp. As mentioned above, the likelihood that all LRJ sites are hunting sites, with limited ranges of artifacts and activities, makes comparisons with other UP techno-complexes and industry types especially difficult.

LRJ Chronology and Absolute Dates

At some multi-layered sites, in situ deposits with LRJ assemblages are sandwiched between late MP and Early or Middle UP layers (e.g., Ilsenhöhle Ranis and Nietoperzowa cave sites). At other sites, LRJ lithics "*have been mixed with both Mousterian and Aurignacian* (*and/or Gravettian*) *artifacts during ancient excavations* (*e.g. Paviland*, *Hyena Den*, *Kent's Cavern*, *Pin Hole*, *Spy*, *Goyet*" (Flas, 2011, p. 608). These observations certainly indicate an early Upper Paleolithic chronostratigraphy for the LRJ. Furthermore, as far as we know, the LRJ has never been found above or stratified between Gravettian layers, which also negate a later, mid-UP status for the industry.

Absolute dates for the LRJ corroborate the stratigraphy for the most part, showing a range period between c. 44–42 and 36 or 31 ka cal BP (e.g., Jacobi et al., 2006; Jacobi, 2007, pp. 278–307; Flas, 2011, pp. 608–609; Cooper et al., 2012, pp. 83–85, 88–90; Krajcarz et al., 2018, pp. 396–398; Kot et al., 2021). For the purposes of this article, it is most important to understand the initial appearance LRJ and its correlation with GI-11–GI-9 (c. 43–40 ka cal BP) and possibly even with GS-12. At the same time, some later dates have also led researchers to suggest that the LRJ industry survived HE-4 and the CI super eruption events at c. 39–36 ka cal BP. Taking into consideration the possible "LRJ later chronological phase," the chronology of the J-type blade-point industry appears to overlap with the Proto-Aurignacian, which seemingly existed before and after HE-4 and the CI, whereas the LRJ's possible later post-HE-4 and CI phase chronologically coincides with the Early Aurignacian.

Here, it is also worth mentioning many problems with absolute dating of multi-layered cave sites having LRJ artifact-bearing sediments, recently critically analyzed for the Kraków–Częstochowa Upland region. Krajcarz et al., (2018, pp. 387, 396) identify the following factors in a study of Nietoperzowa Cave: "*possible admixture of some material in sediment*, *and of redeposition between layers*" caused by "*frost action*, *animal burrowing*, *and human digging or construction* *activity*," explaining why "*we have presented a number of dates that do not fit with the chronological order of the layer.*" In this site, sample selection and dating were further complicated by low collagen levels in many dated bones and also by both "*attribution of material to particular layers was not always certain during excavation* (*Teresa Madeyska*, *pers. comm.*)" during the 1956–1963 excavations. Unfortunately, cave bear "*bones with signs of human activity* (*cut marks*) *were not accessible for this study*" (Krajcarz et al., 2018, p. 396). Another study for Koziarnia Cave (Kot et al., 2021: Tables 1–3) underlined some more problems. They conclude that "*U-series dating is probably unreliable at this site*" (Kot et al., 2021, p. 6) due to the presence of two U-series dates on ursid teeth around 25–24 ka BP, one of which, sample B 200 (a cave bear tooth) from the late MP layer I/17, was also AMS radiocarbon dated to 40,600 ± 1200 uncal BP (Poz-116687). They state that "*Koziarnia Cave indeed was alternately occupied by humans and bears*" (Kot et al., 2021, p. 1), concluding that a considerable amount of material admixture could have occurred within the sediments.

The insecurity of U-series dating at Koziarnia Cave might have some significance for the single TL date for a burnt leaf blade-point of 31,100 ± 5700 uncal BP from the Beedings site (QTLS BDG2) (Jacobi, 2007, pp. 299, 318–321). The single Beedings date has an overly large standard deviation and it certainly only indicates a minimum age for the site (e.g., Jacobi, 2007, pp. 299, 305; Flas, 2011, p. 608). Moreover, the recently established chronology for the Koziarnia Cave late MP—mid UP sedimentary sequence shows Gravettian occupations dated to around c. 35–31 ka cal BP (Kot et al., 2021). It is indeed reasonable not to believe that the LRJ was produced after c. 36 ka cal BP (after GS-8/GI-8) and that it is not associated with the Gravettian techno-complex in any respect.

In summary, geochronological, stratigraphic, and archaeological evidence indicate that the LRJ industry overlaps the time range of both the late IUP, beginning just before HE-4 and the CI, and the early EUP, just post-HE-4 and CI. At the same

Table 1 Overview of radiocarbon dating for Líšeň/Podolí I site after Škrdla, 2017: Tab. 4.1; calibrated using CalPal software (Weninger & Jöris 2008) on the IntCal13 curve (Reimer et al., 2013)

Lab no	^{14}C BP	STD	calBP	2 sigma	year	Context
Poz-37344	38,400	± 700	42,419	± 290	2010	PT03/10, charcoal concentration
Poz-76152	16,050	± 240	19,394	± 294	2015	Scattered charcoal
Poz-76153	32,800	± 1200	37,582	± 1410	2015	Scattered charcoal
Poz-76199	29,000	± 300	33,432	± 436	2015	Scattered charcoal
Poz-76201	18,300	± 210	22,198	± 207	2015	Scattered charcoal
Poz-76202	30,100	± 500	34,594	± 477	2015	Scattered charcoal
Poz-87125	37,900	± 700	42,129	± 338	2016	Lens
Poz-87126	37,100	± 800	41,659	± 476	2016	Lens
Poz-87128	36,900	± 600	41,630	± 379	2016	Lens
Poz-87129	35,800	± 600	40,797	± 560	2016	Lens
Poz-87130	39,400	± 1000	43,164	± 658	2016	Lens
Poz-87131	35,500	± 600	40,540	± 563	2016	scattered charcoal

time, on a pan-European scale, the LRJ overlaps with the entire known time range for the Proto-Aurignacian, while it also co-occurs with the Early Aurignacian during post-HE-4 and CI times. The fact that the LRJ seems to have coexisted with the two earliest phases of the Aurignacian is consistent with stratigraphic evidence from some sites in Great Britain and Belgium where LRJ layers are overlain by chronologically more recent Late/Evolved Aurignacian layers. Detailed studies of material from Great Britain and Belgium (e.g. Flas, 2009) show conclusively that the LRJ and Aurignacian differ in almost all lithic techno-typological criteria and cannot be viewed as components of a single techno-complex, as was once suggested by the term "*Aurignacian with leaf-points*" (see Flas, 2009, p. 135). Accordingly, at least two successive parallel IUP / EUP industry types, Proto-Aurignacian and then Early Aurignacian, co-existed in central and western Europe with the LRJ. In this regard, it is important to note that the two Aurignacian industry types are just different components of the broader Aurignacian techno-complex, whereas the LRJ is considered to be a single techno-complex with no important industrial changes through time.

The Makers of the LRJ

It has been always stated that no human remains are directly associated with LRJ sites and assemblages, which is consistent with the idea that all known sites are short-term and ephemeral hunting stations. Nevertheless, the clear UP techno-typological characteristics for LRJ assemblages and some human remains at Kent's Cavern (see below) led to the proposition that *Homo sapiens* produced the industry (e.g., Swainstone, 1999, pp. 41–42). On the other hand, the long-argued connections between the LRJ and the late MP in north-western Europe, as well as the Spy Cave Neanderthals have led some scholars to argue that Neanderthals produced LRJ assemblages (e.g., Otte, 1990, pp. 248–249; Jacobi, 1999, p. 37). The latter point of view was strongly advocated by Flas and J.-J. Hublin (e.g., Flas, 2011, pp. 616–618; Hublin, 2015, pp. 198–200). At that time, the attribution of the LRJ to Neanderthals was based on new dates for the Spy Cave Neanderthals of c. 41.2–37.8 cal BP (Semal et al., 2009), which seemed to overlap with the known LRJ chronology, although before it was thought that the Belgian cave's Neanderthals belonged to Mousterian. However, more recently, dates for Neanderthals from Spy and two other Belgian caves have been obtained using the new CSRA method for AMS dating. These newly-derived ages show older dates for the latest Belgian Neanderthals, c. 44.2–40.6 cal BP. Based on this information, the LRJ does not look like the product of these Neanderthals, who probably produced late Mousterian assemblages (Devièce et al., 2021). Returning to Kent's Cavern, we point to radiocarbon dates associated with the *Homo sapiens* partial right maxilla, discovered in 1927: the direct date of c. 36.4–34.7 ka cal BP obtained in the 1980s and the date of c. 44.2–41.5 ka cal BP obtained in 2010–2011 (Higham et al., 2011). The later AMS dates were run using ultrafiltration during collagen extraction from faunal remains found just above and below the maxilla find spot. These bones and the human fossil were likely associated with LRJ artifacts, "*a small number of broken blades, but deeper than a group of artefacts tentatively identified as Aurignacian*" (Jacobi, 2007, p. 307). Although some skepticism has been expressed about the dating of the Kent's Cavern *Homo sapiens* maxilla and its archaeological association (Hublin, 2015, p. 200), its connection to LRJ is more likely than the Spy Cave Neanderthals.

Stratigraphic, anatomical and chronological evidence do not permit us to conclude definitively whether Neanderthals or *Homo sapiens* produced the LRJ. Both taxa are associated with overlapping AMS dates for the GS-12–GI-10 geochronological interval, clearly preceding HE-4 and the CI event. From our point of view, the LRJ "anthropological puzzle" can be resolved only through insights from archaeological evidence.

LRJ Site Distribution in Europe and Hypotheses about the Industry's Origin

LRJ assemblages have a distinct geographic distribution within Europe. Flas (e.g., 2011: Fig. 1) counted in total 40 LRJ loci, with 32 of them (80%) located in Great Britain (see also Jacobi, 2007: Figs. 39, 42, 49). Adding to the British loci three more loci in the neighboring Belgium and The Netherlands, 35 of the 40 (87.5%) known LRJ loci are situated within the north-western part of Europe. The remaining five loci, in Germany and Poland, confirm that LRJ sites and find spots occur in the so-called lowland belt of northern Europe. This site geography led to the hypothesis that the LRJ represented cold environment-adapted life styles in the "*steppe-tundra or tundra of the Lowlands*," associated with the creation of "*improved kinds of hunter's weapons*" (Kozłowski & Kozłowski, 1979, p. 23).

The location of LRJ loci in north-western Europe has also led to various ideas about the industry's origin in this part of Europe and the neighboring Germany. One common view is that the roots of the LRJ can be found in some late Middle Paleolithic industries with bifacial leaf points, such as the Belgian Evolved Mousterian and German Altmuehlian (e.g., Chmielewski, 1961; Allsworth-Jones, 1986; Kozłowski, 1990; Otte, 1990, 2000; Ulrix-Closset, 1995; Flas, 2000–2001), although a recent re-evaluation of the Altmuehlian shows that it is part of the southern German Late Micoquian (Richter 2008–2009). At the same time, the absence of late MP industries with leaf points, similar to the Belgian and German ones, in Great Britain is a notable anomaly, given the large number of LRJ loci there. Despite some industrial-chronological problems for the Belgian and German late MP find complexes (see Flas, 2008, pp. 107–120), it is still acknowledged "*…that some technical behaviors seen in the LRJ already existed in industries from the first half of the Interpleniglacial in Northern Europe: the presence of bifacial leaf-points and blade production, especially from bidirectional cores* (*Piekary IIa and Ksiecia Jozefa sites*)" with a conclusion that "*LRJ thus developed around 38,000 BP* (*c. 43,000 cal. BP*) *and shows both an* '*Upper Paleolithic*' *technology and typology and similarities with the Late Middle Paleolithic industries of the regions where it evolved.*" (Flas, 2011, p. 616). The proposed late MP origin for the LRJ industry was also a reason for considering it to have been produced by Neanderthals.

LRJ: a Short New Resume

On the basis of this extended and critical overview of the LRJ industry, we can challenge to some extent many accepted views about the industry, its technology and chronology. We proposed the following.

Geochronologically, the LRJ dates cover the period before (from c. 44–43 ka cal BP) and after (maximum up to c. 36 ka cal BP) HE-4 and the CI event, c. GS-12/GI-11–GI-8/GS-8. It closely coincides in time, but not in geography, with the Proto-Aurignacian.

Technologically, LRJ demonstrates a variety of primary reduction methods. The best known one is aimed at the serial production of long and wide blades, which were in turn used mainly for manufacturing J-type points. The blade technology is based on application of central *lame à crête* technique to opposed-platform bidirectional cores. Platforms were adjusted through faceting and often with edge abrasion, and there is no use of core tablet technique. Two forms of ad hoc bladelet reduction featured the use of both cores on flakes/truncated-faceted pieces and burin-cores. The bladelets produced were probably not retouched and were probably used as cutting tools rather than as parts of hunting projectile weaponry. As a result, the primary reduction methods do resemble some known Eurasian industries within the time range from early MP to later IUP, but they do not resemble Aurignacian or Gravettian technologies.

Typologically, LRJ assemblages are deficient in retouched tools besides the characteristic points. This is due to the fact that known localities are limited to short-term, ephemeral hunting stations. Most of the shaped tools are J-type blade-points with partial bifacial flat retouch most likely serving as projectile points. We argue that these artifacts are best understood as a blade variant of the Emireh Levallois point type. Fully bifacial points are much scarcer and might be not purposefully made bifaces at all but rather heavily re-worked or rejuvenated blade-points. So called domestic tools are limited to a few simple endscrapers and burins, as well as slightly more numerous retouched blades and flakes, including denticulates and notched items. Accordingly, LRJ tool-kits are rather typologically neutral aside from the J-type blade points and bifacial points, which show not MP but UP technological characteristics. All of this lithic and chronological evidence points to the LRJ being closely affiliated with the IUP. The absence of any real evidence for the occurrence of bone tools and personal ornaments in LRJ assemblages (Flas, 2011, p. 613) should probably be attributed to the fact that known localities are limited to short-term hunting sites rather than to the "primitive" nature of the industry.

Further Possibilities for Better Understanding the LRJ

There are several research priorities for future studies of the LRJ. First, it should be possible to get a more in-depth understanding of some already excavated sites through multi-disciplinary studies (e.g., Kot et al., 2021; Pope et al., 2013). Second, detailed studies of some particular artifact forms, bifacial leaf points for example, will help clarify their relationships with other industries (e.g., Weiss et al., 2019). Third, more dating efforts are desirable for both particular sites (e.g., Krajcarz et al., 2018) and human remains, such as the new attempt at directly dating the Kent's Cavern *Homo sapiens* maxilla. Fourth, systematic search for new LRJ sites with evidence of more than just hunting activity, such as longer-term living sites, would produce a much broader understanding of LRJ adaptations. Finding LRJ workshops could also improve understanding of primary and secondary manufacture processes (M. Kot, personal communication, 2019). Fifth, some loci and assemblages representing possible LRJ sites and/or containing characteristic J-type blade-points have been rejected from the lists of LRJ sites (e.g., Flas, 2011, p. 608), but these data should be checked.

The sections which follow demonstrate the results of studies following the last two research priorities in southern Moravia, Czech Republic, with additional observations for some materials in other parts of central Europe.

Twenty-First Century Research on the IUP and EUP in Southern Moravia

Beginning in 2005, one of us (P. Š.) initiated a new research study (in collaboration with G. Tostevin) on the IUP and EUP in southern Moravia, in the south-eastern part of Czech Republic. This project continues to the present day. The project was further expanded (by P. Š.) with new excavations at the sites of Líšeň/Podolí I and Ořechov IV in 2015–2018 (e.g., Škrdla et al., 2016a; 2017). The other author of this article joined in research on the UP of southern Moravia in 2015. Results from the first 12 years of the new research project on the IUP and EUP in Moravia were published in book form in 2017 (Škrdla, 2017). Research on the IUP and EUP continued after 2017 with excavations and studies of other IUP and EUP sites from southern Moravia (e.g., Demidenko et al., 2017, 2020). As is explained below, this work, combined with a re-evaluation of older and recently-excavated collections from the region, led to a hypothesis that the LRJ actually originated in Moravia.

Earlier Discoveries of LRJ-Like Finds in the Czech Republic

Although the traditional range for the LRJ does not extend into the Czech Republic, some prior finds suggest that in fact the industry also occurred there. In his review of the LRJ, Flas mentioned some isolated J-type points in caves, "*pointes de Jerzmanowice isolées en grotte*" (Flas, 2008, p. 184) in Czech Republic, "*for which chronocultural attributions are debated* (*Nad Kačákem and Pekárna Caves*)", as well as, equally doubtful for him, "*surface collections from Dubicko*, *Ondratice and the Brno region*" (Flas, 2011, pp. 607–608). From our point of view, the two clusters of finds, the caves and surface find spots, should be analyzed separately one from another. Each cluster contains genuine-looking J-type points but in very different contexts.

The two caves, Nad Kačákem in the Bohemian Karst, the westernmost region in Czech Republic (Ernestová, 2006; Prošek, 1947) and Pekárna Cave, in the southern part of the Moravian Karst, southern Moravia (Valoch, 1960, 1999), are mostly known for Late UP, Magdalenian finds. Pekárna is still considered to be a key Magdalenian site in Moravia (Svoboda, 2000, p. 182). At the same time, some typical J-type blade-points were identified in the two caves. The point on flint from Nad Kačákem Cave, now lost but published and illustrated (Fig. 8: 5), was extracted together with a blade of yellow limno-quartzite from a loess sediment in the cave in the late 1940s by F. Prošek (1947, pp. 9–11; Obr. 13). Valoch (1999: Obr. 4, 8–10, 14) also illustrated what we have identified as four J-type blade-points (Fig. 8: 1–4) among the mostly Magdalenian lithics excavated by K. Absolon in the 1920s at Pekárna Cave. Unfortunately, these points cannot be associated with other

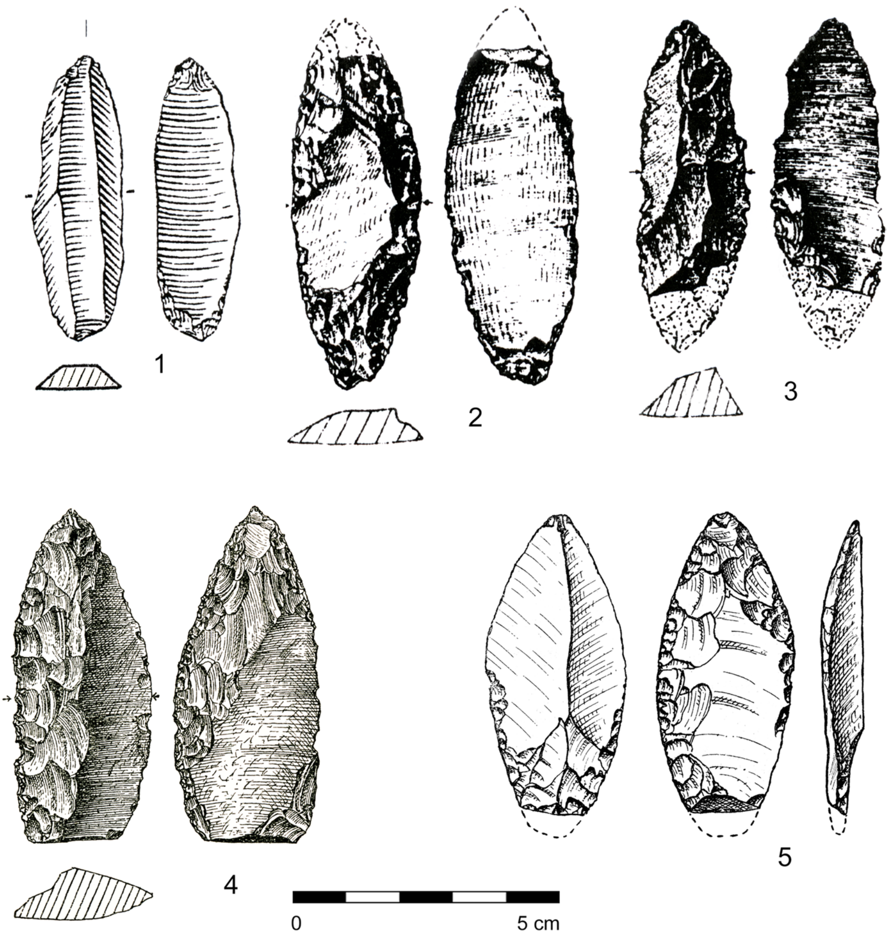

Fig. 8 Pekárna Cave, southern part of Moravian Karst, Southern Moravia, Czech Republic: 1–4—J-type blade-points (modified after Valoch (1999)); Nad Kačákem Cave, Bohemian Karst, Bohemia, Czech Republic: 5—J-type blade-point (modified after Prošek (1947))

possible LRJ lithics at the two caves. Nonetheless, these points are just as convincing as specimens widely accepted as blade-point finds at many loci in north-western Europe. Therefore, the two Czech caves should be included into the list of LRJ sites in Europe.

The surface find spots, aside from the Dubicko loci, located in Olomouc Region of Moravia, which we have not yet re-studied, typically contained artifacts representing multiple UP components, and it was always difficult to identify loci with industrially homogeneous UP finds. However, the J-type blade-point is an unambiguous typological indicator of the LRJ. Such points have quite often been described from surface find spots in Moravia. A review of the published data (still ongoing) shows that J-type points are noted for the following loci: loci situated in Bobrava River Valley in southern Moravia, e.g., Ořechov (Valoch, 1956: Tab. III, 25), Želešice I (Valoch,1956: Tab. VI, 78–79), Želešice (Hahn, 1977: Tafel 133, 12); various Ondratice I-X loci in the Olomous Region of Moravia, e.g., Ondratice IV-Syrovátky (Valoch, 1967: Tab. V, 2, 4); Ondratice (Svoboda, 1980: Obr. 39, 9; Allsworth-Jones, 1986: Fig. 39, 2); the Neslovice loci in southern Moravia, c. 15 km in a straight distance to the southwest-west of Brno city (Valoch, 1958: Tab. VIII, 1 3). The most noteworthy are two "Bohunician" loci close to the Stránská skála limestone cliff, the well-known Stránská skála Bohunician and Evolved Aurignacian sites and chert outcrops at the eastern margins of the Brno Basin in southern Moravia—Podolí I and Líšeň (Valoch, 1962: Tab. VII, 4; Oliva, 1981: Abb. 5, 2–3, 7; 9, 2–4, 8; Svoboda, 1987: Obr. 32, 1–12; 33, 1, 4; 34, 14). The Podolí I and Líšeň surface loci were and still are of a particular interest having multiple examples of artifacts which appear to be J-type points: at least four pieces in Podolí I and at least 20 pieces in Líšeň (Figs. 9 and 10). Most of the other find spots contain just one or two such points, although in his tool type-list for Szeletian surface loci Ořechov and Želešice I, Valoch noted the presence of eight "*pointes à face plan*" for Ořechov and 14 for Želešice I. Unfortunately, there are no illustrations of the points (Valoch, 1957: Tab. I). J. Svoboda later identified these as real J-type points, "*čepelové hroty s ventrální retuší omezenou na bazální a terminální cast. Tyto artefakty označuje W.* Chmielewski (1961) *jako hroty typu Jerzmanowic*" (Translation: "*blade points with ventral retouch restricted to their proximal and distal ends. W. Chmilewski* (*1961*) *determined those artifacts as Jerzmanowice-type point*") (Svoboda, 1987, p. 86).

At the same time, the Podolí I and Líšeň loci, with multiple artifacts appearing to be J-type points, also led some Moravian researchers to consider J-type points as an integral part of the Bohunician and Szeletian techno-complexes, not identifying any proper LRJ assemblages in the region. For example, the Podolí I finds served M. Oliva (1981) as the key assemblage for identification of the Bohunician industrial phenomenon in southern Moravia. Comparing the Líšeň surface lithics, which we believe represent a mixture of Bohunician and Evolved Aurignacian artifacts, with excavated materials from the nearby Stránská skála III and IIIa in situ and industrially homogeneous Bohunician lithic assemblages, Svoboda (1987, p. 86) in fact noted that the in situ assemblages only contained a single atypical example of J-type point, at Stránská skála IIIa (Svoboda, 1987: Obr. 26, 12). Even this specimen does not in fact look like a J-type point to us but is instead a true Levallois point with ventral-terminal retouch (see Svoboda, 1987: Obr. 24, 4). Furthermore, another

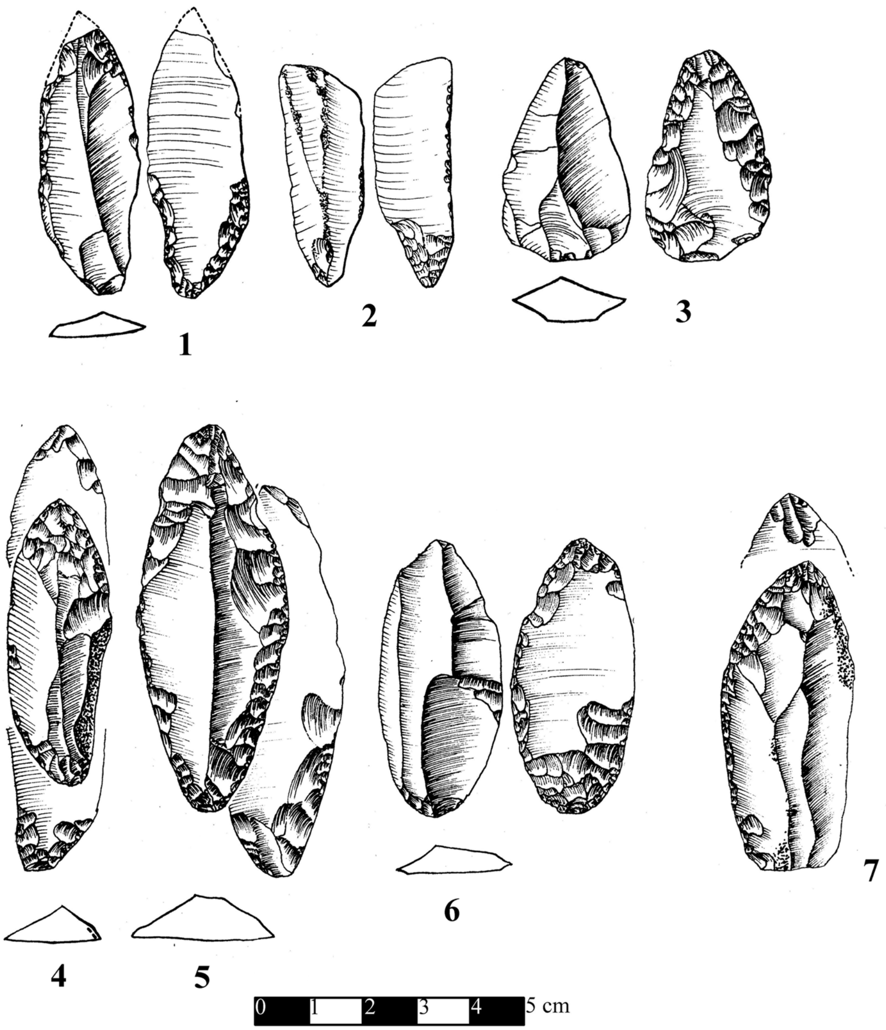

Fig. 9 Podolí surface loci, Southern Moravia, Czech Republic: 1–3—J-type blade-points (modified after Oliva (1981)); Líšeň surface loci, Southern Moravia, Czech Republic: 4–7—J-type blade-points (modified after Oliva (1981))

Bohunician site, Stránská skála III, excavated in 1982 by Valoch, did not contain any pieces resembling J-type points (Valoch et al., 2000). Thus, the homogeneous, stratigraphically in situ Bohunician assemblages did not contain any true J-type points, at least at the Stránská skála—Podolí /Líšeň site-loci cluster. This same inconsistency for the occurrence of J-type points in excavated and surface Bohunician sites was noted by J.K. Kozłowski 30 years ago (Kozłowski, 1990, p. 132).

Thus, a true role of J-type points within the Moravian IUP/EUP techno-complexes and industry types was still not clear when Flas was very carefully evaluating the occurrences of J-type points at Czech open-air sites more than 10 years ago.

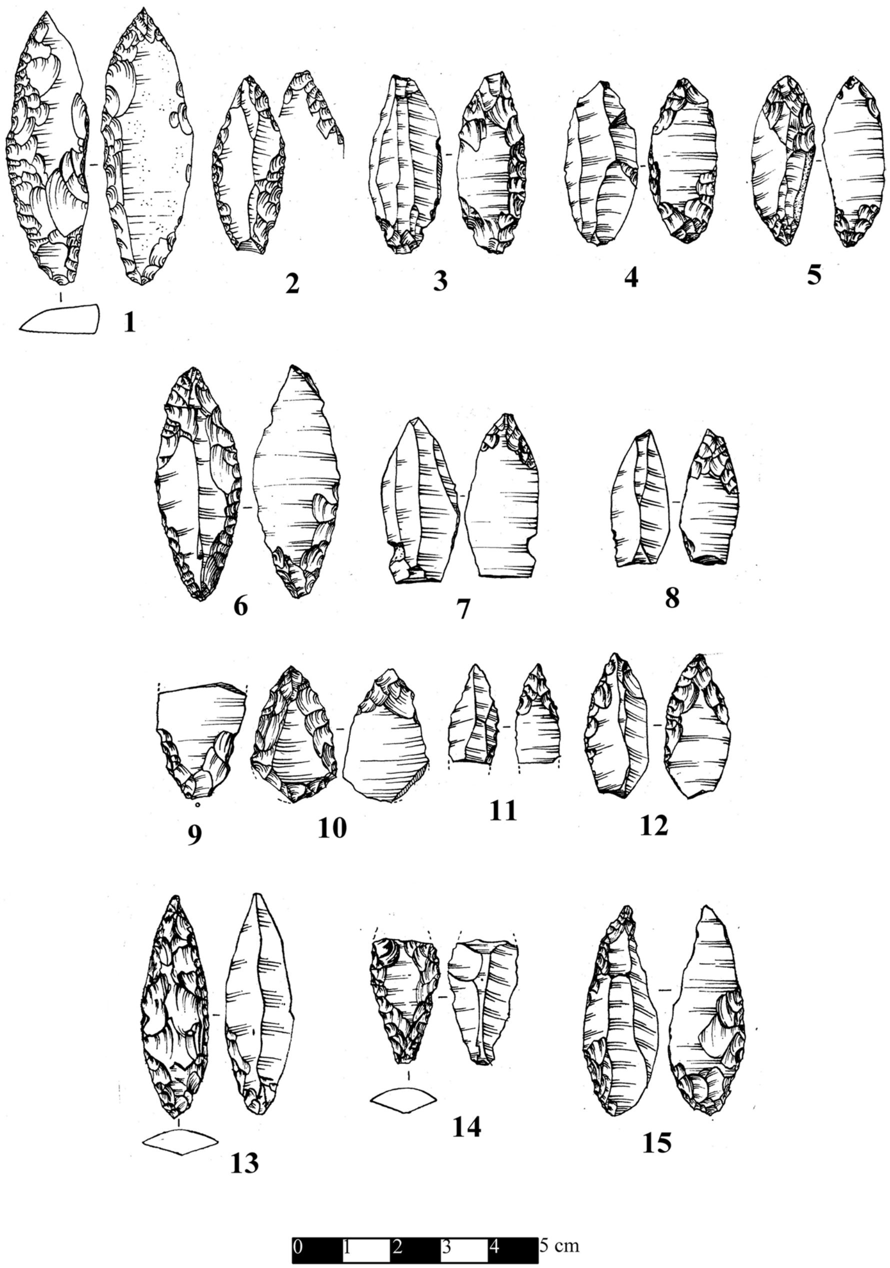

Fig. 10 Líšeň surface loci, Southern Moravia, Czech Republic: 1–15—J-type blade-points (modified after Svoboda (1987))

Possible LRJ Sites and Assemblages Investigated During the Twenty-First Century in Southern Moravia

Initial study of some new IUP Southern Moravian assemblages in 2019 resulted in suggestions on the presence of real and distinct LRJ assemblages in that region. Further work was interrupted by the Covid-19 pandemic. As a result, site and assemblage data and interpretations presented here are based upon our studies as of 2019, and these findings should be considered preliminary.

We emphasize that recent excavations did not confirm the in situ occurrence of potential LRJ deposits at all the above-mentioned surface loci with reported J-type blade-points in Moravia. For example, intensive field observations at the Ondratice loci excavations at the Ondratice I/Želeč in situ site (Mlejnek, 2015; Mlejnek et al., 2016) did not lead to recovery of any possible LRJ lithic types. It is likely that the part of the locus with an LRJ component had been already lost to erosion or destroyed by other processes. On the other hand, excavations at some other loci brought to light in situ deposits with Upper Paleolithic finds unusual for Moravia. We can now propose that, in addition to Pekárna Cave in southern Moravia, four Moravian sites and their artifacts represent LRJ sites with a good series of domestic tools, as well as core and debitage pieces in each assemblage (Fig. 11 Map). Two of the sites are the most informative for us (Želešice III/Želešice-Hoynerhügel and Líšeň/Podolí I), while two other sites (Líšeň I/Líšeň-Čtvrtě and Tvarožná X/ Tvarožná—"Za školou") have been, for different reasons, less informative to date.

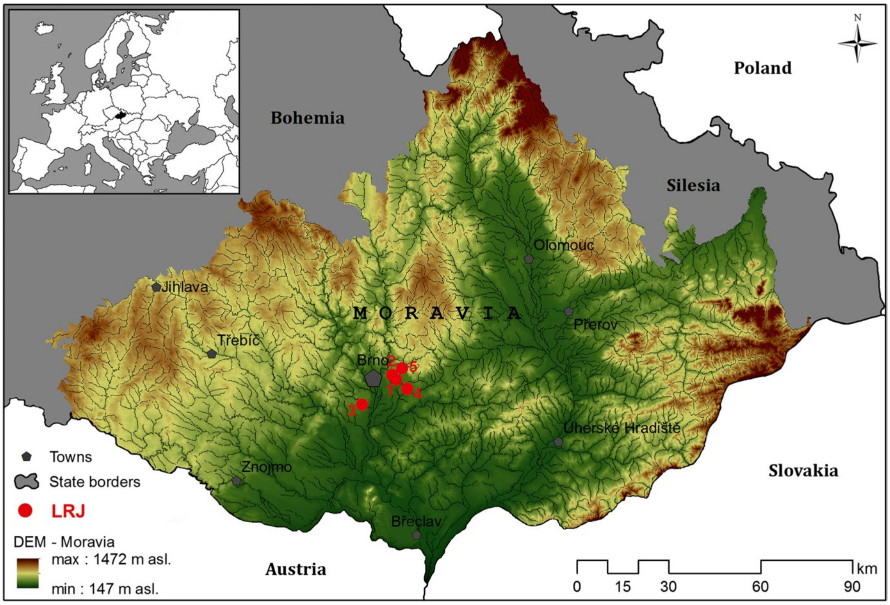

Fig. 11 Map of Moravia with location of LRJ sites in Southern Moravia mentioned in the article: 1—Líšeň/Podolí I, 2—Líšeň I/Líšeň—Čtvrtě, 3—Želešice III/Želešice-Hoynerhügel, 4—Tvarožná X, "Za školou," 5—Pekárna Cave

Želešice III/Želešice-Hoynerhügel Site (Fig. 11 Map)

This locality is situated in the Bobrava River area, within the official territories of Ořechov, Hajany, Želešice, Popovice, and Modřice municipalities (see Valoch, 1956: Obr. 1). The area has been revisited and studied many times since initial discoveries of many UP surface lithics in the 1920s. Early investigations recognized a dominance of Szeletian-associated lithic types, along with some Aurignacian and Bohunician related artifacts (Škrdla, 2017, pp. 32, 62–64). A detailed survey was conducted the late 2000s at Hoynerhügel (now also called Hajansky) field, where surface scatters of UP lithics cover an area of c. 450 × 400 m, to search for sediments preserving intact UP deposits. This led to the recognition of a smaller, denser cluster of UP finds covering an area of 120 × 130 m along the slope edge. A nearby area with no surface lithics was selected for 2010–2013 excavations, to test for buried deposits (Škrdla, 2017, pp. 26–30; Škrdla et al., 2014). In total, c. 16 m^2 were systematically excavated and all sediments were wet sieved using a 3-mm sieve. There is some "*vertical distribution of excavated artifact*s" and probably "*artifacts in the upper part of the section moved from a nearby area*, *where they laid on the surface and were subsequently redeposited*," and geology data "*indicated that artifacts in the upper part of the section were redeposited before its formation* (*MIS 2 or earlier*)" (Škrdla, 2017, p. 27). However, taking into consideration some data on artifact refits, raw materials, technology, and typology, the assemblage of artifacts recovered is industrially homogeneous. Three charcoal samples were dated at Poznan and Oxford labs to the time period preceding HE-4/CI Event, older 40 ka cal BP (Škrdla et al., 2014: Fig. 9). Two of them (from both Poznan and Oxford) are virtually of the same age, c. 46–44.6 ka cal BP, probably indicating GI-12 interval, which overlaps with dates for two in situ Szeletian sites, Vedrovice V, and Moravský Krumlov IV, located c. 20 km to the south-southwest (Škrdla et al., 2014, p. 95).

Of the 1505 lithic artifacts recovered during excavations at Želešice III/Želešice-Hoynerhügel, 413 pieces were recorded and mapped in place during excavations. The remaining 1092 pieces were collected during wet-sieving operations. The recovered assemblage differed from a collection of 629 specimens found on the surface. The most important difference is the presence of at least four bifacial tools in the surface collection (Škrdla et al., 2014: Fig. 4, 1, 15–16, 19) and the absence of these presumably Szeletian tools in the stratified assemblage. In addition, artifacts made from radiolarites and Olomučany and Rudice-type cherts, having their original sources at a substantial distance from the site, were more abundant among the stratified lithics. The stratified assemblage contains cores and debitage pieces with faceted striking platforms and butts, and J-type blade-points. At the time, it was argued that the Želešice III in situ assemblage belonged to Szeletian, representing a sort of third type of Early Szeletian in addition to Szeletian in Hungary (Szeleta Cave, lower layer) and in southern Moravia (Vedrovice V and Moravsky Krumlov IV, layer 0). At that stage of our research, it was also acknowledged that "*the most important typological feature of the Moravian Szeletian is the presence of Jerzmanowice-type points*," which occurred in the Bohunician as well (Škrdla et al., 2014, pp. 99–100).

In fact, this would be a very unusual Szeletian assemblage. There are no in situ bifacial leaf points and only a few possible bifacial shaping/thinning flakes but abundant evidence for faceting of core striking platforms during preparation and re-preparation. The lithic artifacts are distributed vertically through up to 1 m of sediment. The horizontal distribution indicates that about half of the find concentration has been excavated so far. Our analysis of the buried lithic assemblage calls into question not only its Szeletian industrial affiliation but also the entire industrial integrity of the recovered stratified assemblage. For example, among illustrations of surface lithics found at the site (Škrdla et al., 2014: Fig. 3, 10–18; 4, 1–21), there are material types and Szeletian-like and Bohunician-like pieces, as well as clear J-type points identical to what was found in situ (Škrdla et al., 2014: Fig. 3: 1–9; 12, 1–36). We emphasize also the absence of any definite Aurignacian core and/or tool type in either surface or in situ lithic artifact collections, meaning that Želešice III can in no way be associated with the Aurignacian.

These anomalous and ambiguous features led us to re-check the industrially homogeneous character of the Želešice III 2010–2013 in situ assemblage, looking for possible Szeletian-like, Bohunician-like and Jerzmanowice-like pieces, and adding some data from small-sized items coming from the wet-sieved collection. The preliminary results of the study are as follows.

Possible Szeletian-Like Artifacts and Industrial Features

Possible Szeletian Bifacial Tools and Associated Debitage

Although the Želešice III assemblage was initially proposed to be Szeletian, there is not a single bifacial artifact, even a fragment, among the 413 items recorded in place during excavations. Our subsequent check of the 1100 piece assemblage from wet sieving did not turn up any bifacial tool, even tiny fragments. Five bifacial shaping flakes were recognized in the earlier study (Škrdla et al., 2014: Fig. 3, 5–8) and two of them were even refitted one to another (Škrdla et al., 2014: Fig. 3, 5), allegedly demonstrating on-site bifacial tool production. The two refitted pieces are on erratic flint while the three unrefitted pieces are on Krumlovský les-type (KL) chert. Subsequent re-examination leaves only two possible bifacial treatment flakes (Škrdla et al., 2014: Fig. 3, 7–8) in the assemblage now. The two refitted pieces on erratic flints lack the acutely-angled facetted butts typical of bifacial shaping flakes. In fact, the two small flakes could have come from any exhausted core in the assemblage. One flake on KL chert (Škrdla et al., 2014: Fig. 3, 6) has no proximal segment, the most diagnostic part for identifying bifacial shaping flakes. So this particular flake could again result from any sort of core reduction. Additionally, a thorough analysis of the wet-sieved collection did not add any other flakes/chips from bifacial shaping and thinning. Thus, evidence of Szeletian-like bifacial tool manufacture in the in situ assemblage component is limited to two artifacts resembling biface shaping flakes.

Possible Szeletian Core Reduction Evidence

Among in situ Szeletian sites located close to Želešice III, local KL chert is the only (Moravsky Krumlov IV, layer 0) or predominat (Vedrovice V) raw material type. KL chert is also the predominant raw material at Želešice III, although it accounts for c. 42% of the mapped, in situ assemblage but c. 82% of the surface collection (Škrdla et al., 2014, pp. 90, 96). We decided to use this particular raw material for identification of Szeletian core and debitage data. Indeed, the following Szeletian-like features can be detected for Želešice III:

- Generally Szeletian-like, "undeveloped" reduction methods, reflected by mostly multiplatform and irregular cores
- A predominance of flakes over bladey pieces
- The absence of crested blades, implying no use of *lame à crête* technique

However, radial/discoidal cores (Valoch, 1993: Tabl. 2 on p. 70) and technologically associated pseudo-Levallois points (Valoch, 1993, p. 30), common in the in situ Moravian Szeletian, are not present in the Želešice III assemblage. Moreover, bladey debitage items account for 17.4% of the assemblage (Škrdla et al., 2014, p. 97), while blades are nearly absent in Moravsky Krumlov IV and compose only 6.19% in Vedrovice V (our calculation after Valoch, 1993: Tabl. 1 on p. 69). Aside of the unstandardized amorphous cores, the in situ assemblage from Želešice III contains some blade and bladelet cores: these include an opposed-platform bidirectional blade core on flake with an edge abrasion for one of the two striking platforms, a single-platform unidirectional narrow-faced bladelet core with a lower crest (conjoined from two fragments), and a core fragment with exclusively bladelet removal negatives. Bladelet cores are unknown in both Hungarian and Moravian in situ Szeletian assemblages. Furthermore, the presence in Želešice III of some unclear and amorphous cores may be explained by the raw materials—"*poor quality nodules with many inhomogeneities … explains the increased presence of precores*, *irregular cores*, *core fragments*, *massive flakes*" (Škrdla et al., 2014, p. 90). The absence of *lame à crête* technique could be additionally explained by the real difficult of knapping KL chert using traditional UP reduction methods and techniques. It is no wonder that KL chert was not widely used during later UP time periods, and it was certainly the supplementary raw material type for some Bohunician assemblages, never reaching even a half of all pieces in any Bohunician assemblage.

In sum, although it was first attributed to the industry, the Želešice III assemblage only contains two likely Szeletian items, the bifacial treatment flakes, and nothing else.

Possible Bohunician-Like Lithics and Their Characteristics

Previous discussions of Želešice III have addressed the possibility of Bohunician elements in the assemblage.

Several artifacts have a faceted striking platform (Fig. 3: 1–4, 7, 8). However, in contrast to the Bohunician technology (cf. Škrdla & Rychtaříková, 2012), the faceting is coarser without the characteristic overhang. The dorsal scar pattern is unidirectional (Fig. 3: 1, 3, 4) or centripetal (Fig. 3: 2, 7, 8) rather than bidirectional or opposed directional. We can conclude that although several artifacts have a faceted striking platform, the general character of those artifacts differs from the products of Bohunician technology (Škrdla et al., 2014, p. 97).

The 2019 re-check of the Bohunician-like pieces with faceted butts, as well as the wet-sieved collection, leads us to additional observations. Only four pieces have faceted butts. One of them, on erratic flint (Škrdla et al., 2014: Fig. 3, 2) has such minor butt preparation that it should not be called facetted at all. Two pieces were made on KL chert (Škrdla et al., 2014: Fig. 3, 1, 4) and one more piece was produced on Stránská skála-type chert (Škrdla et al., 2014: Fig. 3, 2). The three lithics are not real Levallois points, which would certainly identify them as part of a Bohunician component. Moreover, only one of the pieces (Škrdla et al., 2014: Fig. 3, 1) has a central *demi-chapeau* butt but no "Y-arête" scar pattern, whereas another item (Škrdla et al., 2014: Fig. 3, 3) has a crudely-faceted butt. The last specimen (Škrdla et al., 2014: Fig. 3, 4) has a straight, fine-faceted butt. Remembering that true Bohunician Levallois products have mainly central *demi-chapeau* and *chapeau* butts, the three items from Želešice III would not be Bohunician sensu stricto. However, we do note that the absence of typical Bohunician bidirectional scar patterns might not be significant, as all three of the pieces with faceted butts are proximal parts, and negatives from opposed platforms cannot always be expected to occur. Wet-sieved small-sized artifact sample did not contain any additional Bohunician-like debitage pieces with central fine-faceted/*demi-chapeau*/*chapeau de gendarme* butts. Moreover, morphologically characteristic preparation and re-preparation lateral or débordant flakes and blades detached for creation of "Y-arête" scar pattern leading to removal of a Levallois point then are also absent. The latter fact is even more important from a technological point of view for establishing the Bohunician character of an assemblage.

All in all, there are two possible solutions here. First, it can be said that the three debitage items with faceted butts do represent an integral part of the Želešice III assemblage. Faceted butts can occur in small numbers even in assemblages without other evidence of systematic core platform preparation. Second, it is also possible that the three debitage pieces do belong to a Bohunician component, indicating a quantitatively minor presence of the Bohunician admixture here.

Summing Up Possible Presence of Szeletian and Bohunician Artifacts in the Želešice III Assemblage

Szeletian

Aside from the two possible bifacial treatment flakes, there are no techno-typological features among the site's in situ lithics that could be associated with Szeletian. At the same time, if the Želešice III assemblage actually belongs to the LRJ industry, it is worth remembering that the LRJ can also include bifacial tools (almost exclusively leaf points) and bifacial production, although only a minority of assemblages contain them. Therefore, these two bifacial treatment flakes could be also of LRJ affiliation, though the assemblage does not contain a single bifacial tool fragment. Consequently, the two bifacial treatment flakes might either represent an occasional intrusion of Szeletian artifacts, present in the surface assemblages (Škrdla et al., 2014: Fig. 4, 15–16, 19), or a genuine part of LRJ.

Bohunician

The above-discussed three flakes with faceted butts are the only candidates for Bohunician presence within Želešice III assemblage. However, their affiliation with the Bohunician is doubtful. Moreover, at the LRJ Beedings site, large-sized blades often have finely-faceted butts (but no characteristic Bohunician *demi-chapeau/chapeau de gendarme* butts). So flakes with facetted butts from Želešice III could be consistent with an LRJ affiliation.

Absolute Dating and the Admixture Factor

The three calibrated dates show two dating clusters: c. 46–44.6 ka cal BP for two dates and c. 42,000 cal BP for one more date (Škrdla et al., 2014: Fig. 9). Accordingly, some IUP/EUP "charcoal palimpsest" might occur at the site.

All in all, the excavated Želešice III lithic assemblage is not predominantly either Szeletian or Bohunician. If Szeletian and/or Bohunician admixture is present, and absolute dates are consistent with this possibility, they contributed very little to the total assemblage.

Possible LRJ-Like Elements

We believe that the Želešice III assemblage is best understood as an LRJ assemblage. It has multiple J-type unifacial and partially bifacial points but no bifacial leaf points indicative of the Szeletian. Some debitage pieces have fine faceted platforms but no real *chapeau de gendarme* butts, as can be found with Bohunician Levallois points but not in the LRJ. At this still preliminary stage, the best way to understand the assemblage is to examine different raw material types independently. Although, our study remains incomplete, it is still possible to do this for cores and tools, with some additional artifact class data particularly for KL chert and radiolarite.

Core-Like Pieces

There is only a single core made on an "exotic" raw material in the collection of piece-plotted artifacts from Želešice III, a core on flake of Olomučany-type chert (Škrdla et al., 2014: Fig. 12, 36). This raw material outcrops in the Moravian Karst, c. 26 km north-northeast of the site (Fig. 12: 1). The presence of such chert might indicate a sort of human network in southern Moravia allowing supplying different human groups with the particular raw material. Accordingly, it is possible to speculate on a series of such human groups and, if Želešice III represents LRJ industrial tradition, this site cannot be the only such site in the region. All 11 other core-like items are on KL chert (Škrdla et al., 2014, p. 97) which can be considered "local" for the Želešice III site. As discussed above, the KL chert cores are mainly flake cores, which should be understood as a response to the poor flaking qualities of the chert nodules. The reliance on poor-quality KL chert nodules could indicate that the creators of the assemblage came from elsewhere and were not familiar with sources of high quality chert nodules. Also, there are two bladelet cores, a single-platform narrow-flake and a core fragment. Furthermore, with all the problems in primary reduction of KL chert and the presence of many flake cores, it still surprising to see an opposed-platform bidirectional blade core on a flake (Škrdla et al., 2014: Fig. 3, 9). As discussed, one striking platform shows traces of edge abrasion, a technological feature never observed in stratified Szeletian assemblages but sometimes found in the LRJ.

The Želešice III KL chert cores are so-called free-hand reduction pieces. They are supplemented by three splintered pieces (Škrdla et al., 2014: Fig. 12, 20, 34) (Fig. 12: 2–3), actually bipolar hammer-on-anvil cores, two made of KL chert and one of erratic flint. The use of the bipolar anvil core reduction has never been recorded for stratified Szeletian assemblages. It also speaks about the poor quality of KL chert nodules for the regular, free-hand primary reduction, so that the site's occupants had to use the bipolar anvil core technology.

The Želešice III cores, though limited in number, show a number of technological features distinguishing the assemblage from other Moravian IUP industries (Bohunician and Szeletian), including bladelet cores, core striking platform edge abrasion, and bipolar anvil core technology. Along with the core-on-flake (a sort of truncated-faceted piece), the Želešice III cores are more consistent with the LRJ.

Debitage Data

This is the least studied part of the Želešice III assemblage. The blade index of 17.4% was calculated for artifacts recorded in situ (Škrdla et al., 2014, p. 97), and the presence of blade and tool fragments (see below) in the sieved fraction would certainly alter the index. At the same time, a few (four on radiolarite and two on KL chert) pieces were detached from cores by a soft hammer from plain and edge abraded cores striking platforms, a technique never documented for in situ Szeletian assemblages but well-known for the LRJ.

Retouched Tools

The still preliminary list of retouched pieces from among the items recorded in situ includes 40 tools, distributed across 10 categories:

- endscrapers—12/30.0%
- J-type points—8/20.0%
- burins—3/7.5%
- retouched blades—1/2.5%
- truncated pieces—2/5.0%
- bec—1/2.5%
- side-scrapers—1/2.5%
- retouched pieces—4/10.0%
- microliths—1/2.5%
- tool fragments—7/17.5%.

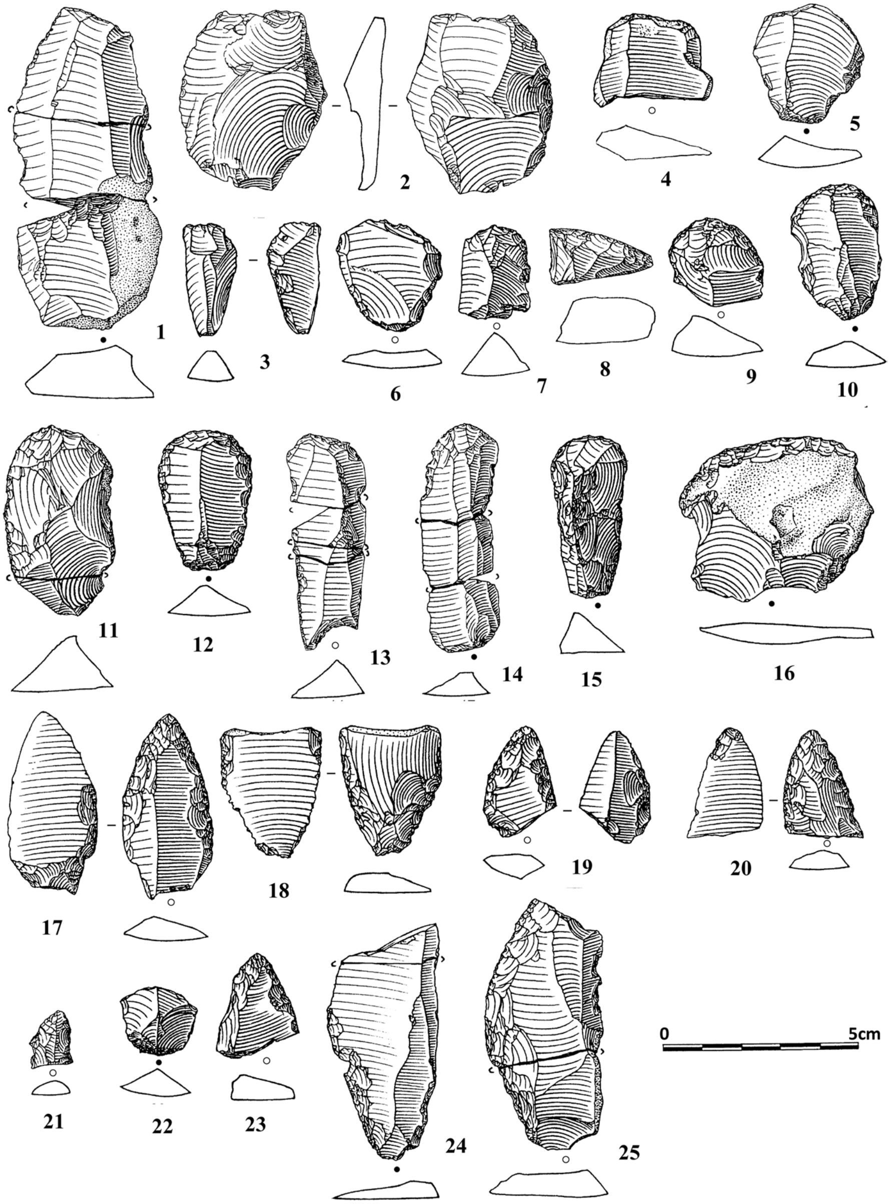

Fig. 12 Želešice III/Želešice-Hoynerhügel site, Southern Moravia, Czech Republic: 1—core on flake; 2–3—bipolar anvil cores; 4–15—endscrapers; 16—side-scraper; 17–24—J-type blade-points; 25—conjoined but still too fragmented tool (modified after Škrdla et al. (2014))

The three most numerous tool categories, endscrapers, J-type points, and tool fragments, account for 67.5% of the assemblage. Each of the three categories deserves some detailed descriptions.

Endscrapers (Škrdla et al., 2014: Fig. 12, 8–19) were made on both flakes and blades (Fig. 12: 4–15). More than half (7) were made on KL chert. Overall, endscrapers show a high degree of intensive reshaping and resharpening at the site, including multiple retouched edges and use of fragments as blanks. Three endscapers, plus one fragment, are made on blades (Fig. 12: 4–15), something nearly unknown in in situ Szeletian collections. Some endscrapers have thick fronts, and the frequent convergent treatment of the fronts makes them different from the known Szeletian endscrapers (Fig. 12: 7–9, 11, 15). It is also worth noting that a crested blade was used as a blank for one of the KL chert endscrapers (Škrdla et al., 2014: Fig. 12, 16) (Fig. 12: 15). The *lame à crête* technique is nearly unknown for the true Szeletian but an integral part of the LRJ. Of seven KL chert endscrapers, four (57.1%) are fragmented pieces, probably occurring during retouching of their lateral edges (Škrdla et al., 2014: Fig. 12, 11, 15) (Fig. 12: 9, 11) or were produced on fragmented debitage items (Škrdla et al., 2014: Fig. 12, 18–19) (Fig. 12: 4, 7). Overall, except for two too fragmented items (Škrdla et al., 2014: Fig. 12, 9, 11) (Fig. 12: 8–9), eight out of the remaining 10 endscrapers have retouched lateral edges (one item on radiolarite has additionally an opposite notch—Škrdla et al., 2014: Fig. 12, 14—Fig. 12: 13)—a possible sign on multiple and variable use of debitage pieces where raw material is scarce. The piece on radiolarite (Škrdla et al., 2014: Fig. 12, 14) (Fig. 12: 13) and a piece on "plazma" rock (Škrdla et al., 2014: Fig. 12, 17) (Fig. 12: 14) were conjoined from four and three parts, respectively. They were most likely broken during lateral edge retouching. Noting no evidence for on-site reduction of radiolarite and plazma cores, the two endscrapers of these materials were likely brought to the site already formed as endscrapers and then were used, broken and left at the site.

J-Type Points

In total, eight pieces from Želešice III were classified as J-type points. All points have the typical partial-bifacial scalar semi steep and flat retouch treatment (e.g., Škrdla et al., 2014: Fig. 12, 29) (Fig. 12: 22), aside from pointed distal fragments (e.g., Škrdla et al., 2014: Fig. 12, 1) (Fig. 12: 21). The 2019 analysis actually doubled the previously recognized sample of four J-type points exclusively produced on radiolarite (Škrdla et al., 2014: Fig. 12, 3–5, 7) (Fig. 12: 17–20). While two new points are also on radiolarite (Škrdla et al., 2014: Fig. 12, 1, 29) (Fig. 12: 21–22), one is on KL chert (Škrdla et al., 2014: Fig. 12, 2) (Fig. 12: 23) and another on Olomučany-type chert (Škrdla et al., 2014: Fig. 12, 23) (Fig. 12: 24). The latter piece shows just initial tool formation during which its distal part was broken. The same probably relates to a new point on KL chert and one of the points on radiolarite (Škrdla et al., 2014: Fig. 12, 2, 29) (Fig. 12: 22–23). Of special importance is one of the points on radiolarite (Škrdla et al., 2014: Fig. 12, 7) (Fig. 12: 18) to which two retouch chips were refitted in 2019. The refitted chips clearly show the point's basal dorsal formation but, unfortunately, the piece was transversally broken during ventral retouching of its left lateral edge and was not finished. On the other hand, the remaining three pieces on radiolarite (Škrdla et al., 2014: Fig. 12, 3–5) (Fig. 12: 17, 19–20) were brought to the site in already shaped, pointed form and were then fragmented during on-site rejuvenation and/or after hunting activity. There is no evidence for on-site core reduction using radiolarite, but we have recognized a series of radiolarite retouch chips relating to J-type point production and rejuvenation. Consequently, it is possible to argue that four J-type points on radiolarite were mainly brought to the site already formed as points, while humans made at least four more points of various materials at the site. Defining the dorsal scar patterns for the point blanks is not an easy task. Five points (Škrdla et al., 2014: Fig. 12, 1–4, 29) (Fig. 12: 19–23) are too fragmented for clear reading of the dorsal scar pattern. One broken point (Škrdla et al., 2014: Fig. 12, 7) (Fig. 12: 18) still has a recognizable unidirectional-crossed scar pattern. The scar pattern for the longest broken point (Škrdla et al., 2014: Fig. 12, 23) (Fig. 12: 24) is unidentifiable, but it is definitely a blade (5.7 cm long, 3.0 cm wide, 0.7 cm thick). The only rather complete point (Škrdla et al., 2014: Fig. 12, 5) (Fig. 12: 17) is certainly a unidirectional blade (4.6 cm long, 2.3 cm wide, 0.6 cm thick). Although the latter two points do not achieve the c. 10 cm "length standard" for many J-type points from published LRJ assemblages, they are among the longest and largest pieces within Želešice III tool assemblage, something typical for J-type points in the LRJ. As a result, the Želešice III J-points are best considered LRJ blade-points.

Tool Fragments

Seven of the tool fragments are small transversal blade fragments broken during retouching. The actual number is in reality higher if we include conjoined items from four more illustrated pieces (Škrdla et al., 2014: Fig. 12, 14–15, 17, 24) (Fig. 12: 11, 13–14, 25). This particular tool category is important for two reasons. Because the tool fragments are pieces of blades, this would raise the known blade index for Želešice III. Second, so many fragmented tools indicate very intensive on-site tool rejuvenation and re-shaping, typical of the LRJ. The latter fact forces us to think about a special human activity at the site—an intensive primary and secondary ungulate carcass dismembering around a hearth after a successful hunt (?), after many rejuvenated/re-shaped tools many retouch chips are present in the assemblage and probably then some repaired tools were taken by humans to another site.

The remaining 13 tools have not been studied in detail, but it is still possible to make some brief observations for them. Aside from a single transversal side-scraper on KL chert (Škrdla et al., 2014: Fig. 12, 25) (Fig. 12: 16), the remaining retouched pieces belong to various UP tool categories. Along with the many endscrapers, this makes the Želešice III assemblage very different from in situ Szeletian assemblages, which are characterized by abundant MP-like sidescrapers. The lone microlith is a tiny complete radiolarite chip (1.1 cm long, 0.9 cm wide, 0.2 cm thick) with dorsal marginal retouch at the right lateral edge. The microlith is one of the two chips refitted onto one of the J-type point's dorsal surface forming its basal part (Škrdla et al., 2014: Fig. 12, 7) (Fig. 12: 18).

Summary

The preliminary re-study of the Želešice III lithic assemblage has two implications for the current paper. First, despite its earlier (cautious) attribution to the Szeletian (Škrdla et al., 2014, pp. 97–100), the assemblage in fact bears little resemblance to other in situ Szeletian assemblages in Moravia. Second, the Želešice III assemblage does not fit into either the Bohunician or Aurignacian. The only industry with which Želešice III really fits is the LRJ. Features identifying it as LRJ include the occurrence of blade and bladelet core reduction, some use of a soft hammer technique, and several true J-type blade-points. More work with Želešice III lithics will certainly detail LRJ features. One of the research subjects will be also the raw material side. Remembering the suggested Olomučany-type chert pieces exchange by LRJ people (there are c. 50 such chert specimens in addition to the already discussed core on flake in the assemblage), the presence of c. 20 Stránská skála-type chert pieces in the assemblage allows us to speculate that Líšeň/Podolí I LRJ site humans (see below discussion for Líšeň/Podolí I), living near Stránská skála cliff chert primary outcrops, were not in a direct connection to Želešice III LRJ people as in this case Líšeň/Podolí I would well supply Želešice with Stránská skála-type chert. Accordingly, it is possible to hypothesize there was a series of different and rather numerous LRJ human groups in southern Moravia. For now, in our view, Želešice III could be a sort of hunting station at a KL chert outcrop where LRJ humans hunted in the area (see J-type point data) and also came to know this new to them raw material outcrop area.

Líšeň/Podolí I Site

Líšeň/Podolí I is located in the Čtvrtě and Podolí area near the Stránská skála cliff at eastern edge of the Brno Basin. The site has been known since before the World War II. It was introduced to a larger scientific audience by M. Oliva (1981) as the Podolí I site. Oliva used the materials from the site for the definition of a (then) new EUP industry, the Bohunician, replacing K. Valoch's initial proposal of a "*Szeletian of Levallois facies*," based on the Brno-Bohunice site (Valoch, 1976a). Accordingly, Podolí I is actually the type site for the Bohunician. However, the materials studied by Oliva were surface finds, not from stratified context. Previous archaeological investigations at Líšeň/Podolí have been summarized by Škrdla (2017, p. 95).

In 2009, a survey at Líšeň/Podolí produced a collection of c. 400 lithic artifacts from the surface, which were systematically mapped. Subsequent excavations of a series of test pits showed the presence of in situ artifacts in one of them (Škrdla et al., 2011b). ^{14}C dating of a charcoal sample from this test pit produced an age of 38,400 ± 700 uncal BP (Poz-37344). Then, a larger excavation nearby (Škrdla et al., 2011b) produced a sample of 148 artifacts, including pieces with facetted striking platforms and bidirectional dorsal scars, along with fossil marine shell (Škrdla et al., 2011b: Fig. 2). Excavation at the site, which was thought to represent the Bohunician, was expanded in 2015 and 2016 to a total area of 46.5 m^2. The in situ finds from 2015 to 2016 are the basis for our re-appraisal of the Líšeň/Podolí I site.

Site Location (Fig. 11 Map)

The site is situated on the summit of a ridge, on a shallow, southeast-facing slope, at an elevation of between 297 and 300 m. It is 2.2–2.5 km east-northeast from the Stránská skála cliff, the principal raw material outcrop. The site location provides a good overview of the southern Moravian river valleys, with the Pavlov Hills, 35 km to the south, visible in the background.

Stratigraphy (Škrdla, 2017, pp. 96–97)

All excavated areas display the same stratigraphy. The modern soil is separated by a sharp boundary from the underlying Pleistocene sediments. The sharp boundary indicates intensive erosion of sub-surface deposits. The intact Pleistocene layer is a calcareous paleosoil up to 40 cm thick. Because the sediments are homogeneous it is not possible to subdivide them into additional sub-horizons. A single homogeneous artifact-bearing horizon is present, restricted to the lower part of the paleosoil. The vertical distribution of artifacts is highly coherent, with little dispersal of either large or small-sized lithics. The connections between refitted artifacts are also consistent with the assertion that the assemblage is homogeneous.

Radiocarbon Dates and the Proposed Chronology (Table 1)

Five samples of dispersed charcoal from the 2015 excavation (Poz-76152–76,153, 76,199, 76,201–76,202) were dated, covering a time span from the LGM to GI-8 with no significant probability overlap. Six samples (Poz-87125–87,126, 87,128–87,131) from the 2016 excavation came from concentrated features, making it more likely that they are in good context. The resulting time range is much narrower, GI-9 to GI-12. All of the 2015–2016 excavations charcoal samples were identified as *Larix/Picea* sp. (by J. Novák). The samples were small and of insufficient weight to satisfy the ABOx/SC pretreatment protocol, so ABA pretreatment was used.

In interpreting the ^{14}C dates from Líšeň/Podolí I, we need to consider two observations. First, the artifact-bearing horizon was located directly below the plow modern soil, often separated by up to 10–40 cm of intact sediment. Therefore, contamination by younger material from the overlying sediments (burrows, drying cracks, fertilizers) cannot be excluded, especially for the samples of dispersed charcoal. Second, dates from the samples collected within coherent charcoal lenses and identified as the same species (*Larix/Picea* sp.) are much less dispersed, subsuming a time span of no more than 3000 years. Consequently, we argue that the earliest dates, from the charcoal features, are more credible, while the younger dates may have been affected by contamination. The most relevant dates for dating human presence in Líšeň/Podolí I are related to two charcoal lenses located in two opposite parts of the excavated areas. Two samples from the southeastern corner collected c. 50–70 cm apart provided ages of 38,400 ± 700 uncal BP (Poz-37344) and 37,100 ± 800 uncal BP (Poz-87126), with overlapping probability distributions. Four charcoal samples from the western part of the excavated area yielded dates ranging from c. 39 to 36 ka uncal BP, again with all probability distributions overlapping. Three of them were collected within c. 40 cm of each other and the fourth (37,900) was from c. 1.5 m away. Based on the totality of the dating evidence, we propose that the human occupation at the site took place around GI-11—GI-10, c. 42–40 ka cal BP.

Lithic Artifacts

The lithic artifact collection from the 2015–2016 excavations is composed of 613 pieces mapped in situ, and 2964 pieces found during wet-sieving. Raw materials have been studied only for the sample of mapped pieces. Then, 89.2% were struck from Stránská skála-type chert nodules. Other local quartzite, spongolite, sandstone, and pebble pieces, together with heavily burnt specimens (1.1%) account 7.2% of all lithic artifacts. Raw materials from more distant sources include red and green radiolarites (2.3%) and a few pieces on erratic flint and KL Les chert, and make up less than 4% in the assemblage. At present, raw material data indicate that the inhabitants of the site relied primarily on local raw materials, with the few pieces of more exotic raw material possibly indicating some networks with other human groups.

Primary Flaking Processes

Aside from a single bladelet core on green radiolarite, all 27 core-like pieces are on Stránská skála-type chert. Core reduction data for the local chert nodules demonstrate the entire *chaîne opératoire* process occurred on site. Primary flaking began from pre-cores. Pre-cores often have a crest running around the entire circumference and might even look like discoidal cores. However, the pre-cores were further modified to start primary reduction from two opposed striking platforms through one of its narrow sides (Škrdla, 2017: Fig.4.4, 18) (Fig. 13: 1). Shaping and reduction continued with a formation of two opposed striking platforms for a systematic bidirectional blade/flake reduction from a wide flaking surface (Škrdla, 2017: Fig.4.4, 21–22) (Fig. 13: 2–3). Core flaking surface convexity was periodically rejuvenated through lateral *débordante* removals. Core striking platform rejuvenation was sometimes accomplished through partial faceting but with crude preparation and no *chapeau de gendarme* platforms. Typical Bohunician *chapeau de gendarme/demi-chapeau* platforms are absent. Platform edge abrasion was often used for core striking platform rejuvenation before detachment of each blade/flake. No core tablet technique is evidenced. At the same time, the assemblage's debitage pieces frequently have lipped/semi-lipped platforms, with acute/semi-acute exterior platform angles, indicating a use of an organic soft-hammer. A series of crested blades are also present, including some endscrapers on crested blades (Fig. 13: 5–7; 14: 9–10), clear evidence of a central *lame à crête* technique during initial formation and reduction of the Líšeň/Podolí I cores.

Although some blade/flake cores do bear a few bladelet removal negatives on their flaking surfaces, the core assemblage also contains two single-platform unidirectional, cylindrical, or sub-cylindrical bladelet cores with plain and semi-acute striking platforms, and a single multi-platform bladelet core of green radiolarite (Škrdla, 2017: Fig. 4.4, 20) (Fig. 13: 4). The bladelet cores (no more than 3 cm long) are a result of

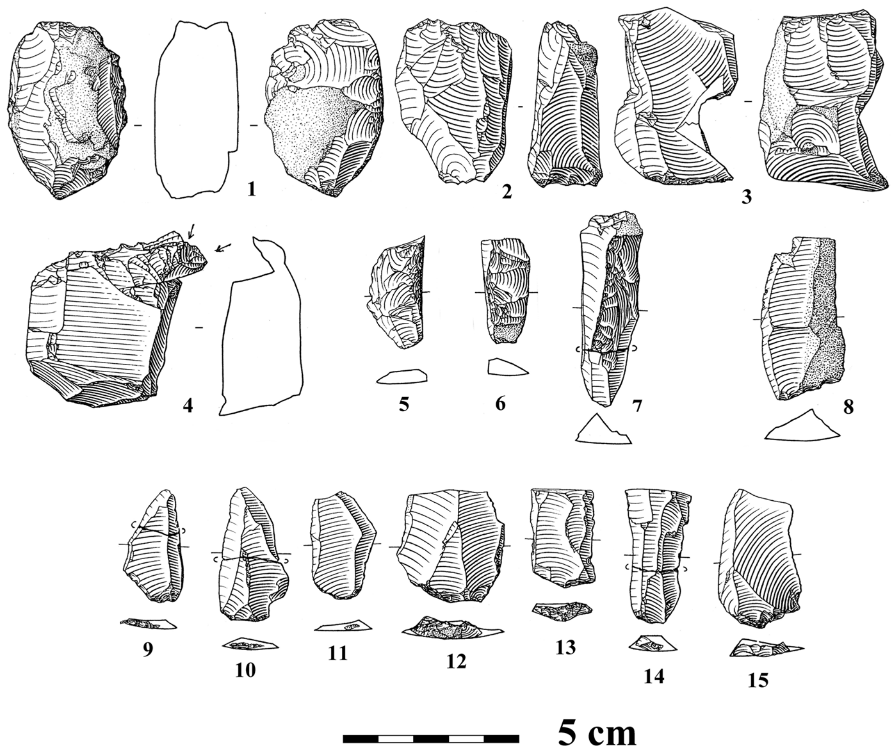

Fig. 13 Líšeň/Podolí I site, Southern Moravia, Czech Republic: 1–4—cores; 5–7—crested blades; 8—bipolar anvil core; 9–15—ex-Bohunician debitage pieces (modified after Škrdla et al. (2014))

a distinct bladelet production strategy and not residues of blade cores, although the absence of core tablets for bladelet cores might indicate brief and unsystematic bladelet production at Líšeň/Podolí I, which could also explain why the recovered bladelets (e.g., Škrdla, 2017: Fig. 4.5, 4–10) (Fig. 14: 1–7) are rather irregular.

Finally, the above-described free hand core reduction methods were supplemented by splitting of three bipolar anvil cores (Škrdla, 2017: Fig. 4.4, 26; 4.5, 22) (Fig. 13: 8; 14: 8).

In sum, Líšeň/Podolí I core reduction processes include a wide range of primary flaking methods that do not occur in combination in Bohunician, Szeletian, and Aurignacian assemblages from Moravia.

Debitage

The core reduction characteristics can be supplemented by still preliminary debitage data from the sample of artifacts mapped in situ during excavation. Although flakes (c. 57%) predominate, blades (c. 37%), and bladelets (c. 6%) together account for c. 43% of all debitage items (re-calculated after Škrdla, 2017, p. 101). However, many more bladelets were identified in the wet-screened sample, so the proportions will change once this part of the assemblage is analyzed.

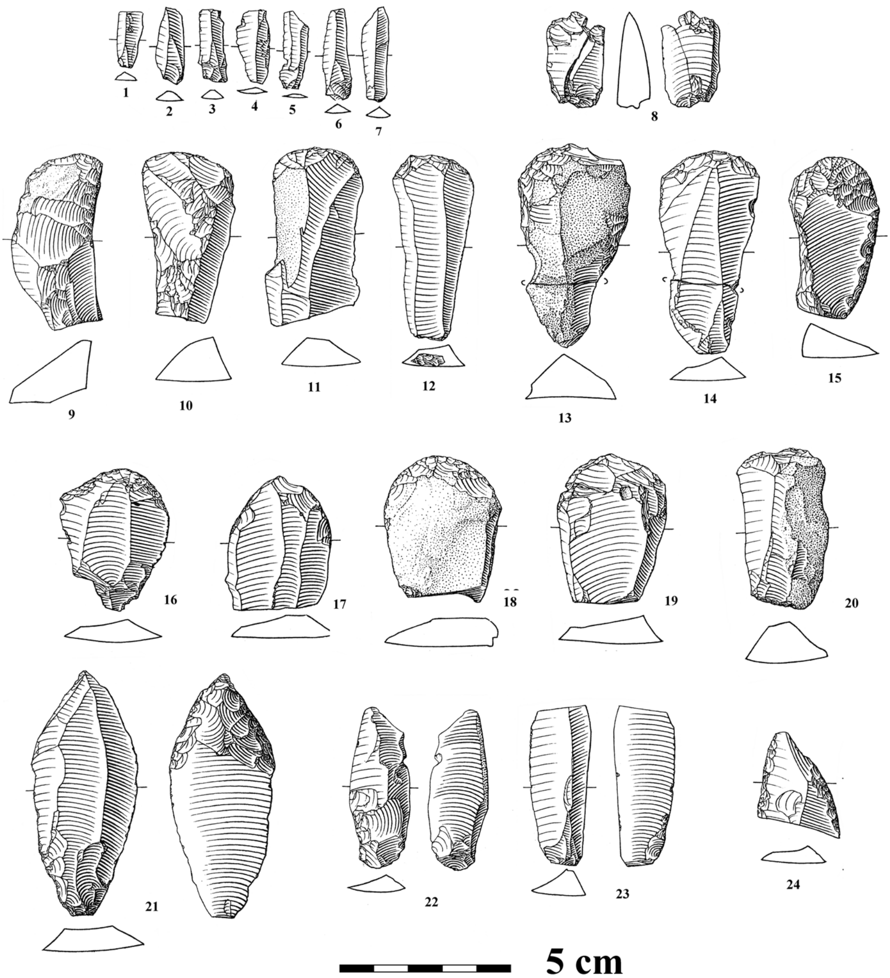

Fig. 14 Líšeň/Podolí I site, Southern Moravia, Czech Republic: 1–7—bladelets; 8—bipolar anvil core; 9–20—endscrapers; 21–24—J-type blade-points (modified after Škrdla (2017))

The original Bohunician industrial attribution for the assemblage was based on observations of converging and non-converging flakes and blades with facetted butts (e.g., Škrdla, 2017: Fig. 4.4, 1–5, 8, 11) (Fig. 13: 9–15). Detailed re-analysis of each Bohunician-like item led to the conclusion that they are actually not Levallois in character and cannot be regarded as Bohunician. Butts are plain or partially or crudely facetted, and there are no *chapeau de gendarme* butts. A single piece does have a finely facetted butt but lacks the typical Bohunician "Y-arrête" scar pattern (Škrdla, 2017: Fig. 4.4, 5) (Fig. 13: 13). One additional piece shows edge abrasion (Škrdla, 2017: Fig. 4.4, 11) (Fig. 13: 15), something unknown in the Bohunician.

Toolkit Data

To date, 30 retouched tools have been identified in the Líšeň/Podolí I excavated sample:

- endscrapers—13/43.3%
- Jerzmanowice-type points—4/13.3%
- retouched blades—3/10.0%
- truncated pieces—2/6.7%
- notched piece—1/3.3%
- retouched pieces—2/6.7%
- microliths—2/6.7%
- tool fragments—3/10.0%

Endscrapers are the most numerous tools (Škrdla, 2017: Fig. 4.5, 28–39) (Fig. 14: 9–20). Ten of them are on Stránská skála-type chert and one on erratic flint (Škrdla, 2017: Fig. 4.5, 38) (Fig. 14: 11). This piece is the only erratic flint artifact in the entire assemblage. One more endscraper is on local spongolite (Škrdla, 2017: Fig. 4.5, 35) (Fig. 14: 10). At least five of them (38.5%) are on blades and blade fragments and two additional specimens are made on crested blades, making endscrapers on blades (58.3%) more common than endscrapers on flakes (41.7%). Several endscrapers have thick working fronts, but none are carinated with true lamellar negatives. These morphological features make the endscrapers different from tools typically found in Moravian Bohunician, Szeletian, and Aurignacian sites. Retouch chips were also refit to two endscrapers' fronts (Škrdla, 2017: Fig.4.5, 31, 35) (Fig. 14: 11, 19) showing that they were produced and/or rejuvenated on site. It should also be emphasized that no bladelet/microblade detachments were removed during shaping of the endscrapers, meaning that they are tools, not cores.

J-Type Points

All points are on Stránská skála-type chert blades. They are as follows: a single complete and typical J-type point (Škrdla, 2017: Fig. 4.5, 42) (Fig. 14: 21), two semi-products of J-type points (Škrdla, 2017: Fig. 4.5, 43–44) (Fig. 14: 22–23) and a possible distal fragment of J-type point (Škrdla, 2017: Fig. 4.5, 24) (Fig. 14: 24). While the former three items have typical partial ventral-dorsal semi-steep and flat retouch treatment, the last only bears dorsal retouch. All four points were found in 2016 in neighboring squares in the eastern part of the excavation block. Two chips refitted to the complete point demonstrate a flat ventral treatment of the point's distal part (Photo 1). A flake from the same core and one of the semi-products (Škrdla, 2017: Fig. 4.5, 43) were recovered in the same squares. Based on this evidence, we suggest that all blade-blanks for J-type points were produced and shaped in the same part of the site. The results of J-type point manufacture represented in the assemblage derive from episodes that ended with either non-successful point formation (Škrdla, 2017: Fig. 4.5, 42–43) (Fig. 14: 21–22) or fragmentation (Škrdla, 2017: Fig. 4.5, 24, 44) (Fig. 14: 23–24). These data lead us to suggest that points were made at Líšeň/Podolí I but never actually used.

Photo 1 Líšeň/Podolí I site, Southern Moravia, Czech Republic: J-type blade-point with two refitted chips (modified after Škrdla (2017))

Other Flaked Artifacts

The in situ retouched tool assemblage includes three retouched blades (e.g., Škrdla, 2017: Fig. 4.5, 25) of Stránská skála-type chert with scalar dorsal retouch on their lateral edges. The microliths (e.g., Škrdla, 2017: Photo 4.2) are proximal parts of bladelets/chips on Stránská skála-type chert bearing a lateral dorsal marginal retouch. All other tools (besides unidentifiable fragments), are either of UP character (truncated pieces) or of non-diagnostic forms (notched and retouched pieces).

In sum, Líšeň/Podolí I tools are of exclusively UP character that is not typical at all for the known in situ Szeletian and Bohunician toolkits in Moravia, which always contain some MP tool classes and types. At the same time, the absence of carinated pieces among the endscrapers negates the possibility of Aurignacian industrial affinity.

Ochre

A series of ochre pieces were found during the Líšeň/Podolí I 2015–2016 excavations. Red ochre (hematite) dominates being most often only several millimeters by size (38 pieces) with the largest pieces just 18 mm long. Only six pieces of ochre are of a yellowish-brown color. Both color varieties originate from local sources known in the Brno Basin.

Tertiary Mollusk Shells

A collection of 36 non-local fossil mollusk shells were discovered, mostly in the course of the 2015 and 2016 field campaigns. Six of the shells were perforated and covered by red hematite and/or black manganese oxides (Škrdla, 2017: Photo 4.4). In contrast to the manganese oxides, the hematite is not found in the area surrounding the site, and could have been brought to the site from Stránská skála (studies by J. Petřík). Hladilová identified two possible source areas for the Líšeň/Podolí I mollusks: Sarmatian sediments in the Vienna basin (nearest outcrop in c. 40 km to the south) and Badenian sediments in the Brno Basin and other locations in southern Moravia. The use of at least two different sources indicates not only systematic collecting of mollusks for non-utilitarian purposes, but also good knowledge of geological outcrops within a large territory and possibly a network of human groups using these objects. The identified mollusks include various sub-species of *Pirenella* (Sarmatian) and three specimens of *Ancilla glandiformis* (Badenian). The species determination of six items is not clear, but they include possible *Cepaea* sp., *Euthria* sp., *Nassarius* sp., *Turitella* sp., and a fragment of an unidentified bivalve. Two mollusks preserve perforations, and four pieces were probably perforated but broke through the hole. As the mollusk surfaces are weathered, the perforation technology cannot be studied in detail. Only one small fragment shows a deep cut on its surface. The spatial distribution of mollusks indicates a cluster within a lithic artifact concentration in the southeastern part of the excavated area. Vertically, the mollusks were distributed randomly throughout the artifact bearing horizon.

Faunal Remains

Several dozen small bone fragments collected during wet sieving were burnt. Although the species could not be determined, some of them were placed into categories based on animal size by M. Nývltová Fišáková: two were assigned to large-sized mammals, four to middle-sized mammals, and five to small-sized mammals. Several molar fragments were identified as a horse (*Equus germanicus*). The most important bone fragment is a 28-mm-long fragment of a large-sized animal with a series of parallel grooves oriented perpendicularly to the edge (Škrdla, 2017: Photo 4.3). However, the surface is weathered and the intentionality of the modification cannot be demonstrated unequivocally.

An Overview

Many features of the Líšeň/Podolí I site and its artifact assemblage indicate that it was a sort of residential base camp near the Stránská skála chert outcrop. It is located in a topographic position with a good view of the surrounding area, allowing visitors to monitor ungulate herds passing nearby. Proximity to an outcrop of good quality chert was another advantage. The presence of several varieties of ochre and multiple personal ornaments made of mollusk shells and Tertiary mollusks collected at some distance from the site demonstrate (1) non utilitarian activities not strictly related to hunting, and (2) a central position of the Líšeň/Podolí I site in a social network.

As for its cultural affiliation, the site's lithic artifacts do not fit into common criteria for the Bohunician, Szeletian, Aurignacian. Initially, Škrdla also rejected an LRJ attribution, arguing that the Líšeň/Podolí I artifact assemblage should be assigned to an industry type within the Moravian IUP and EUP record, "*rather than try to force it into one of the previously defined techno-complexes*" (Škrdla, 2017, p. 110). However, our close re-examination of the artifact assemblage now seems to support the LRJ hypothesis. All of the techno-typological features discussed for Želešice III are also represented in the Líšeň/Podolí I assemblage. Even the retouched tools are dominated by the same two artifact classes, endscrapers and J-type blade-points. There remain many specific differences, such as in the raw materials exploited, more evidence of imported artifacts (e.g., a part of J-type points) for Želešice III, and the presence (Líšeň/Podolí I) and absence (Želešice III) of personal ornaments. We argue that these differences indicate that the two sites and their artifacts represent functionally different loci. They may also indicate that multiple LRJ human groups exploited various resources and terrain types in different ways.

Líšeň I/Líšeň—Čtvrtě Site

The site has been known for a long time as a surface find spot, with mainly Bohunician but also with Aurignacian and possibly Epigravettian/Magdalenian lithics (e.g., Škrdla, 2000; Svoboda, 1987; Valoch, 1962). However, new field investigations in 2008–2009 revealed an in situ UP layer within an 18.5 m^2 excavation block. A single radiocarbon date on a sample of dispersed charcoal dated to 31,300 ± 800 uncal BP (Poz-33038) calibrated (using CalPal software on IntCal13) to 37,837–34,478 cal BP; 2 sigma (Škrdla et al., 2010) possibly corresponding to time around GI-7.

Site Location

The site is situated on an extensive elevated topographic feature with its summit at c. 331 m, about 2 km north-east of the Stránská skála cliff and a few hundred meters away from the Líšeň/Podolí I site. The situation of Líšeň I is very similar to Líšeň/Podolí I. The location provides a good view over the surrounding landscape, including potential grazing area for wild herds, as well as the Stránská skála primary chert outcrop.

Stratigraphy

The profile exposed during excavation consisted of four main lithological units (Škrdla et al., 2010: Figs. 2, 4–5). Under the Holocene topsoil was a loess layer, followed by more clayey soil, and another underlying loess. The UP artifact horizon occurred within the clayey soil layer, which is 40 cm thick. The layer is homogeneous with no further stratigraphic subdivision. Analysis of conjoined frost-shattered artifacts indicated only very limited post-depositional movement.

Lithic Artifacts

The entire lithic sample recovered during the 2008–2009 consists of 63 excavated lithic pieces recorded in situ, supplemented by 98 mainly small-sized items found in the wet-sieved sediment (3 mm mesh) and not counting 11 conjoined specimens. The assemblage was always considered to be Aurignacian with some possible admixture of a few Bohunician pieces (Škrdla et al., 2010). In 2016, we restudied the Líšeň I material and decided that it was better classified as Evolved Aurignacian (Demidenko et al., 2017).

By raw material types, the 63 artifacts recorded in situ during excavation show a dominance of Stránská skála-type chert (87%), likely procured not from the Stránská skála cliff area itself but from outcrops on the slopes near the site. A few artifacts were made on other raw materials: erratic flint (2), Drahany-type quartzite (1), Cretaceous spongolite chert (1), and Moravian Jurassic chert (1). The presence of only two erratic flint pieces indicate a minor role of raw materials from distant sources and a heavy reliance on local materials for on-site lithic manufacture and refurbishment.

The 151 specimens are distributed across the following broad categories:

– Unworked pieces—2/1.4%/3.3%
– Core-like-pieces—14/9.3%/23.0%
– Core maintenance products (CMP) —5/3.3%/8.2%
– Debitage—34/22.5%/55.7%
– Tools—5/3.3%/8.2%
– Manuport—1/0.7%/1.6%
– Debris—90/59.5%/-

Core Reduction Data

Extensive on-site core reduction processes are evident through the presence of unworked raw material and different types of core-like pieces on chert nodules (2 pre-cores, 8 cores, and 4 core fragments). The eight morphologically identifiable cores include two flake/blade cores (Demidenko et al., 2017: Fig. 3, 16–17) (Fig. 15: 1–2), five blade cores (Demidenko et al., 2017: Fig. 3, 11, 13, 18–19, 21) (Fig. 15: 3–7), and one blade/bladelet core (Demidenko et al., 2017: Fig. 3, 12) (Fig. 15: 8). The technological features indicate a systematic blade core reduction: all cores had blades or bladelets removed at some point. The core sizes range from 4.2 to 8.8 cm in maximum dimension (with a mean of 5.4 cm). This suggests large-sized blades were produced at the site. Blade production seems to be based on single-platform unidirectional core reduction. There are four single-platform cores. For three of the double-platform cores, individual platforms were reduced separately, with no interaction between them during shaping and exploitation (Fig. 15: 1–2, 4, 5). A single opposed-platform bidirectional blade core with one flaking surface (Fig. 15: 5) is present, although the two platforms may have been used independently on this core

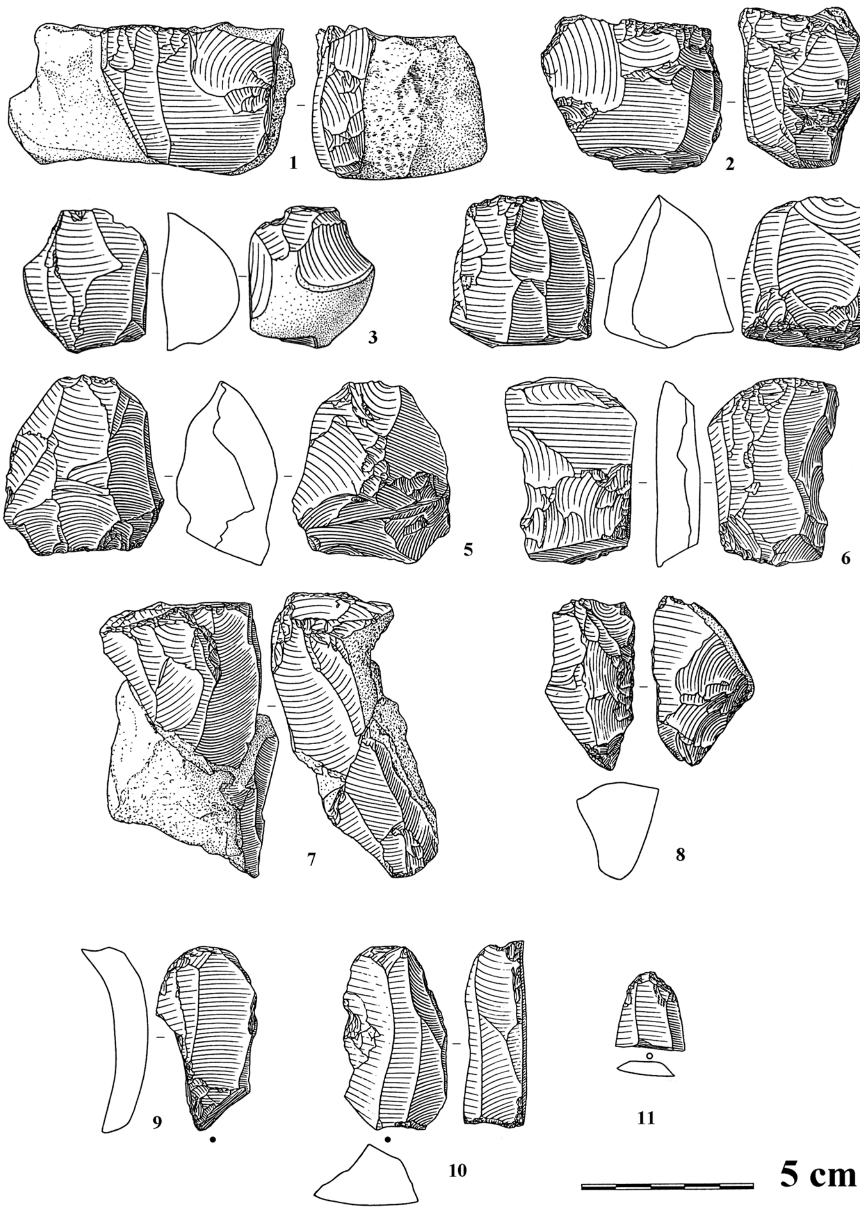

Fig. 15 Líšeň I/Líšeň—Čtvrtě site, Southern Moravia, Czech Republic: 1–8—cores; 9–11—endscrapers (modified after Demidenko et al., 2017)

as well. Core platform rejuvenation seems to have been accomplished by one or two small flake removals. True faceting technique was not documented on cores or detached pieces.

Core Maintenance Products

This category includes five pieces, all crested items: one complete crested blade, one secondary crested blade (distal part), one complete crested bladelet, one re-crested microblade (Demidenko et al., 2017: Fig. 3, 3) and one technologically uncertain fragment. The variety crested pieces shows many aspects of the on-site blade and bladelet core reduction. At the same time, other core maintenance products (CMP) categories, such as core tablets, are missing in the assemblage. The absence of distinctive lateral / fronto-lateral nosed /carinated endscraper-core maintenance flakes (e.g., Le Brun-Ricalens, 2005) indicates that such endscraper-cores were not maintained at the site. We originally interpreted the incompleteness of the CMP sample to mean that while blade core reduction was sometimes carried out at the site and that while this sometimes continued with bladelet production and some rejuvenation of striking platforms, there was no on-site nosed / carinated endscraper-core reduction.

Debitage

The 34 non-CMP debitage pieces were subdivided into the following basic sub-categories:

- flakes—23/67.7%
- blades—8/23.6%
- bladelets (w = ≥ 7 mm— < 12 mm)—2/5.8%
- microblades (w < 7 mm)—1/2.9%

The large number of flakes compared to blades (3 ×) is notable given the numerical dominance of blade cores. A closer look at the debitage pieces suggested the following scenario. Almost three-quarters of the flakes are fully or partially-cortical (17/73.9%) and were detached mainly during nodule decortification, core striking platform preparation, and core flaking surface re-shaping. In contrast, non-cortical pieces dominate among the blades (5/62.5%) and there are no completely cortical items. This indicates to us that blades were the real endproducts of on-site core reduction. More specifically, large-sized blades were the most desired pieces, within the limits of the available nodule sizes. Only three of the eight blades had well-preserved butts and all of them are semi-lipped with semi-acute exterior angles, indicating a soft-hammer technique. Although the sample is quite small, it can be said that such butts on blades do not occur at all in Szeletian assemblages and at best are known by a few examples in Bohunician assemblages. There are only two bladelets and a single microblade (< 7 mm wide), consistent with the presence of a single blade/bladelet core and the absence of both bladelet cores sensu stricto cores and nosed/carinated endscraper-cores. The irregular shape and 1.1 cm width of the two bladelets might indicate that they were unsuccessfully detached blades rather than intentionally produced bladelets. Thus, bladelets appear to have been only occasional and perhaps peripheral products, indicating the leading role of blades in the debitage.

Toolkit Data

The Líšeň I excavations yielded only five retouched tools: three endscrapers, a splintered tool (probably a proper tool and not a bipolar anvil core) and a fragmented retouched piece.

While the latter two pieces are of little chronological or cultural significance, the endscrapers deserve some attention (Demidenko et al., 2017: Fig. 3: 8–10) (Fig. 15: 9–11). All the endscrapers are retouched on the distal ends of large-sized blade fragments (2.0–3.1 cm wide), but they are of different forms. They include one simple endscraper (Fig. 15: 9), a thick specimen (Fig. 15: 10), and an ogival piece (Fig. 15: 11). The thick endscraper is a common type for many IUP and EUP techno-complexes and industry types when a working edge was formed on a thick debitage blank. They lack lamellar removal negatives and should not be confused with true Aurignacian endscrapers. The thick endscraper was manufactured on a bidirectional blade, not typical for any Aurignacian industry, although the ogival endscraper was initially considered by us as an Aurignacian tool type here.

Debris

The most common artifact category in the assemblage (90 pieces) includes the following sub-categories:

- chips—65/72.2%
- uncharacteristic debitage pieces—8/8.9%
- chunks—8/8.9%
- heavily heated pieces—9/10.0%.

Here, it is worth noting a dominance of non-cortical specimens among chips (53/81.5%) indicating some intensive on-site tool shaping or reduction, as well as the presence of a series of heated pieces evidencing an existence of a fireplace/hearth.

Pierced Tertiary Mollusk Shell

A single incomplete perforated specimen of the Tertiary mollusk species *Pirenella picta* ssp. was recovered at the Líšeň/Podolí I site. The hole is evidently of anthropogenic origin.

Faunal Remains

Excavated fauna material was analyzed by M. Nývltová Fišáková and includes bone fragments from horse (*Equus germanicus*), eight bone fragments of a large-sized mammal, a bone fragment of a medium-sized mammal, and three bone fragments of a small, fox-sized mammal.

An Overview

The Líšeň I assemblage was originally suggested to be of an evolved Aurignacian industrial affiliation (Demidenko et al., 2017, pp. 14, 32–33) with, however, "*the absence of any Early UP or Middle UP types.*" At the same time, the cultural attribution for the Líšeň I assemblage was not considered secure. We argued that "*The lack of typical Aurignacian types in this assemblage could possibly be explained by the site function*" (Demidenko et al., 2017, p. 14). At the same time, many similarities with the Líšeň/Podolí I site were emphasized, including "*raw material* (*dominance of Stránská skála-type chert*), *technological unidirectional and bidirectional core reduction*, *dorsal preparation*, *bladelets*, *and typological* (*end scrapers on massive blades*, *but not carinated*) *… the same gastropod species* (*Pirenella picta sp.*) *covered by red ochre was found in the artifact bearing horizon*" (Škrdla, 2017, p. 110). The absolute dating of the Líšeň I site was also questioned—"*with respect to the large probability distribution and a number of failed dates* (true of Moravian IUP & EUP sites), *the relevance of a single date for Líšeň I should be questioned*" (Škrdla, 2017, p. 110).

Now that we have proposed that Líšeň/Podolí I should be viewed as a LRJ assemblage, it is logical to add to it Líšeň I assemblage. The absence of J-type bladepoints and prevalence of core-like pieces over tools (14 vs. 5) allows us a hypothesis that Líšeň I site represents mostly a workshop for blade production with some export of blades to other occupation loci.

Tvarožná X, "Za školou" Site

The site had been known for a long time as a series of mostly Aurignacian surface loci (e.g., Valoch, 1976b). New surface finds discovered between 1990 and 2000 (Škrdla & Kos, 2002) and later in 2005–2006 (Škrdla, 2007) allowed recognition of an UP find concentration in a shallow erosional depression. Excavation of 15 test pits in 2006–2008 led to identification of a c. 200 m^2 area with lithic artifacts found within intact Pleistocene sediments and lacking Aurignacian core and tool types (Škrdla & Tostevin, 2008). The site, already called Tvarožná X, "Za školou," was further excavated in 2008 and 2015 as collaborative project between G. Tostevin and P. Škrdla. Various studies of material from the site, including radiocarbon and thermoluminescence dating, are still in progress, so this is the least well-studied among the four South Moravian sites discussed here.

Site Location

The site is located c.7 km east of the Stránskáskála cliff near the southern edge of the village of Tvarožná, the local toponym is Za školou. The field slopes to the north and is bordered by the Tvaroženský Potok stream to the north, Santon Hill to the west, and a low, expansive, unnamed elevation to the south and east. The elevation of the site ranges between 265 and 270 m. The site does not provide a direct view into the main valley and is protected by the rugged topography of the southern margin of the Drahany Upland to the north. Such the topographic position is not characteristic for known Bohunician sites or for IUP and EUP sites in general in Moravia. Geographically, the site is also located at the entrance to the Vyškov Gate, a natural corridor connecting the Brno Basin with the Ondratice area and valleys further to the north (Upper Morava River Valley, Moravian Gate).

Lithic Artifacts

The collection of artifacts from the 2008 and 2015 excavations is still under analysis by G. Tostevin, although it has already been linked to the Bohunician (Škrdla et al., 2009). All published artifact data to date are related to some studies made by one of us some years ago (Škrdla, 2017, pp. 52–55). The assemblage of artifacts mapped in situ numbers more than 600 items. Additional artifacts, mostly small-sized items, especially chips, were recovered during sieving. Our analysis of the material in 2019 leads us to re-evaluate the proposed Bohunician affiliation of the Tvarožná X assemblage and to hypothesize instead a possible LRJ character.

With regard to raw material, Stránská skála-type chert and cherts that originate in gravels near the Stránská skála cliff account for 62% of the assemblage. KL chert makes up 22% of the assemblage. Here, the in situ assemblage differs strongly from the surface collected assemblage (Škrdla, 2007) where proportions of Stránská skála-type chert and KL chert were approximately equal. Other Moravian Jurassic cherts, probably obtained from local gravels account for 4% of the in situ assemblage. Other utilized rocks include Cretaceous spongolite chert (6%), radiolarite or radiolarite chert (1%), and erratic flint (1%), as well as one item made from limnic siliceous rock and two from Troubky/Zdislavice-type chert. The assemblage is supplemented by two quartz flakes, which may or may not have been worked. Thus, Tvarožná X is rather unique for the IUP in southern Moravia in that the site is located close to the rich Stránská skála chert outcrop but still contains a substantial proportion of artifacts produced on KL chert.

Some Core and Debitage Technological Data

The preliminary published technological data on 2008 and 2015 excavated Tvarožná X assemblage have been summarized as follows:

…a prevalence of debitage, including flakes (58%), blades and blade fragments (21%; including crested items), flake fragments (7%), cores (6%), blades (5%), partly retouched artifacts (1%; including broken blades and flakes), and one bladelet. Tools account for 5% of the assemblage (excluding chips). There are also seven unretouched Levallois points (not included in the above mentioned 5% tools). Characteristic Bohunician attributes including bidirectional reduction of elongated blanks and platform facetting commonly occur. … Initial analyses demonstrate the presence of Levallois debitage with seven unretouched Levallois points … typical of the Bohunician industrial type (Škrdla, 2017, p. 53).

In contrast, the results of our 2019 re-study, which contradict the earlier, Bohunician attribution, can be summarized as follows.

1. The assemblage includes only two cores with possible Levallois-point-like removal negatives (Škrdla, 2017: Fig. 3.7, 19–20) (Fig. 16: 1–2). A Bohunician assemblage might well contain exhausted and re-prepared cores that do not look like proper Levallois point cores, but nonetheless a higher proportion of Levallois cores is expected. At the same time, many Tvarožná X cores are of "volumetric" character and demonstrate a non-Levallois sensu stricto unidirectional and bidirectional core reduction (Škrdla, 2017: Fig. 3.7, 15, 17) (Fig. 16: 3–4). The presence of some evident crested blades are in a good accord with the systematic flake and blade reduction at the site (Škrdla, 2017: Fig. 3.7, 9–10) (Fig. 16: 5–6; 17: 1–2).
2. The artifacts previously identified as Levallois points were re-examined, and only a single piece can be regarded as a true Levallois bidirectional point, with a partially faceted, narrow *chapeau de gendarme* butt (Skrdla, 2017: Fig. 3.8, 25) (Fig. 17: 3). All other previously identified Levallois points might not be true Levallois point at all. The complete items lack true "Y-arrête" scar patterns and/or truly and finely-faceted *chapeau de gendarme* butts (Skrdla, 2017: Fig. 3.8, 20–22, 24, 26–28, 34) (Fig. 17: 4–11). Also, one of other pieces (Skrdla, 2017: Fig. 3.8, 23) (Fig. 17: 12) was not correctly illustrated. Instead of being fully facetted, the butt is mostly plain with a small amount for edge facetting. On the

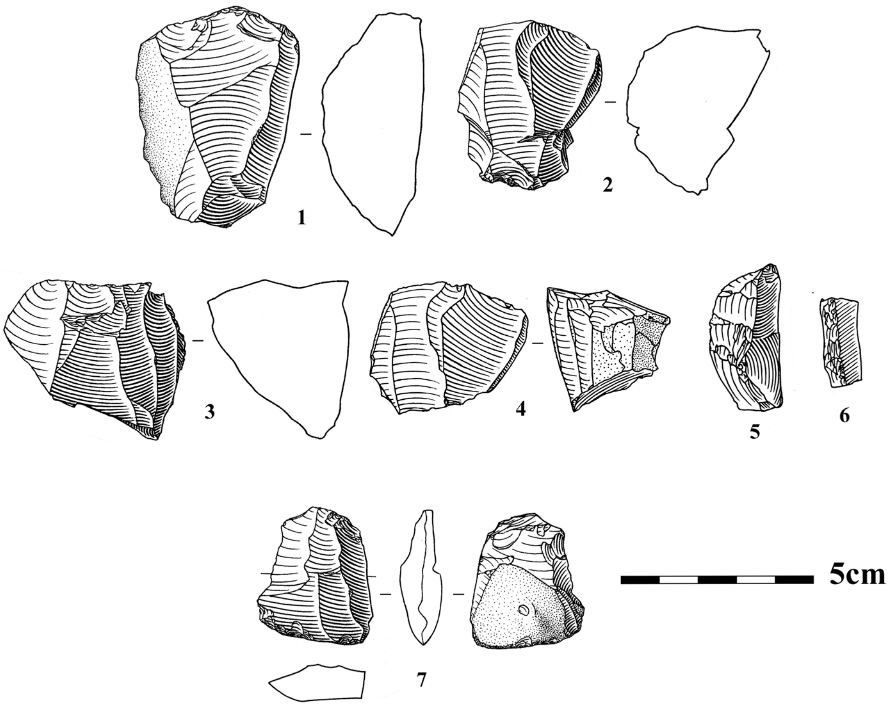

Fig. 16 Tvarožná X, "Za školou" site, Southern Moravia, Czech Republic: 1–4—cores; 5–6—crested blades; 7—bipolar anvil core (modified after Škrdla (2017))

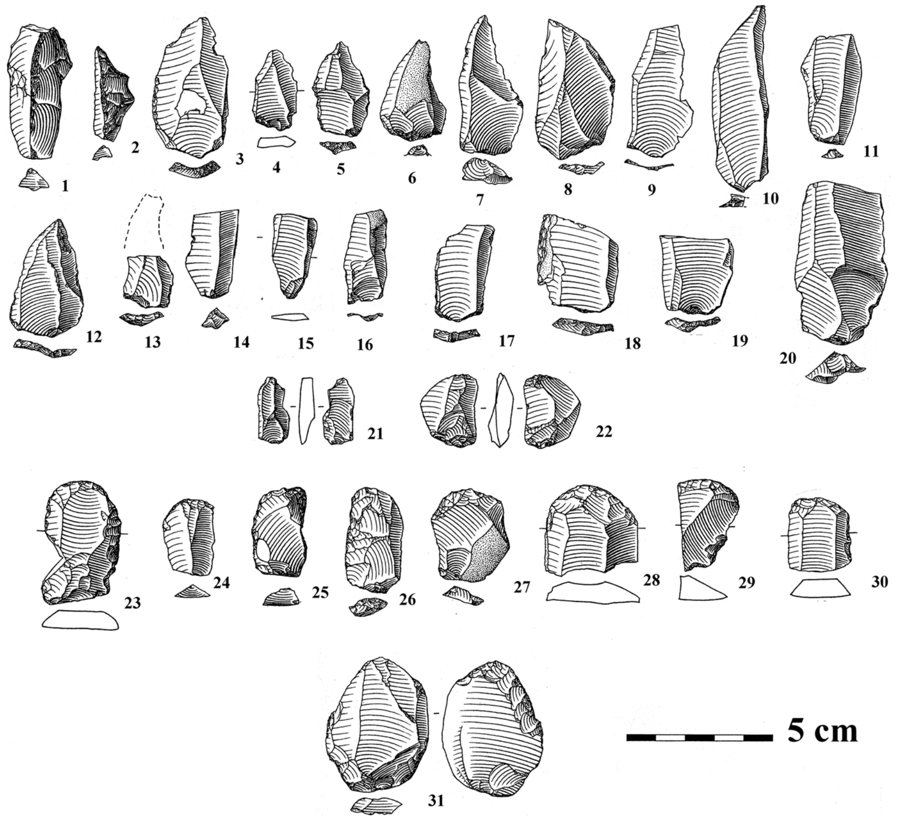

Fig. 17 Tvarožná X, "Za školou" site, Southern Moravia, Czech Republic: 1–2—crested blades; 3—Levallois bidirectional point "Y-arrête" scar pattern and *chapeau de gendarme* butt; 4–20—ex-Bohunician debitage pieces; 21–22—bipolar anvil cores; 23–30—endscrapers; 31—J-type point (modified after Škrdla (2017))

other hand, some fragmented proximal Levallois-like pieces have well faceted butts but no "Y-arrête" scar pattern: these are simply blades with faceted butts (Skrdla, 2017: Fig. 3.8, 31–33, 35–37, 50) (Fig. 17: 13–20). Thus, there is at best a small number of true Levallois points. Similarly, the assemblage contains almost no lateral *débordante* preparation/re-preparation pieces with small faceted butts of the type usually detached from the shoulders of Levallois core *chapeau de gendarme* striking platforms for creating "Y-arrête" scar patterns.

3. The assemblage also contains a series of debitage pieces with facetted striking platforms and butt abrasion, a technological feature never observed in Bohunician. At the same time, the assemblage is like the Bohunician, and the LRJ, in lacking pieces associated with core tablet technique.
4. The presence of at least three bipolar anvil cores is also notable due to the fact that such cores have not yet been identified in any "pure" Bohunician assemblage (Škrdla, 2017: Fig. 3.7, 16; 3.8, 6–7) (Fig. 16: 7; Fig. 17: 21–22).

Some Typological Observations

In 2017, the retouched tools from Tvarožná X were described as follows:

"*The most frequent tool types are endscrapers* (*8 items*; *Fig. 3.8*: *10–17*) *followed by points* (*5 items*). *Points include a convergently retouched Levallois point with a ventral impact scar on its distal end made on limnic siliceous rock* (*Fig. 3.7*: *1*) *and a short Jerzmanowice-type point made of erratic flint* (*Fig. 3.8*: *40*). *There are also several splintered pieces* (*Fig. 3.8*: *6*, *7*), *side-scrapers* (*Fig. 3.8*: *18*), *retouched blades* (*Fig. 3.7*: *7*, *8*), *and retouched blade fragments*. *A burin*, *a notched tool and a retouched flake are also present.*" The occurrence of the retouched Levallois point, endscrapers, and other tool types was considered typical for Bohunician (Škrdla, 2017, p. 53).

The quick re-evaluation of the retouched tools led us to the following two conclusions:

1. A series of well-made endscrapers, some with thick fronts (Škrdla, 2017: Fig. 3.8, 10–17) (Fig. 17: 23–30), resemble endscrapers described above from Želešice III, Líšeň / Podolí I and Líšeň I.
2. The single J-type point, made on Stránská skála-type chert, is relatively short (4.7 cm long, 3.6 cm wide, 0.8 cm thick) (Škrdla, 2017: Fig. 3.8, 40) (Fig. 17: 31). It has bilateral dorsal scalar and semi-steep retouch near the butt. The butt itself was additionally thinned on both dorsal and ventral surfaces, giving the tool's proximal part a sub-ovoid shape. Both lateral edges show partial dorsal retouch, and ventral scalar and flat retouch near the tip. We suggest that the artifact represents unsuccessful on site production. The knapper abandoned it after partial shaping, possibly because it was too wide and short.

All in all, our 2019 re-evaluation for the Tvarožná X excavated lithic assemblage is more consistent with an LRJ industrial status than a Bohunician one. We estimate that no less than 95% of lithic artifacts come from LRJ-like production processes, with more typical Bohunician pieces making up no more than 5% of lithics. We note that *Levallois-like* points and cores can well be produced, in small numbers, through typical LRJ bidirectional reduction where platforms are prepared by faceting.

Some additional arguments in favor of the LRJ attribution for Tvarožná X come from test pits and surface collections. A clear J-type point on a small, elongated flake (3.4 cm long, 1.8 cm wide, 0.3 cm thick) made of Stránská skála-type chert, came from one test pit (Škrdla & Tostevin, 2008: Fig. 45, 1). Three more possible J-type points additionally were collected on the surface: a complete semi-product, a proximal part (Škrdla, 2007: Fig. 4, 7) on Stránská skála-type chert, as well as a small tip on KL chert with lateral dorsal retouch and potential impact damage in the form of a burin-like negative originating at the tip (Škrdla, 2007: Fig. 3, 7). Three cores with parallel removals, one single-platform unidirectional and two and opposed-platform bidirectional, without finely facetted striking platforms (Škrdla, 2007: Fig. 3, 25, 27–28) made on KL chert are of forms never previously observed in in situ Bohunician assemblages. A series of well-retouched blades (Škrdla, 2007:

Fig. 3, 13–15, 17) and blades with finely-facetted but not *chapeau de gendarme* butts (Škrdla, 2007: Fig. 3, 17–22) on KL chert would be again odd features for in situ Bohunician assemblages.

In sum, the surface and test pit lithic artifacts found at Tvarožná X show the same industrial characteristics observed for the in situ finds from the 2008 and 2015 excavation block, with a prevalence of possible LRJ-associated pieces and fewer possible Bohunician items. More thorough study is required for understanding potential co-occurrence of LRJ and Bohunician techno-typological features. It could be the result of a stratigraphic palimpsest of both LRJ and Bohunician finds within a single archaeological layer, or it could be a specific or early LRJ assemblage still containing some definite Levallois-like pointed technological features.

At the same time, the atypical (for the Bohunician) geographic and topographic location of Tvarožná X strengthens the possible LRJ attribution and opens the door for settlement pattern studies of the LRJ in southern Moravia.

The LRJ Within the Moravian IUP and EUP Industrial-Chronological Context

Now that we have identified the LRJ in Moravia, it remains to put it into the regional IUP and EUP industrial and chronological context, finding "space" for it among the Bohunician, Szeletian, and Aurignacian. Indeed, the fact that LRJ artifacts are often mixed with lithics from the other three techno-complexes at Moravian surface find spots implies a close geographic and temporal relationships among the four archaeological units in the region.

Geochronology

The radiocarbon dates obtained so far for the Líšeň/Podolí I and Želešice III sites put the Moravian LRJ into the time period preceding HE-4/CI Event, older than 40 ka cal BP. Keeping in mind the limited geochronological possibilities and potential charcoal palimpsest at Želešice III (mostly LRJ occupations with a possible minor Szeletian component), we suggest an end date of GI-11—GI-10, c. 42 ka cal BP for the LRJ in Morvia. Thus this time range would mean that the LRJ did not overlap in time with the Aurignacian, given that the earliest Aurignacian in Moravia is Aurignacian II/Middle Aurignacian, with dates c. 36–37—34 ka cal BP (Demidenko et al., 2017). More generally, the dates for Moravian LRJ assemblages overlap with the IUP and not with the EUP. At the same time, there is now a good set of absolute dates for in situ Bohunician and Szeletian sites in southern Moravia, showing an earlier chronology, with both starting from GI-13 and/or GI-12, c. 48–46 ka cal BP, and possibly lasting until GI-10, c. 42–40 ka cal BP. We note that some late dates from the Ořechov IV site, if not contaminated, might indicate an Upper Bohunician during GI-9, c. 40 ka cal BP (Škrdla, 2017: 129–130). If the geochronological ranges described here are valid, then LRJ should be considered to be a form of late IUP in southern Moravia, largely postdating, but overlapping with the Bohunician and Szeletian.

Industrial Features

The LRJ is very different from Szeletian both technologically and typologically (see Valoch, 1993; Neruda & Nerudová, eds., 2009; Nerudová & Neruda, 2017), but it demonstrates some clear techno-typological similarities to the Bohunician. Here, it is also worth emphasizing that bifacial leaf points are not yet documented for stratigraphically sealed Moravian LRJ sites. Some bifacial tools were found at Líšeň surface loci (Svoboda, 1987: Obr. 31, 1–4, 6–10; 33, 2–3, 6) which *could* be associated with the LRJ and not the Szeletian, but better data are needed. Here, we present a table comparing technological and typological features of LRJ and Bohunician assemblages in Moravia. It shows not only similarities and dissimilarities between the two archaeological units but also highlights the distinct techno-typological characteristics of the Moravian LRJ.

There are many basic similarities between the Bohunician and the LRJ. The fundamental differences are related to blank production and targeted products, especially points. Both industries are based on opposed-platform core reduction with elongated products, but they differ in how core volumes are exploited (Levallois vs. non-Levallois), how striking platforms are prepared (fine faceting and *chapeau de gendarme* platforms *vs* occasional faceting and platform abrasion) and the use of soft hammer percussion. In the LRJ, bidirectional blade reduction is supplemented with two additional methods (bipolar anvil percussion and bladelet core exploitation). Bohunician knappers targeted Levallois points, which were sometimes retouched, whereas LRJ knappers produced large, elongated blanks that were transformed into J-type blade points. If J-type or Levallois points are not present, it may be very difficult to assign an assemblage to one or the other industry.

Moravian LRJ Sites and Assemblages and Their Comparison with the Already Established European Site and Industrial Parameters for LRJ

Moravian LRJ Settlement Pattern

As was stressed during the LRJ overview, the industry is known almost exclusively from short term hunting stations, and little is known about residential sites, domestic artifacts or domestic features. The four open-air sites in southern Moravia discussed here represent some of the missing non-hunting components of LRJ land use. Furthermore, these sites can be further differentiated by geographic situation and site function.

Two of the sites are close to Stránská skála-type chert outcrops. One, Líšeň/Podolí I, represents a residential base camp, while the other, Líšeň I, was mainly a workshop for blade production. The two sites are characterized by the presence of personal ornaments in the form of pierced mollusk shells. The large collection of shells from Líšeň/Podolí I probably indicates on-site production, while a single ornament at Líšeň I might indicate accidental loss. The third site, Želešice III, could be a hunting station located near a KL chert outcrop, with much primary and secondary lithic manufacture on-site. Tvarožná X could be a special-task site of some sort. Pekárna Cave, located in southern part of Moravian Karst, might be a strict hunting station like many other LRJ sites in Europe. The wide variety of LRJ site types contrasts strongly with other LRJ areas. The region is bound by the Svratka and Bobrava River valleys in southern Moravia from the Brno Basin and the southern part of Moravian Karst in the north and the Bobrava Highland in the south over a linear distance of c. 25 km. Furthermore, given the movement of raw materials, we can infer the existence of networks among different LRJ groups in southern Moravia.

Similarities and Differences Between European and Moravian LRJ Assemblages

Based on site function and location, which are different from the European standards for the LRJ, we should expect that Moravian LRJ assemblages should certainly differ from other known European LRJ sites. Recall first that only a single site, Beedings, has yielded a sample of cores, while nearly all technological data from other European sites come from blade blanks of J-type points. Furthermore, the European LRJ toolkits contain very few modified artifact classes besides than J-type points and some bifacial leaf points, while non-pointed domestic tools are well represented in the southern Moravian LRJ open-air sites.

Technological Similarities and Differences

Taking into consideration some of the external factors (raw materials, site locations, etc.) that can influence flaking processes, the similarities between the Moravian and northern European LRJ sites is noteworthy. LRJ assemblages from Moravia and the rest of Europe are very similar in terms such as the central *lame à crête* technique, permanent faceting of striking platforms, sometimes with edge abrasion, and the absence of the core tablet technique. The Beedings burin-cores are not recognized yet for the Moravian collections, while proper bladelet cores from the Moravian sites are unknown elsewhere. At the same time, there is a seemingly significant difference in blade core reduction. While the few LRJ cores on nodules from Beedings are all opposed-platform bidirectional blade cores, in the Moravian LRJ cores on nodules with parallel detachment of elongated flakes and blades are often unidirectional. These core features seem to correspond well to the debitage data available for southern Moravia where flakes always outnumber blades and unidirectional scar patterns prevail over bidirectional ones for flakes and blades. Here, we also recall our earlier observation that the double-platform cores from Líšeň I (Demidenko et al., 2017, p. 11) did not show true bidirectional flaking, meaning alternate removals from both opposed striking platforms.

Do these core and debitage data make the Moravian materials industrially distinct from the LRJ in northern Europe? Given that most of the data from other areas are so strongly biased toward bidirectional blade-blanks for J-type points, the answer must be negative. The Moravian open-air sites are situated either adjacent to or near outcrops of the main raw materials, with a maximum distance of 7 km (for Tvarožná X). Because they had easy access to local cherts for core reduction, LRJ knappers in the southern Moravian sites were not constrained to extract the maximum from each core. With the possible exception of some nodules with perfect flaking qualities, the Moravian sites show mostly short reduction sequences, resulting in the single-platform unidirectional morphology with many flake removal negatives. At the same time, some more intense core reduction is manifested in both the Moravian and Beedings LRJ sites in the occurrence of so-called secondary flaking, namely burin-cores, cores on flakes/truncated-facetted pieces and splintered pieces/bipolar anvil cores. The presence of some bladelet cores on nodules at Moravian sites might again be an effect of close proximity to raw material outcrops.

Typological Similarities and Differences

A typological comparison among LRJ sites is even more difficult than a technological one because so little is known about shaped tools other than points from most European sites. Nevertheless, absence criteria are worth noting for some tool classes. First of all, the near absence of MP tool classes, and the absence of both Aurignacian and Gravettian tool types could indeed serve as typological markers, putting the LRJ later than the Middle Paleolithic and before the Early and mid-UP, therefore in the timeframe of the IUP. The presence of a few simple endscrapers, non-multi-facetted burins, and some generic types of retouched blades and flakes do not contradict IUP definition for the European LRJ. At the same time, the presence of multiple simple endscrapers and some other rare UP artifact classes in the Moravian assemblages correspond well with the broader European domestic tool component of the LRJ. The presence or absence of bifacial leaf points is not a helpful criterion. Bifacial leaf points have not been observed yet from in situ Moravian LRJ, although some examples among surface finds at Líšeň have a peculiar basal morphology (e.g., Svoboda, 1987: Obr. 31, 3–4) that is not found among bifacial tools in the Moravian Szeletian. However, bifacial leaf points are not found at most LRJ sites in the rest of Europe.

Thus, the only comparable tool type for the southern Moravian open-air and European LRJ sites is the industry's main *fossile directeur*, the J-type blade-point. And here, as with cores and debitage, there are again some problems. While most of the European fragmented J-type points were very likely broken during their use in projectile weaponry during hunting activities, many of fragmented Moravian J-type points were broken during on-site point production (see Líšeň/Podolí I site—Škrdla, 2017: Fig. 4.5, 24, 43–44; Želešice III site—Škrdla, 2014: 12, 1, 23, 29), although some breakage of J-type points in the Želešice III assemblage could be due to hunting damage (Škrdla et al., 2014: 12, 3–5). Breakage prevents precise reading of the blank scar patterns for 13 recognized J-type points and their semi-products from the three Moravian open-air sites. The three complete J-type points include two with bidirectional (Škrdla, 2017:

4.5, 42—Líšeň/Podolí I site; 3.8, 40—TvaróžnáX site) and one with unidirectional (Škrdla & Nikolajev 2014: 12, 5) scar patterns. Two nearly complete J-type points in the Líšeň/Podolí I assemblage show unidirectional scar patterns (Škrdla, 2017: 4.5, 43–44). Scar patterns can also be recognized for specimens fragmented during their production: one of them is unidirectional-crossed (Škrdla et al., 2014: 12, 7) and another piece is unidirectional (Škrdla et al., 2014: 12, 23). Thus, while the northern European J-type points almost always exhibit bidirectional scar pattern, the Moravian J-type points show a variety of scar pattern types. At the same time, at least 99% of the northern European J-type points were produced on blade blanks. The Moravian J-type points for which blank type is determinable are all on blade-blanks, except for a single specimen from Tvarožná X, which is on a flake with a bidirectional scar pattern. As in other LRJ sites, the blade blanks used for J-type point production at the Moravian sites are usually the largest blades within the debitage samples. Retouch characteristics for the northern European and Moravian J-type points are very similar. Blanks were mainly dorsally and ventrally retouched at both the proximal and distal ends, giving the characteristic leaf shape to the points. Lateral edges of blade-blanks were unretouched or lightly retouched. Rare, heavy scalar, and/or stepped retouch extending toward the center of the blanks indicates a correction of irregularities in shape and thickness. Much retouch for known J-type points from northern European localities also occurred as a result of re-shaping and rejuvenation. In contrast, J-type points from two of the Moravian sites were probably never used (Líšeň/Podolí I, TvarožnáX) and only a part of the Želešice III specimens show signs of use. That explains the rather light retouch for the Moravian J-type points in comparison with similar artifacts from other parts of Europe. All in all, considering again the contextual evidence, the documented differences in scar pattern types, overall size, length, and retouch data can probably be explained by differences in the spatial organization of production. The Moravian sites mostly saw on-site production of the points, starting from cores, whereas at most other European sites the best and largest points were brought in from elsewhere. Likewise, the largest pieces may have been exported away from the Moravian sites. Accordingly, we are really looking at different stages in the use lives of a single point type with very similar *chaînes opératoires* for their primary (debitage blank production) and secondary (retouch) production.

Typological and technological data, taken as a whole, lead us to conclude that the tool inventories from the Moravian open-air sites fit very well within the broader European LRJ world.

A Hypothesis About LRJ Origins, and Its Implications

Previously, the dominant hypothesis was that the LRJ originated from northwestern European late Middle Paleolithic industries with bifacial leaf points, and that the industry was produced by late Neanderthals. In light of the new LRJ sites and assemblages from southern Moravia, we argue for a reverse geographical origin of the LRJ. The fact that there are no consistent MP techno-typological features of LRJ assemblages from either the Moravian open-air sites or the LRJ sites from the rest of Europe, the proposition that the LRJ developed directly from the MP looks doubtful. Even in a scenario with some acculturation/trans-cultural diffusion/stimulus diffusion effects coming into the MP cultures of Neanderthals from incoming *Homo sapiens* groups bearing IUP/EUP artifact-making traditions, the new IUP/EUP culture should retain clear and obvious MP traits. A hypothetical autochthonous shift from late MP to LRJ among the same Neanderthal communities would imply that the LRJ should retain even more MP features.

Starting from the new Moravian data, we propose the following scenario for the origin and spread of the LRJ.

First, as was also argued before (e.g., Flas, 2011, 2014), and supported by the Moravian data, the LRJ first appeared during the period just preceding HE-4/CI Event, c. 42–40 ka cal BP.

Second, by all archaeological criteria, the LRJ is an IUP industry which correlates with the proposed likely geochronological beginnings.

Third, as discussed above and summarized in Table 2, there are a number of strong similarities between the Moravian LRJ and Bohunician assemblages. A hypothetical passage from Bohunician into LRJ involves a shift in only one basic artifact class and its production: specifically, Levallois point production for projectile tips in the Bohunician was replaced by technologically similar production of elongated blanks for J-type points. We propose a smooth (a rare case for Paleolithic industries) transition from the Bohunician Levallois bidirectional, pointed, bladey core reduction into LRJ non-Levallois unidirectional/bidirectional bladey technology. Many Bohunician-like techniques were retained, including use of hard hammer, central *lame à crête*, and use of faceting rather than core tablets for adjusting platform angles. Aside from the reorganization of core volume exploitation (from Levallois to more volumetric), what was added in the LRJ was some application of an organic soft-hammer technique and associated striking platform edge abrasion. This technological shift led to more targeted production of elongated flakes/blades compared to the manufacture of Levallois points in the Bohunician. We believe that the LRJ strategy represents some improvement in efficiency of core reduction. Additional technological developments in the LRJ include the appearance of dedicated bladelet core production and bipolar anvil core technology. At the same time, aside from the Levallois and J-type points, there were no substantial changes in the presence/absence and forms of other types of shaped tool. The presence of some thick, non-carinated endscrapers in LRJ is probably due simply to the production of thicker, more robust flakes and blades in the LRJ.

The possibility of a Bohunician—LRJ technological transition, centered on a shift in technology of blank and point production, is also consistent with the geographic distribution of the LRJ industry. Most known LRJ sites occur in northern Europe, where they would have been associated with open steppe-tundra landscapes. This was a harsh environment but very suitable for groups specialized in hunting of large-sized ungulates. This kind of environment would favor wide and rapid movement of people across paleolandscapes, which would favor efficient production of lithics artifacts in general

Table 2 LRJ and Bohunician main techno-typological industrial features

LRJ	BOHUNICIAN
Lithic primary core flaking method	*& Technological features*
Non-Levallois sensu stricto unidirectional and bidirectional blade technology with a central *lame à crête* technique applied	Levallois sensu stricto bidirectional pointed blade technology with a central *lame à crête* technique applied
Target debitage pieces: rather large elongated flakes and blades, used as blanks for J-type point production, with few and atypical Levallois points	Target debitage pieces: typical Levallois points of varying sizes
At best occasional and atypical *chapeau et demi-chapeau de gendarme* faceted butts on flakes/blades	Systematic occurrence of typical *chapeau et demi-chapeau de gendarme* faceted butts on Levallois points
Platform edge abrasion was often used for preparing facetted and plain core striking platforms before detachment of a blank. No core tablet technique	Platform edge abrasion was not used to prepare core striking platforms. No core tablet technique
Some debitage pieces have lipped/semi-lipped acute/semi-acute butts demonstrating use of an organic soft hammer	Lipped/semi-lipped acute/semi-acute butts do not occur, no use of organic soft hammer
Independent bladelet technology represented by cores and bladelets in two out of four sites in Southern Moravia (Líšeň/Podolí I, Želešice III sites)	Bladelets produced only as byproducts of producing 'Y-arrête' scar pattern for small Levallois points at some sites (e.g. Ořechov IV)
Bipolar anvil core technology is present	Bipolar anvil core technology is absent
Shaped tools	*& Tool treatment features*
Endscrapers are the most numerous tools. About a third of them are on blades and blade fragments. A series of endscrapers have thick working fronts, but they are not carinated and lack lamellar removals	*Endscrapers* are the most numerous tools. About a third of them are on blades and blade fragments. Because of the use of thin Levallois blanks, most are thin and flat, and few endscrapers have thick *non-lamellar* working fronts
True J-type points are common (the second most common tool class for Líšeň/Podolí I and Želešice III sites). Retouch chips refitted onto the points show on-site point production at these two sites	*Pseudo-LRJ, non-bifacial points* occasionally occur, in the form of rare Levallois points with some limited ventral-terminal retouch
Burins are rare, simple and mainly atypical	*Burins* are rare, simple and mainly atypical
Other UP tool classes (truncations, borers, retouched blades denticulates/notched pieces), if they occur at all, are represented by a few typologically undistinguished pieces	*Other UP tool classes (truncations, borers, retouched blades denticulates/notched pieces)*, if they occur at all, are represented by a few typologically undistinguished pieces
True Middle Paleolithic tool classes and types are either absent or represented by a few items	*True Middle Paleolithic tool classes and types* are either absent or represented by a few items
Personal	*Ornaments*
Pierced mollusk shells are present at two out of four open-air sites (Líšeň/Podolí I, Líšeň I/Líšeň—Čtvrtě) in southern Moravia	Absent

and hunting weaponry in particular. A need to create expansive social networks among the LRJ within the harsh northern landscapes might also lead to use of personal ornaments (pierced mollusk shells) to facilitate differentiation of friends and strangers at a distance. The use of Tertiary fossil mollusk shells makes sense, as such items are available far from the sea. It is also important to recall that southern parts of Europe were populated by other cultural groups, first by the makers of the Proto-Aurignacian, before the HE-4/CI event, and later by Early Aurignacian *Homo sapiens*. Perhaps, the intrusion of Aurignacian populations encouraged the advanced Bohunicians, or LRJ humans, to move into the northern territories in the continent.

Fourth, arguing for the IUP Bohunician industrial roots of the LRJ, and making it a late IUP, has implications for its makers. *Homo sapiens* are assumed to be the exclusive makers or the IUP Emiran and related industries in Eurasia, including, of course, the Bohunician industry (e.g., Škrdla, 2017: 9–11, 133; Hublin et al., 2020). Consequently, we should conclude also that *Homo sapiens* were the makers of the LRJ.

Fifth, the mystery of what happened to the Bohunician and its *Homo sapiens* makers is resolved with the identification of the LRJ as successor to/descendent of the Bohunician. After appearing in central and eastern Europe, with Kulychivka in western Ukraine (Demidenko & Usik, 1993a; Demidenko, 2018: 271; Škrdla & Nikolajev, 2014; Škrdla, et al., 2016b; Škrdla, 2017: 83–86), the Bohunician transformed into the LRJ and spread across the northern territories of central and western Europe, thanks to a newly developed adaptation to cold and open environments.

Six, the occurrence of more than a half of all the known LRJ loci (even including the six Czech sites) in Great Britain could be a consequence of this being the end of the process dispersal. Analogous cases can be cited in both Paleolithic and later prehistoric archaeology. Later in time, the Tripolye-Cucuteni Chalcolithic culture (e.g., Menotti & Korvin-Piotrovskiy, 2012), known across vast territories of modern Romania, Moldova, and Ukraine, came to a climax of its development and prosperity in its easternmost region, Ukraine, where it is characterized by so-called giant settlements. The LRJ site distribution might well be of the same character where the industry's origin place is situated at the opposite edge of its distribution where the most known sites occur.

Concluding Remarks

This study began with an intensive overview of the LRJ industry, including lithic artifacts, site characteristics and distributions, geochronology, and questions about its makers, either Neanderthals or *Homo sapiens*. The main outcome of the overview was the understanding of limitations in our current data on the LRJ, which is represented by ephemeral and/or temporary hunting stations with restricted artifact inventories. In fact, the LRJ is the only European UP industry defined based upon such limited information. At the same time, it was also argued that the LRJ represented an IUP industry, following the late Middle Paleolithic but preceding the Aurignacian.

The second part of the study provided an overview of four recently excavated open-air sites in southern Moravia, covering geochronology, lithic artifacts, raw material use, and settlement pattern. Evidence from southern Moravian open-air sites led us to propose that they contained LRJ assemblages dating to the time span right before HE-4/CI event, c. 42–40 ka cal BP. Previously known finds of J-type points at Nad Kačákem Cave and Pekárna Cave further document the presence of the LRJ industry in Moravia. The six loci with LRJ artifacts in the Czech Republic would now compose c. 13% of the 46 known LRJ sites in Europe. Moreover, the newly recognized Moravian in situ open-air sites are not just hunting stations but have varying characteristics. The sites include a sort of residential base camp near a Stránská skála chert outcrop (Líšeň/Podolí I site); a workshop, also near a Stránská skála chert outcrop, for blade production and some export of blades to other locations (Líšeň I/Líšeň-Čtvrtě site); a sort of hunting station at the Krumlovsky Les chert outcrop (Želešice III/Želešice-Hoynerhügel site); a special-task site near the entrance to the Vyškov Gate (Tvarožná X/Tvarožná—"Za školou" site); and an ephemeral hunting station in the Moravian Karst area (Pekárna Cave). These variable occupations allowed us proposing a logistic/radiating mobility settlement pattern system for these sites. Finally, we identified a number of technological and typological similarities between the Moravian LRJ assemblages and earlier Moravian Bohunician assemblages. This led to the hypothesis that there was a smooth technological transition from Bohunicial to LRJ, based mostly on the change in how tips for hunting weapons were made, i.e., a shift from Levallois point manufacture to production of J-type blade-points. As a result, we further propose that the LRJ industry originated in Moravia, in central Europe, and that it was produced by *Homo sapiens* groups who then spread across the northern latitudes of central and western Europe.

Finally, we note that studies of the southern Moravian sites are still in early stages, and that further, comprehensive studies of artifacts and sites are planned. Accordingly, in the future we hope to provide more information on these first in Europe LRJ assemblages and how the *Homo sapiens* groups who made them coped within the surrounding environments.

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At the same time, we alone are responsible for the data and ideas expressed in the article, and any shortcomings in them.

Data Availability The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Conflict of Interest The authors declare no conflict of interest.

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