The distribution and importance of Turonian flints from the north-eastern margin of the Holy Cross Mountains in the flint raw material economy of the earliest Danubian communities

ABSTRACT


The article is an attempt to create a comprehensive analysis of the phenomenon of distribution of Turonian flints sourced on the north-eastern margin of the Holy Cross Mountains and to determine their actual participation and importance in the overall system of flint raw materials economy of the earliest Danubian communities residing both sides of the Carpathians. The research confirms the existence during the Linear Pottery Culture development period of a system of multidirectional and far-reaching distribution of this group of lithic resources (especially, Świeciechów flint), proceeding within a few basic, intermediate stages, characterized by a different form of the inflow, and by the extent to which these materials were processed within individual clusters of settlement. The analysis of the territorial dispersion of the finds, taking into account the stylistic diversity of ceramics discovered in the same context, indicates also the existence of telling distinct differences in the direction, intensity and forms of distribution of Świeciechów flint during the oldest, middle and younger stage of development of the Linear Pottery Culture. These differences are a reflection of some much more general phenomena and cultural transformations taking place in the upper basin of the Vistula River at the turn of 6th and 5th millennia BC.

Key words: Neolithic; Poland; Linear Pottery Culture; north-eastern margin of the Holy Cross Mountains; Turonian flints

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INTRODUCTION

The issue of the use of Turonian flints of the north-eastern margin of the Holy Cross Mountains during the oldest stage of the Neolithic has never been the subject of a separate and comprehensive analysis1. All the interpretations of this

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phenomenon contained in extant literature were undertaken only on the margin of a broader study on the economy and distribution of the flint raw materials among the Linear Pottery Culture (further LPC) communities (e.g. Kozłowski 1970; Lech 1979; 2003; Balcer 1983; Caspar et al. 1989; Mateiciucová 2008), or in general among cultural groups continuing the Danubian traditions at large (e.g. Kaczanowska, Lech 1977; Kaczanowska 1985). Definitely in individual studies least attention was devoted to the technical and technological aspects of the processing of this group of raw materials. Authors have focused mostly on issues of their spatial distribution, which confirmed the existence of interregional contacts between LPC concentrations in southern Poland, and other — sometimes very distant — ecumene occupied by communities of the same culture during the oldest phase of its development (Kozłowski 1958; 1970; Lech 1979; 1989b; 2003; Kaczanowska, Kozłowski 2005). All of the earlier conclusions relate only to Świeciechów flint, for a long time, the only variety of Cretaceous flint sourced in the Holy Cross Mountains area documented and identified within individual lithic inventories. Its economic importance in the oldest phase of the Neolithic was usually defined as local, i.e. limited mostly to settlement centers in south-eastern Poland (mainly in the region of Rzeszów) and, at best, of secondary importance as compared to Jurassic-Cracow flint and Chocolate flint used extensively during this period (e.g. Kaczanowska, Lech 1977; Kulczycka-Leciejewiczowa 1979; Lech 1979; Kaczanowska 1985; Caspar et al. 1989; Kaczanowska, Kozłowski 2005; Mateiciucová 2008). Only in a very few cases Świeciechów flint has been a subject of a separate analysis which addressed the entire period of the development of Danubian culture groups in the area north of the Carpathians. However, these studies were purely regional, limited mostly to the area of the Lublin and the Sandomierz Upland (Kowalewska-Marszałek 2002; Zakościelna 2002), and to a much lesser extent, also to the western reaches of the historical regions of Lesser Poland and Kujavia (Domańska 2002; Górski, Trela 2002). The most important reason for the outlined state of research has been, it seems, the very slow accretion of the source database, especially in areas lying in the immediate vicinity of outcrops of Turonian flints, and the generally poor and incomplete degree and rate of scientific description of successively acquired lithic inventories. These factors have prevented, on the one hand, the making of a full diagnosis of the scale, directions, the actual territorial range and the nature of the distribution of this lithic resource during the oldest phase of the Neolithic, on the other hand, limited significantly the assessment of its actual economic importance within individual centers of LPC settlement. A marked progress in research and the accretion of material sources noted over recent years created unprecedented opportunities for undertaking a comprehensive study of these issues while allowing also a major update, as well as a verification of the many opinions on their subject circulating in current literature. The present contribution attempts to fill in only the most significant gaps in this regard.
LOCATION OF TURONIAN FLINT DEPOSITS IN THE HOLY CROSS MOUNTAINS REGION

In their geological distribution the deposits of Turonian flints are limited to a relatively narrow region, found in the outlying area of the north-eastern, Mesozoic margin of the Holy Cross Mountains (Fig. 1). They coincide closely with the extent of two local tectonic structures, i.e. the Tarłów ditch, lying to the west of the Vistula (S a m s o n o w i c z 1934a; P o ż a r y s k i 1948), and the Rachów anticline, situated on the right bank of that river. The main components of the local Cretaceous layer took form as a result of sedimentation processes of the...
Lower Turonian transgression, and are represented mainly by white and gray siliceous limestone and, to a lesser extent, also by detrital limestone bryozoans (Samsonowicz 1934a; 1934b; Pozaryski 1948; Złonkiewicz 1994; 1998; Michniak 1995). Flints occurring in these sediments are marked by a great diversity of their macroscopic features, especially the colour of their primary substance, which is in various shades of grey and black. These differences have been the main criterion in earlier classification attempts (e.g. Krukowski 1920; Krzak 1965; 1970; Balcer 1975; Libera, Zakościelna 2002) their result the identification of a number of local varieties with variously marked individual properties.

Some of these flint varieties have been provenanced to individual exposures (e.g. Zawada flint), other, to somewhat larger areas of Turonian outcrops (e.g. Gościeradów flint, Janików flint, Ożarów flint, Świeciechów flint; see Fig. 1). Individual varieties are at present available for observation both in the form of regular lodes, from exposures in a fairly large number of quarries (especially within Tarłów ditch), and as accumulations of fragmented subsurface concretions directly overlying the uppermost level of eroded rock and limestone, or alternately, redeposited somewhat in relation to their primary locations (Krukowski 1921; Balcer 1971; 1976; Michniak 1995; Libera, Zakościelna 2002; Budziszewski 1986; 1995). This type of secondary concentrations played a key role in the system of raw materials supply of prehistoric communities, including the oldest phase of the Neolithic, because of their ready availability and abundance of concretions and chunks of various lithic resource materials, generally of a good quality. This applies especially to the area of the Rachów anticline where many of these outcrops are found (i.a. Świeciechów flint and Gościeradów flint; cf. Balcer 1971; 1976; Libera, Zakościelna 2002). This region, to judge from what is known at present, would have been the main supply zone, the area where Turonian flints were sourced by LPC communities. Moreover, we cannot discount the possibility that local outcrops were exploited during this period also using basic mining methods2.

The occurrence of secondary concentrations of Holy Cross Mountains Turonian flints has been documented also at a much greater distance from their geological deposits. The presence of surface accumulations of concretions and chunks of the

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2 Past excavations of the prehistoric Turonian flint mines at Świeciechów-Lasek and Ożarów (Za Garncarzami field), have allowed the correlation of the main mining and processing activities undertaken at these sites with, especially, culture groups of the Middle Neolithic (Balcer 1971; 1976) and also, with those of the Bronze and the Early Iron Age (Budziszewski 1980; 1986; 1997; Bargiel, Libera 1995; 1996). At the same time, they failed to retrieve unambiguous evidence on the mining of the local deposits during the oldest phase of the Neolithic. Even so, the feasibility that LPC communities used simple mining methods when they sourced the Turonian flints (especially Świeciechów flint) may be considered as quite likely. This is supported indirectly by extensive studies on early Neolithic quarrying of the Jurassic-Cracow flint (Lech 1979; 1980; 1981; 2011), and by excavated evidence from e.g., the Chocolate flint mines at Tomaszów (Schild et al. 1985), or chert mines in the region of the Krumlov Forest in Moravia (Oliv a 2004; 2011). These finds confirm the familiarity with and the use of methods of mining of various siliceous rocks, already at the stage of LPC communities development.
The distribution and importance of Turonian flints...  

An overview of the source database

Flint finds distribution and diversity

According to current research, the period of the development of LPC and related Eastern Linear groups is documented by at least 54 archaeological sites which produced artifacts struck from Turonian flints sourced in the Holy Cross Mountains. These finds are a very heterogeneous group, in terms of quantity and quality, which includes both single artifacts and inventories featuring a larger number of morphologically diverse forms (Table 1) spread over a broad territory on both sides of the Carpathians (Fig. 2). The quantitative and qualitative properties of these finds indicate a territorial pattern dependent to a significant extent on the distance of individual sites from the outcrops of the Turonian flints. The least numerous and least varied inventories derive from locations found at a greatest distance from this source area (approximately between 200 and 500 km), situated on the inner (Lower Austria, Czech Republic, Eastern Slovakia) and the outer (Kujavia, Chełmno Land) side of the Carpathians (Table 1; Fig. 2).

1 The likelihood that LPC communities of south-eastern Poland visited these surface concentrations and sourced them for chunks is very high. This is intimated by the small number of these lithic finds and, on occasion, also by the quality of the natural surfaces which survive on artifacts struck from dark gray and black varieties of Turonian flint recorded in the Rzeszów settlement concentration of this culture (Table 1).

4 The presence of secondary concentrations of lithic raw materials from the Holy Cross Mountains region within glacigenic formations in the Vistula headwaters region, is not limited to Turonian flints only. The best example of this would be the occurrence in the vicinity of Kraków of whole flint concretions and chunks of Chocolate flint, something that was observed already early into the second half of the last century (Kozłowski 1960), and recently complemented by the discovery of a major concentration of this material in the Niepolomice Forest (Górski et al. 2006; Wilczyński 2008).

5 They include mostly inventories from regular archaeological excavation. The only departure from this pattern are finds — just a handful — obtained during a series of field surveys carried out in eastern Slovakia, in the region of Spiš (Spišský Štiavník, Rakúsy/Spišská Bela, Veľka Lomnica). Given the nature of the Slovak fieldwork — very meticulous and repeated — and also, the morphology and metrology of artifacts struck from Świeciechów flint, they are likely to belong to the early Neolithic occupation horizon associated with LPC communities identified in these sites (Sóják 2000b).
Table 1

The size and basic raw material diversity of Turonian flint artifacts of north-eastern margin of the Holy Cross Mountains related to LPC within particular sites; prepared by M. Szeliga.

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<thead>
<tr>
<th>Lp.</th>
<th>Localization and number of archaeological site</th>
<th>The number of flint artifacts</th>
<th>LPC phase</th>
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<td>II</td>
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<td>12.</td>
<td>Jankowice 9, p. Jarosław, w. podkarpackie</td>
<td>35</td>
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# The Distribution and Importance of Turonian Flints...

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<td>Ludwinowo 7*, p. Włocławek, w. kujawsko-pomorskie</td>
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<td>44.</td>
<td>Zwięczyca 3, p. Rzeszów, w. podkarpackie</td>
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The inventories from southern side of the Carpathians
(AT — Austria; CZ — Czech Republic; SK — Slovakia; B. — Bezirk; o. — okres)

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<td>Asparn an der Zaya-Schletz*, B. Mistelbach, AT</td>
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<tr>
<td>50.</td>
<td>Poprad – Matejovce*, o. Poprad, SK</td>
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<td>51.</td>
<td>Rakúsy/Spišská Belá Kahlenberg (Stirn)*, o. Kežmarok, SK</td>
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<td>52.</td>
<td>Spišský Štiavník*, o. Poprad, SK</td>
<td>1</td>
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Present catalogue contains findings which were published or mentioned in literature until the end of 2013.
X — confirmed, number of artifacts unknown; * — data only from literature; pers. comm. — oral inform; I–III — range of stylistic diversity of LPC pottery (I — pre-music note phase; II — music note phase; III — late phase); B — Bükk culture, classic phase. Site numbers as in Figures 2, 6, 8.
Fig. 2. The territorial spread of early-Neolithic Turonian flint findings of north-eastern margin of the Holy Cross Mountains, and the range of stylistic diversity of accompanying ceramic materials; prepared by M. Juran and M. Szeliga.

A–C — Linear Pottery Culture (A — phase I; B — phase II; C — phase III); D — Bükk culture, classic phase; E — location of Świeciechów flint outcrop. Site numbers as in Table 1.
Fig. 3. The morphological structure of Turonian flint products from north-eastern margin of the Holy Cross Mountains, discovered on selected LPC sites; prepared by M. Szeliga.

A — Łańcut, powiat Łańcut, województwo podkarpackie, site No. 3; B — Rzeszów, powiat Rzeszów, województwo podkarpackie, site No. 16; C — Fredropol-Kormanice, powiat Przemyśl, województwo podkarpackie, site No. 1; D — Trzebiesławice, powiat Sandomierz, województwo świętokrzyskie, site No. 1; E — Sandomierz-Kruków, powiat Sandomierz, województwo świętokrzyskie, site No. 20; F–H — Tominy, powiat Opatów, województwo świętokrzyskie, site No. 6, seasons 2006–2009 (F — all artifacts made of Turonian flints; G — Świecechów flint; H — other Turonian flint variety).

1 — pre-core forms, cores and hammerstones; 2 — blades; 3 — flakes, chips and spalls; 4 — retouched tools.
There are some equally modest finds from sites found a little closer to the outcrops, in western Lesser Poland and eastern parts of the Lublin Upland. From all these areas we currently have a record on only single artifacts and small groups of a few specimens at most, mostly blades, flakes or retouched tools⁶. All of them were struck from Świeciechów flint.

An apparent increase in the number of finds of worked Turonian flints is noted in the immediate vicinity of the area with the deposits of this lithic resource, in the Sandomierz Upland and its foreground, and in the western part of the Lublin Upland (Table 1; Fig. 2). A similar pattern is noted also in sites identified in the Subcarpathian region, more precisely, in the Rzeszów concentration of LPC settlements, described unanimously in current literature as a zone of the most intense influx and use of this group of materials during the oldest phase of the Neolithic (e.g. Kozłowski 1970; Lech 1979; Balcer 1983; Kaczanowska 1985; Caspar et al. 1989). Inventories from these areas are marked by the highest morphological diversity and quite often include lithic forms from every stage of the core preparation and reduction, blanks modification and tool production process (Fig. 3:A–E). Of these the most outstanding is the inventory from site No. 6 at Tominy (SzeliGA, ZakoscielnA 2007; SzeliGA 2008), currently the richest assemblage of worked flints struck from the discussed materials in the entire documented area of their use during the oldest phase of the Neolithic (Table 1). When it comes to its morphological structure, the inventory from site No. 6 at Tominy is dominated by the group of flake forms, which vastly outnumber blades and retouched tools, and the frequency of cores is minimal (Fig. 3:F). It is notable that these frequencies were found to be very similar for the inventories of Świeciechów flint and other varieties of Turonian flint (Fig. 3:G–H). It is safe therefore to interpret the site at Tominy as a flintworking settlement, the structure of its inventory evidently similar to the structure of inventories from other settlements of this type identified at e.g., Kraków-Olszanica and Vedrovice-Zábrdovice (Lech 1982; 2003; 2008).

Turanian flint varieties in LPC lithic inventories

Regardless of their territorial location, when analyzed for lithic resources used, the inventories revealed, every time, an overwhelming predominance of the Świeciechów flint with, usually only a very minor percentage of other Turonian flint varieties. The latter were documented for 11 sites only (Table 1) and were represented mostly by very small groups of artifacts, or even just a single one (mostly flakes), struck from uncharacteristic varieties of dark gray flint which

⁶The list of these most remote finds is completed by some splintered pieces recovered at a number of sites in the historical region of Kujavia in Poland (DomanskA 2002).
The distribution and importance of Turonian flints... could not be identified conclusively as to its material. The only exception of this is the inventory from mentioned site 6 in Tominy where, beside the dominant position of Świeciechów flint (66.78%), also other varieties of Turonian flints have reached high participation, taking the second position in the cumulative, raw material structure of collection, prior to participation of other materials, i.e. Chocolate flint and Jurassic-Cracow flint. The vast majority of these artifacts were struck from dark grey flints, which share many of their macroscopic properties with the variety known as Zawada flint (Budziszewski, Michniak 1989; Budziszewski 1995), available from outcrops found right next to the site at Tominy, approximately 100 meters to the north of it (Fig. 5:A–B). Only exceptionally an inventory included Ożarów flint, a variety marked by the irregular colour of its primary substance, in various shades of gray, resulting in a unique mottled pattern (Krzak 1970; Budziszewski 1980; 1986).

The presence in inventories of different flint resources, and their different frequencies, suggests that in selecting individual varieties of Turonian flints sourced in the Holy Cross Mountains region the people of different LPC communities were guided by specific preferences; their main focus was sourcing and working the Świeciechów variety; in general, other varieties were used by them only on a very minor scale if their deposits were found in the neighborhood or only a small distance away (Sandomierz Upland, western part of the Lublin

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7 E.g. the lithic resource of an industrial chunk from Sandomierz-Kruków (Table 1) was identified in its source publication as Gościeradów flint (Michałak-Ścibior, Taras 1995). In my view the macroscopic properties of this specimen do not allow such a detailed identification.

8 These data refer to LPC features excavated in 2006–2009.

9 The macroscopic description of the Zawada flint is as follows: dark grey in colour, with numerous lighter speckles (Diam. ranging between 1 and up to 20 mm), a characteristic, fairly narrow (2 to 4 mm wide) dark purple streak divides the cortex from the main substance of the flint (Fig. 5: C–D).
Upland and the Subcarpathian region). These differences are reflected also by the substantially different nature and the range of working individual flint varieties. Morphological analyses of inventories taken into account in the present study (first of all, the largest assemblage, from Tominy) validate the conclusion that the working of dark grey flint (including Zawada flint) involved primarily the reduction of cores to obtain flakes and Świeciechów flint — at least at the initial stage of core reduction — was almost always worked to obtain blades (Szeliga 2013).

Classification of finds and internal periodization of LPC

According to the current research status artifacts made of Turonian flints sourced in the north-eastern margin of the Holy Cross Mountains were recorded in
contexts with pottery representative for every phase of LPC development: the pre-music note (I), music note (II), and late LPC (III), in its two separate variants, phases Želiezovce and Šárka. A closer taxonomic classification of pottery found in inventories from the upper basin of the Vistula helps us to refer the phenomenon of Turonian flint use and distribution (especially the Świeciechów variety) to between the older stage of the pre-music note phase (i.e. Gniecho-wice phase; Kulczycka-Leciejewiczowa 1979; 1983; 1987) and the younger segment of the Želiezovce phase (i.e. Želiezovce IIb; see Pavúk 1969; Kadrow 1990a; 1990b). This corresponds, at this time, to the full range of the stylistic development of LPC in the study area (Kadrow, Zakoscielna 2000; Czekaj-Zastawny 2008; Nowak 2009). Nevertheless, the full scale of the stylistic and typological range of pottery concurrent with Turonian flint artifacts is now documented only in the Sandomierz region (to be exact, on at Samborzec I; see Kulczycka-Leciejewiczowa 2008; Lech 2008). In the other enclaves of LPC settlement the pottery found in context with Turonian flints is limited in its style to the classic and late stages of LPC development (Fig. 2).

The analysis of all the available inventories reveals quite sharp disproportions in the frequency of assemblages corresponding to individual developmental stages of LPC. Its oldest phase is documented only by a very small number of finds, all of them made of Świeciechów flint (Table 1). Definitely the largest group are inventories attributed to the music note phase, which also map out the maximum distribution range of this lithic resource during the early Neolithic (see Fig. 2). The nature and the size of these inventories demonstrate, as compared to the earlier period, the growing role in the economy and resource distribution systems of LPC of Świeciechów flint and other varieties of Turonian flint sourced in the north-eastern margin of the Holy Cross Mountains (see Lech 2008; Mateiucová 2008). Finds associated with the music note phase definitely have a higher frequency than assemblages from the late phase of LPC, all of them except one in the Želiezovce style, the exception being one inventory with pottery in an early Šárka style (Brześć Kujawski, Site No. 4; see Grygiel 1976; 2004). However, these disproportions may not be interpreted automatically as an index of the decrease in the intensity of use and distribution of Turonian flints at the late stage of development LPC. This is because they may reflect a broader cultural shift taking place in the region bordering the Carpathians in the north and the north-east ever since the onset of the music note phase. This shift involved a gradual weakening, and with time, a complete waning in this region of impact from the former cultural centre in south-western Slovakia which, in these communities, put a stop to the stylistic and typological development of the pottery (Kozlowski 1985). The main implication of these processes in the study area postulated in literature was a further, long-term stagnation of music note traditions in the pottery production and decoration, which proceeded parallel to the impact, limited geographically in its range, from Želiezovce styles, and was spread out in time as far as the decline of LPC (Kadrow, Zakoscielna 2000;
Because of the general scarcity of absolute dates there is no way at present to make a chronological classification of individual lithic inventories basing only on the stylistic differences of pottery finds discovered in the same context. Consequently, we cannot hope to make a correct assessment of the actual intensity of use and the scale of distribution of the Turonian flints over the entire early period of development of LPC identified with the music note and the Želiezovce style of vessel decoration.

**DYNAMICS OF DISTRIBUTION AND ECONOMIC IMPORTANCE OF TURONIAN FLINTS OVER THE DURATION OF LPC DEVELOPMENT**

Interpretation constraints outlined earlier permit only an assessment of the economic importance of the Turonian flints from the north-eastern margin of the Holy Cross Mountains and a reconstruction of the scale, nature and principal directions of distribution of this lithic resource only within two main chronological horizons which correspond to the older phase and, jointly, to the middle and the younger phases of LPC development. These horizons reflect some evident differences in the use and distribution of Turonian flints, which closely correspond to the phenomena and culture change observed in the southern region of Poland at the turn of the sixth and the fifth millennium BC.

The older horizon

At present it is safe to attribute to this period only six LPC sites where the lithic inventory consisted entirely of Świeciechów flints (Table 1). These sites are recorded on a very broad territory which takes in areas on both sides of the Carpathians (Fig. 6). In the upper basin of the Vistula this horizon is represented, on the one hand, by very modest groups of artifacts from Samborzec; these include: a blade with a broken tip, a sidescraper and a splintered piece (site No. I; see Fig. 7: 1, 3–4), an endscraper on a cortical blade and a chip (site No. II; L e c h 2008), on the other hand, by the inventory from Kazimierza Mała I, having an unknown quantitative and qualitative structure (L e c h 2003; M a t e i ci uč o v á 2008). These finds are complemented by a very modest series from the region on the other side of the Carpathian range: a single blade discovered at Brunn am Gebirge IV (M a t e i ci uč o v á 2008) and a broken endscraper with harvesting polish from Bylany I (fig. 7:2). On the basis of the latter find the percentage of

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10 This concept would also be an alternative interpretation of the problem of the so-called “stylistic gap” observed in pottery finds from the upper basin of the Vistula river, between LPC and the earliest of the post-linear formations; it challenges the widely accepted argument on a settlement hiatus in the region during the first quarter of the fifth millennium BC (e.g. K o z ł o w s k i 1985; 2004; G o d ł o w s k a et al. 1987; K a m ię s k a, K o z ł o w s k i 1990; K a c z a n o w s k a, K o z ł o w s k i 1994).
Fig. 6. The distribution of Świeciechów flint in the older horizon of the LPC development; prepared by M. Juran and M. Szeliga.

A — finds attributed to LPC pre-music note phase; B — conjectured direction of distribution; C — location of outcrops. Site numbers as in Table 1.
Świeciechów flint in this inventory, assigned to the oldest occupation horizon at Bylany site No. I was estimated as a mere 0,9% (L e c h 1988; 1989a). A very small number of artifacts made of Świeciechów flint, one of them a slim perforator, were discovered also at Mohelnice (K o z ł o w s k i 1958; 1970).

Data invoked here suggest a generally sporadic economic importance of the Świeciechów flint everywhere in the area where its use and distribution during the oldest phase of LPC development is documented. The seriously limited scope of the source evidence, in the absence of a scientific description of a significant part of this material, precludes at present an unambiguous assessment of the nature and the actual scale of the distribution of Świeciechów flint in the upper basin of the Vistula, and especially, the patterns of its inflow to areas in

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Fig. 7. A selection of Świeciechów flint artifacts, LPC pre-music note phase; prepared by M. Juran and M. Szeliga.

1, 3–4 — Samborzec, powiat Sandomierz, województwo świętokrzyskie, site No. I; after J. Le c h (2008, Fig. 2: d; 4: e–f); 2 — Bylany, okres Kutná Hora, site No. I; after J. Le c h (1989b, Fig. 14: b).
the immediate vicinity of its geological source, i.e. in the Sandomierz Upland. A significant impediment in this regard is the very poor recognition of the actual intensity of the oldest LPC settlement in this area, due to the very low frequency of most local finds and their nature, which usually renders them of little use in this respect\(^{11}\). Using the conclusions reached for the younger horizon it may be safe to assume that the LPC communities of the Sandomierz settlement concentration had direct access to the outcrops of Świeciechów flint and that it occupied an important position in the system of its distribution to much more distant areas (Lech 2008).

The distribution of sites under discussion suggests that during the oldest phase of LPC development the distribution of the Świeciechów flint only had a south-western direction and was exported along the the upper course of the Vistula River to the Moravian Gate, and on to the more distant areas of Bohemia and Moravia and Lower Austria (see Fig. 6). At the same time, the morphological diversity of the finds recoded in the region beyond the Carpathian range (looking from Poland) shows that Świeciechów flint entered this area only as blades and prepared tool forms. They spread across the region through exchange, in several stages, from one group to the next, within a system which was centered mainly on the distribution of Jurassic-Cracow flint (e.g. Lech 1987; 1990; 2003; Janák, Prichystal 2007; Mateiucová 2008). The nature of these finds and, each time, the marginal (<1%) frequency of Świeciechów flint, confirm the non-economic basis of phenomena associated with and directly related to its exchange.

The younger horizon

The bulk of artifacts made of Turonian flints from the north-estern margin of the Holy Cross Mountains are attributed to the younger horizon, on correlated chiefly with the middle and the late phase of LPC, and the classic stage of Bükk culture development. Materials classified in this manner derive from jointly 49 sites (Table 1) which have a territorial spread definitely much more extensive than during the preceding period (Fig. 8). Compared to this earlier period they reflect a significant increase in the importance of Świeciechów flint in the raw materials economy of communities of that age, complete with the continued development of the multidirectional and far-reaching system of its distribution (Lech 2008; Mateiucová 2008). The presence of a larger variety of flints in the inventories from this horizon confirms the awareness and the use during this period also of other varieties of Turonian lithics, like Zawada flint and

\(^{11}\) Other than Samborzec site No. I, the best recognized in this regard and most extensively explored (Kamieńska, Kulczycka-Leciejewiczowa 1970; Kulczycka-Leciejewiczowa 2008), LPC pre-music note stage occupation in the Sandomierz Upland is documented by a modest group of pottery finds recovered from only a small number of sites either as stray finds or residual intrusive finds (Michalak-Ścibior 1993).
Fig. 8. The distribution of Świeciechów flint in the younger horizon of the LPC development; prepared by M. Juran and M. Szelig.

A — finds attributed to the classic and the late phase of LPC and the classic phase of Bükk culture (Humenné) with the percentage of this material in selected inventories; B — distribution of pre-core forms and prepared blade cores; C — certain and putative directions of distribution of blades, flakes and retouched tools; D — location of outcrop. Percentages from publications presented in Table 1; Site numbers as in Table 1.
The distribution and importance of Turonian flints... Ożarów flint (Table 1; Fig. 4). At the same time, the ways and the extent to which they were worked, as well as their frequencies observed in individual assemblages, indicate that their economic significance was never more than local and usually marginal (except for the settlement at Tominy; see Fig. 3–4); their participation in the distribution system was altogether minimal — and not more than hypothetical (see Footnote 3).

An analysis of the dispersion of finds assigned to the classic and the late stages of LPC development reveals their highest concentration in south-eastern Poland, and a far lower frequency in other clusters of settlement (Fig. 2). So far, the highest percentage of Turonian flints from the north eastern margin of the Holy Cross Mountains is recorded in inventories from the northern area of the Sandomierz Upland and its northern foreland, lying right next to their geological deposits (Fig. 8). At Sandomierz-Kruków, site No. 20, out of the total number of flint finds attributed to the LPC occupation horizon the percentage of Świeciechów flint has been estimated at approximately 81.10% (Michałak-Ścibior, Taras 1995), for site No. 6 at Tominy — at approximately 66.78% (see Fig. 4). These frequencies show clearly the strategic importance of this lithic resource in the local production and make the local communities its most important users during this period. The size and the morphology of the inventory from Tominy confirm moreover the comprehensive range and the higher than average scale of working of the Świeciechów flint within the settlement, where it was brought as pre-core forms with evidence of only very limited preparation (Szeliga 2013).

The functioning of production settlements close to the deposits of Świeciechów flint, confirmed by finds from Tominy, suggests that their communities played a leading role in the system of distribution of this resource and that they produced a surplus of a wide selection of lithic forms; exchanged in due course with communities established at a greater distance from the deposits, most notably, those in the Sandomierz Upland and the Rzeszów region (Fig. 8). The richest inventories recovered there display fairly varied frequencies of this material, ranging from a dozen-odd (Olchowa, site No. 20 — 14.3%; Rzeszów, site No. 3 — 17.24%; see Kadrow 1997; Mutura, Zycz 1999) to a several dozen percent (Kraczkowa, site No. 1 — 32.00%; Łańcut, site No. 3 — 43.12%; Trzebiesławice — about 46.48%; see Kulczycka-Leciejewiczowa 1979; Kaczanowska 1985; Gruszczynska 1992). They indicate, each time, the essential, or even, the most important ( Łańcut, site No. 3) role played by the Świeciechów flint in the local system of lithic resources supply and reduction.

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12 The scale of exploitation and the ways in which this resource entered the LPC settlement at Sandomierz-Kruków, site No. 20 cannot be determined conclusively because the LPC lithic inventory was eroded to an unknown extent when the same site was occupied by communities of Malice culture (Michałak-Ścibior, Taras 1995; Szeliga 2013).

13 The production of surplus flint products is documented for some settlements in the Western European zone of LPC (e.g. Verlaine in Limburg; see Allard 2005; Allard, Burnez-Lanote 2006). A similar character is postulated also for workshop-settlements which relied on Jurassic-Cracow flint, known from Kraków-Olszanica and Bolechowice-Zielona (Lech 2003).
The results of morphological analysis of individual assemblages suggest that the bulk of Świeciechów flint artifacts introduced into the region in question was as pre-core forms and initially prepared blade cores (Fig. 9). They found their way to at least a few of the “central settlements” (e.g. Łańcut, site No. 3; Rzeszów, site No. 16; Trzebiesławice, site No. 1; Zwięczyca, site No. 3) where they were worked in a comprehensive range of ways to obtain blanks (both blades and flakes) and to manufacture tools. The same sites also played a leading role in the later distribution of these resources, both locally and outside the region, mainly in the form of blades, flakes and retouched tools (Fig. 8). Apparently, only occasionally the redistribution of the Świeciechów flint took place as pre-core forms and cores. This is indicated by the inventory from Fredropol-Kormanicz, site No. 1 containing a few specimens of this description, and also by a few reffittings from the initial steps of reduction of this resource in that site (Fig. 10). The lowest percentage of Świeciechów flint in the sum total of the lithics identified in the inventory from Fredropol-Kormanicz, site No. 1 (1.6%; see Kozłowski 1970) add weight to the argument that the inflow of this flint to the site took place through the communities established in the Rzeszów region (see Fig. 8).

Everywhere else in the northern foreland of the Carpathians the intensity of distribution and the economic importance of Świeciechów flint were much lower. This is indicated unambiguously by the frequencies of this resource, as a rule not more than 1%, which are observed in inventories recorded in the regions Kujavia, Chełmno Land, western Lesser Poland and eastern Lublin Region (cf. Fig. 8). The contents of these inventories and the nature of finds from individual sites indicate that Świeciechów flint entered these areas always occasionally and completely devoid of any economic justification, as flakes, blades, and tools fashioned from them (Fig. 11); in the case of Kujavia, also as an occasional splintered piece (e.g. Kruszyn, site No. 10; Krzywosądż, site No. 3; see Komorowski 1959; Domańska 2002; Kabaciński 2010). At the same time, the unambiguous identification of the source areas, especially for the finds from western Lesser Poland and eastern Lublin Region is quite complicated. In the case of Lesser Poland the most likely direction of inflow would be the north-eastern (Milisaukas 1986); this is supported by the situation observed during the pre-music note phase of LPC development (Fig. 6). Nevertheless, eastern provenance cannot be discounted entirely, namely that blanks and tools entered by way of the communities established in the Rzeszów region (Fig. 8). This would be justified by the very intensive exchange and connections documented in the archaeological record for these two settlement regions. This give and take is expressed, on the one hand, by an intense inflow of Jurassic-Cracow flint into settlements on the Middle Wisłok River (e.g. Kozłowski 1970; Lech 1979; Kaczanowska 1985; Caspar et al. 1989), and on the other hand, by the intermediate position of LPC groups

14 The only departure from this pattern, an irrelevant one from the economic point of view, would be the inventory from Brześć Kujawski, site No. 4 where the frequency of Świeciechów flint is estimated at 2.1% (Lech, Małecka-Kukawka 1987).
Fig. 9. Łańcut, powiat Łańcut, województwo podkarpackie, site No. 3. Two pre-core forms from pit No. 63; drawn by M. Szeliga; first publication M. Dębiec (2006).
Fig. 10. Fredropol-Kormanice, powiat Przemysł, województwo podkarpackie, site No. 1.

Selection of Świeciechów flint artifacts; drawn by M. Szeliga.

1–2 — pre-core forms; 3–4 refittings of debitage from striking platform preparation (3) and early phase of exploitation (4) of blade cores.
Fig. 11. A selection of artifacts from the most distant areas of the distribution of Świeciechów flint, covered by this material, during LPC development period: 1 — Tarnoszyn, powiat Tomaszów Lubelski, województwo lubelskie, site No. 1; after A. Zakościelna (1981); 2 — Brześć Kujawski, powiat Brześć Kujawski, województwo kujawsko-pomorskie, site No. 4; after R. Grygieł (2004); 3 — Świerszów, powiat Hrubieszów, województwo lubelskie, site No. 28; after K. Gawryjolek-Szeliga (2009); 4 — Ludwinowo, powiat Włocławek, województwo kujawsko-pomorskie, site No. 7; after J. Kabaciński (2010); 5 — Humenné, okres Humenné, site Pod Sokolom; after M. Kaczanowska, J. K. Kozłowski (2002); 6 — Strané pod Tatrami, okres Kežmarok, site Pod Kamenným vrchom I; after M. Soják (1999a); 7–9 — Rakúsy/Spišská Belá, okres Kežmarok, site Kahlenberg (Stirm; after M. Soják (2000b).
of the Rzeszów region in supplying the communities in western Lesser Poland with the Slovak-Hungarian obsidian (Milisauskas 1986; Szelig 2009). As for the single finds of Świeciechów flint recorded in the eastern Lublin Region (Świerszców, site No. 28; Tarnoszyn, site No. 1), their likely source area could both be the cluster of settlement in the western part of the Lublin Upland and the one in the Rzeszów region (Fig. 8). This question cannot be resolved easily given the considerable distance which divides the sites under discussion from the settlement clusters and the very poor understanding of the intensity and the nature of LPC settlement in the vast territory found between them.

The last group of finds associated with the chronological-cultural horizon of interest are artifacts recorded in the region on the inner side of the Carpathian arc, centered around two separate zones, i.e. the western and the eastern (see Fig. 8). In the first of these areas the distribution of Świeciechów flint is a direct continuation of processes initiated during the pre-note phase (Fig. 6). This lithic resource, and also the slightly better represented Chocolate flint, continue to be only a marginal addition accompanying the main supplies of Jurassic-Cracow flint from the LPC clusters of western Lesser Poland (e.g. Kaczanowska 1985; Lech 1989a; 2003; Mateiciucová 2001; 2008; Janák, Přichystal 2007). Nevertheless, in comparison to the earlier period, the influx of Świeciechów flint to these areas seems to be somewhat weakened. This would be suggested by its only sporadic occurrence, confirmed so far only at Asparn an der Zaya-Schletz in Lower Austria (Kaczanowska, Kozłowski 2005; Mateiciucová 2008)15.

A vast majority of Transcarpathian finds originates from north-eastern and eastern Slovakia, where they are mostly recorded in the clusters of LPC settlement in Spiš, and on a single occasion, also in the area occupied by the communities of the classic phase of Bükk Culture (Fig. 8). Similarly as in the western zone, the influx of Świeciechów flint to these areas completely lacked economic justification and was only in the form of blades, flakes and finished tools (Fig. 11), which at individual sites are represented usually by a single specimen or only a small group of these artifacts (Table 1). The participation of this lithic resource in local inventories has been estimated at only 0.06% — Humenné, site Pod Sokolom (Kaczanowska, Kozłowski 2002); 0.36% — Strané pod Tatrami, site Pod Kamenným vrchom I; 0.9% — Rakúsy/Spišská Belá, site Kahlenberg (Stirn; cf. Sojak 1999a; 2000b).

The location, form and frequency of Slovak finds invoked here leads us to identify their source areas in the clusters of LPC settlement in south-eastern Poland (Kaczanowska 1985; 1986; Sojak 2000b; 2001), first and foremost, the Rzeszów region. This is confirmed also by the quite frequent occurrence in north-eastern and eastern Slovakia, and in north-eastern Hungary too, of specimens made of other, “northern” lithic resources, such as Chocolate flint and Volhynian flint. Their presence has been recorded in inventories associated

15 Moreover, I. Mateiciucová (2008) attributes to the late LPC horizon some specimens struck from this resource discovered at Mohelnice.
with both the LPC (the Spiš cluster) and the Eastern Linear culture groups (e.g. Kaczanowska 1976; 1985; Kaczanowska, Kozłowski 1997; Biró 1998; Sóják 2000b; 2001). The frequencies of these resources in individual inventories are marginal, very similar to those of the Świeciechów flint, and indicate that like in its case, the mechanisms which motivated and regulated their distribution to this region had an entirely non-economic background.

The influx and spread to Slovakia and Hungary of artifacts made of varieties of flint sourced in the north-eastern margin of the Holy Cross Mountains and in Volhynia are a part of a much broader context of intercultural phenomena; they are a direct reflection of intensive contacts initiated during the music note phase by LPC communities from the concentration established in southern Poland with the Eastern Linear groups living on the other side of the Carpathians (e.g. Kaczanowska 1976; Godłowska 1982; Kozłowski 1985; Kadrów, Zakosicielna 2000). To the north of the Carpathians this exchange is documented in the material record both by numerous finds of imported Slovak-Hungarian obsidian, the result of an intensive influx (Szeliga 2007; 2009, with a list of references) and the frequent presence in LPC sites of stylistic references in pottery vessel decoration to Eastern Linear styles, and even of imports from that environment (Kulczycka, Kozłowski 1960; Godłowska 1982; Kaczanowska, Godłowska 2009). The dispersion and the presence of obsidian in individual inventories from the upper basin of the Vistula confirm the leading role played by the communities living in the Rzeszów region in the redistribution of this resource to other areas of southern and south-eastern Poland (Szeliga 2009). This agrees very well with the postulated, previously leading position of the local ecumene in the process of the emergence and development of the network of long-distance, Transcarpathian, intercultural exchange going back to the classic phase of LPC development.

CONCLUSION

The evidence presented so far confirms the existence, during the period of LPC development, of an extensive system of territorial distribution of Świeciechów flint, which proceeded in a number of basic intermediate stages. These stages differed in their spatial extent, which finds expression in the irregular distribution of this lithic resource and the differences in the ways and the extent to which it was processed within individual settlement clusters and areas. This system was an element of a much more extensive network of interregional exchange of flint raw materials functioning on both sides of the Carpathians starting from the oldest phase of LPC development and took in all of the flint resources used in these areas by the early farming communities (e.g. Lech 1979; 1987; 2003). The main ground of this exchange of various materials — setting aside any subsequent technological and economic implications apart because their nature seems to be secondary and far less important — were interregional contacts and
socio-cultural ties. They determined both the main directions and the scope and the course of the distribution process and the resulting circulation of individual resources (see Malęcka-Kukawka 1994 [with a list of references]). One perceptible manifestation might be the earlier discussed varied dynamics and zonality of the spread of the Świeciechów flint during LPC development allowing us to examine this phenomenon in terms much broad than simply as an effect of action taken to meet the demands of the local economy. This is confirmed further by observation of other varieties of flint and obsidian involved in the system of raw materials exchange in the northern foothills region of the Carpathians. They are a vivid indicator of the intensity of contacts and ties between individual groups, both at a local (e.g. between communities of the Sandomierz and the Rzeszów clusters) and an interregional level (e.g. between the Rzeszów cluster and the Eastern Linear groups). At the same time, the nature of these contacts and the ways in which they unfolded are part of a much more broader context of the cultural phenomena and change mentioned earlier at work in the upper basin of the Vistula river at the turn of the sixth and the fifth millennium BC consisting of a gradual decline and, in due course, the full waning of the former culture centre in south-western Slovakia (resulting in a gradual decline of the stylistic development of linear pottery in the region) and an observable increase in the influence and impact from the Eastern Linear cultures (Kozłowski 1985; Zakosciełna, Kadroow 2000). The focusing of the main influx of the Świeciechów flint on settlement clusters in south-eastern Poland (most notably, Rzeszów cluster) observable during the classic and late phase of LPC development, and also, the evident shift of its receiver zone across the Carpathians to eastern and south-eastern Slovakia, occupied by i.a., Eastern Linear communities, might be one of the most important and archaeologically best documented manifestations of these cultural processes.

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