MULTAS PER GENTES ET MULTA PER SAECULA

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IOANNI CHRISTOPHO KOZŁOWSKI DEDICANT

Paweł Valde-Nowak, Krzysztof Sobczyk
Marek Nowak, Jarosław Źrałka

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Institute of Archaeology
Jagiellonian University in Kraków
Gołębia 11 Street
31-007 Kraków
Poland
http://www.archeo.uj.edu.pl
E-mail: archeo.sekretariat@uj.edu.pl

Alter Radosław Palonka (Publisher)
Śliczna 30B/43 Street
31-444 Kraków
Poland
Phone: +48 606-781-823
http://www.wydawnictwoalter.pl
E-mail: alter@wyd-alter.pl

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The erratic stone raw material reservoir in the Polish Lowland and its procurement and selection within the local late Neolithic societies. Choices between the 'gift' from the glacial past and the Earth's natural resources of the 'south'

Piotr Chachlikowski

Abstract: For the late Neolithic communities in the Polish Lowland the primary raw material employed to manufacture their stone implements was obtained by extensive exploitation of local Fennoscandian erratics. The wide use of glacially deposited rock fragments in the local stone industry was common and frequent, whatever the physical dimensions, tool purpose and the lithological composition of appropriate raw material used for its production were needed. The Polish Lowland abounded in glacial erratics which constituted an extremely rich and exhibiting considerable lithological variety source of all necessary raw materials for the local stone worker. The raw material abundance in all necessary materials for the local stone industry virtually eliminated any necessity for importing raw materials from areas of their natural deposits. The relics of the glacial past of the Polish Lowland with their rich lithological variety fully satisfied the demand of the local population for raw materials necessary for the local stone production, making the stone industry of the local early agrarian communities fully independent of the stone deposits in the South. The documented attractiveness of the inventory of erratics in the Polish Lowland thereby challenges the traditional and the so far well-established scholarly explanation of most of the manifestations of the acquisition and exploitation of raw materials imported to the Polish Lowland in the Neolithic as a deliberate action aimed *in extenso* at supplementing supposed shortcomings in certain types of rock in the local early glacial available resources.

Keywords: geoarchaeogeology of the Polish Lowland, late Neolithic stone industry, erratic raw materials versus imported raw materials

Preliminary comments

Late Neolithic communities in the Polish Lowland and, within a broader perspective, the general population that inhabited the areas that had been covered by the last Pleistocene glaciation in the past exploited raw materials for stone production mainly by way of extensive exploitation of the local resources of erratic blocks, i.e. Fennoscandian erratics – boulders and pebbles that were present in the formations of the early glacial landscape in the Lowland areas (Chachlikowski 1994; 1997; 2000; 2007; 2013 – further literature references therein). The exploitation of the erratic raw materials close at hand in the stone production of the population of the Funnel Beaker Culture (FBC) and Global Amphorae Culture (GAC) was decidedly common and well-practiced as it tends to appear, regardless of the type of the final product. Far less common among the inhabitants of the area was the exploitation of rock raw material evidenced by exogenous provenance that was procured by means of 'imports' from the areas that were rich in stone resources and were largely situated south of the Polish Lowland[1].

[1] The exploitation of exogenous rocks – i.e. those of the provenience from beyond the Polish Lowland – by the local population was a phenomenon not only uniform (both with regard to the lithological variety of raw material and the area of its provenance and the intensity or chronology of the reception of the 'import' in the Lowland communities in the Neolithic), but also, what is particularly important, of marginal significance in the economy of stone raw materials in early agrarian societies in the Polish Lowland. In view of the present-day knowledge on imported raw materials that were used in the area in the Neolithic, this 'import' did not include all raw materials available in the regions of their natural deposits outside the Lowland areas, but was limited to rock concretions that were used by the then population to produce a relatively narrow assortment of products, predominantly those forms that were culturally characteristic, tools with cutting edge in particular. What is more, even within this particular category of products – except the products of the early Neolithic stone industry and, to a lesser degree, middle Neolithic

Meanwhile, until quite recently, the recognition and identification of the structure of glacially deposited rock blocks occurring in the Polish Lowland (with regard to assortment and frequency) as well as the evaluation of the local resources of glacially deposited rocks belonged to these issues in archeology that either had not been addressed by researchers at all or had been discussed but not documented. This state of affairs resulted mainly from the lack of appropriate methodological approach in the relevant research and, primarily, from the absence of field works and surveys on the inventory of erratic raw materials in the Polish Lowland – Fennoscandian erratics – that would have been well documented in sources (more on that in: Chachlikowski 2013; 2017).

This inadequate state of recognition of Scandinavian erratics occurring in the early glacial areas – their lithological variety and frequency – made it virtually impossible to continue any in-depth, comprehensive and, first of all, reliable study that would provide characteristics of the glacial lithic inventory of the area – the only locally available source of raw material for the stone production of the inhabitants of the Polish Lowland areas in the remote past. Considerable shortages of appropriate – i.e. interdisciplinary – field surveys and accompanying research output as well as methodical shortcomings of heretofore research projects, regrettably pursued only incidentally, have limited to the minimum any attempts to approach erratic raw materials from the perspective of the evaluation of the participation of local lithic resources in satisfying the demand for rock raw materials for the stone production of the Lowland population in the past (more on that in: Chachlikowski 2013; 2017).

Likewise, the unsatisfactory current state of archeological research on the resources of glacially deposited stone raw materials in the Polish Lowland as well as unreliable geological determinations concerning the structure of Fennoscandian erratics (assortment and frequency) throw doubt on the hitherto well-established theories that assume the absence or, alternatively, low frequency of certain types of rock among the local erratics. The available geological publications, in particular those of Andrzej Prinke and Janusz Skoczylas, have established a strong foundation for the opinion (especially popular among archeologists) about the supposed scarcity of the early glacial areas in sufficiently numerous and suitable material that would exhibit considerable lithological variety for stone production (cf., eg. Prinke, Skoczylas 1980). In this way, the claim that the supposed shortcomings in raw materials in the Polish Lowland were supplemented by means of mass procurement and exploitation of exogenous rock boulders – i.e. imports from the areas of their natural stone deposits – has been additionally validated. According to this theory, the phenomenon of the import of raw material among the early agrarian societies in the Polish Lowland was to include chiefly those types of rock that were to be widely and commonly used in the production of different stone tool implements with a cutting edge (i.e. adzes, hand axes and others) and were to include amphibolite, basalt, diabase, diorite, gabbro and biotite gneiss (Chachlikowski 1997; 2000; 2007; 2013; Chachlikowski, Skoczylas 2001a; 2001b) – i.e. those raw materials that were believed until recently to have been missing, or represented scarcely, among the glacial erratic blocks that sit atop the early glacial areas (Prinke, Skoczylas 1980: 46-49).

In light of the above conclusion, the far-reaching translocation of exogenous rock materials to the Polish Lowland area in the past was inspired only by actions triggered by a necessity to balance the deficits (i.e. a lack of or low frequency of local material) of some high-quality types of rocks among the local Fennoscandian erratics. This hypothesis, widely accepted today in academic circles (mostly by archaeologists), leads in my opinion to the controversial view that the main reason for the take-up and use of raw materials imported by the local societies in the prehistory were the supposed inadequacies in the local resources of glacial rocks appropriate for the stone production of all stone tool implements. In other words, the phenomenon of the 'import' is treated in this approach as a manifestation of activities related at full length to the acquisition of raw materials of appropriate quality for stone production caused by deficiencies (in terms of technical and utilitarian properties) in a number of types of petrographic rocks among the available erratics in the Polish Lowland. The authors as well as the supporters of this hypothesis assume then that the communities living in the areas of the Polish Lowland did not have a sufficient number of rock raw materials properly diversified in terms of their assortment needed for the production of stone

colonists of the Polish Lowland that represented cultures that spread from the Danubian region, the share (and contribution) of imported raw materials was only incidental (Chachlikowski 1996; 1997; 2013; Chachlikowski, Skoczylas 2001c – further literature references therein).

tools at home, which meant that shortages were supplemented with imported raw materials[2].

The above indicated limitations and shortcomings in the proper recognition of the resource of raw materials in the Polish Lowland, as well as the controversy surrounding the issue of the supposed scarcity of a local reservoir of glacial rocks in the material suitable for stone production, could have been overcome only by means of interdisciplinary field works and surveys dedicated exclusively to this problem. The results of the interdisciplinary studies in this regard (both field work and the following research output) now justify the pursuit of a more comprehensive, yet reliable, assessment of lowland Fennoscandian erratics, and, more precisely, of those that were available in the Lubusz Land and the Kuyavia region. The output of these studies provides not only the general characteristics of the structure (assortment and frequency) of raw materials occurring among the local erratics, but also multi-faceted estimations of the resources of local lithic erratic raw materials that can be further applied with regard to the recognition of the stone experience of the communities that inhabited the Polish Lowland in the late Neolithic[3].

Fennoscandian erratic raw materials and stone working practices in the late Neolithic societies of the Polish Lowland (the Kuyavia region)

The assortment and frequency of Fennoscandian erratic rocks occurring on the area of the Lubuskie Lakeland (Chachlikowski 2013: 40-59) and the Kuyavia region (Chachlikowski 2013: 60-128), and in particular the multi-faceted evaluation of the Kuyavia lithic inventory (Chachlikowski 2013: 129-203), all prove that the local endogenous glacial rocks constituted an exceptionally rich source, exhibiting at the same time a considerable lithological variety of raw material extracted for stone production by the local population in the past. For the late Neolithic inhabitants of the Polish Lowland (and within a wider perspective, for prehistorical inhabitants of the region) it was an extremely rich, indeed almost inexhaustible, inventory of stone raw material, both with regard to the number of available boulders and pebbles and their appropriate petrographic variety.

This is further confirmed, for example, by the observations and conclusions that can be drawn from a juxtaposition of the frequency structure (%) of the available assortment of rock raw material to be found in the local resources of erratic materials as well as in mentions of the local stone production in the late Neolithic attested in sources.

Therefore, by juxtaposing the frequency (%) of the assortment composition of glacially deposited rock blocks identified among the erratics occurring in the Kuyavia region and among the products of the local stone production of late Neolithic societies of FBC and GAC, we come to a conclusion that there is a relatively similar frequency (%) of most of the raw materials and a relatively comparable sequence – though at times also alternating – of particular types of rock in either of the lithic resources under investigation: i.e. those that are represented by the glacial erratic material and the sources related to the manifestations of stone production (Table 1; Figs 1, 2).

A similar tendency to a decided domination of just four raw materials has been attested among both the erratics from the Kuyavia region and the stone implements that originated in the region in the societies of both cultures, namely: gneiss, granite, quartzitic sandstone and quartzite. The aggregate percentage share of these raw materials in all glacial boulders and pebbles that sat in the Kuyavia region is 87.00% (from the number of 25,276 of all the erratic concretions (nodules) under examination) and, by taking into consideration the values of the average

[2] This approach to the explanation of the majority of the manifestations of practices of acquisition and exploitation of exogenous raw materials in the Neolithic does not provide though any explanation as to the reasons behind the uneven inflow of raw materials imported to this area throughout time nor the very distinct differences to be observed in the assortment composition or provenance of the then rock 'import' (more on that in: Chachlikowski 1996; 1997; 2013).

[3] The results of a study on the erratics that occur in the areas of the Great Plain Belt of the Lowlands are widely discussed by the present author in his publication (Chachlikowski 2013). In all, 13 samples of Fennoscandian erratics have been examined. The insight into the structure of erratic blocks deposited in the Kuyavia region was greatly facilitated by the results of the analysis of 12 samples of lithic material, whereas the structure of the erratics deposited in the Lubusz Land is characterised by a single stone sample selected from rock nodules that form the so-called moraine pavements – i.e. glacial accumulations of boulders and pebbles of different dimensions. In general 39,046 erratic blocks were determined petrographically. For the samples isolated in the Kuyavia region, determinations as to lithological variety was carried out for 25,276 boulders and pebbles, whereas for the erratics extracted in the Lubusz Land, selected from the glacial pavement near Torzym, the petrographic determination was carried out for 13,770 specimens. The stone tool production practice characteristics for the FBC and GAC societies can be attested by the sources obtained as a result of excavations in 30 sites. In total, 3647 stone products were examined. Stone products related to FBC constituted 2887 finds, while 760 products were attributed to the stone tool production of GAC stone workers.

Table 1. A comparison of the percentage share (%) of the rock raw material assortment in the erratic material and among products of the stone tool production of FBC and GAC societies in the Kuyavia region

Raw material		Amphibolite	Basalt	Diabase	Diorite	Gabbro	Gneiss	Biotitic gneiss	Granite	Quartzite	Quartzitic sandstone	Pegmatite	Porphyry	Syenite	Other	Total
Erratic material	Total percentage share	0.84 %	1.10 %	0.18 %	0.31 %	3.43 %	17.97 %	1.60 %	39.19 %	10.52 %	19.32 %	0.40 %	3.28 %	0.72 %	1.13 %	100 %
	Average percentage share	0.92 %	1.5 %	0.20 %	0.34 %	3.44 %	18.03 %	1.63 %	39.80 %	10.38 %	19.08 %	0.36 %	3.14 %	0.76 %	0.87 %	100 %
Stone products	Total percentage share	3.10 %	1.26 %	1.21 %	1.43 %	3.21 %	22.07 %	3.43 %	15.90 %	8.77 %	34.74 %	1.37 %	1.40 %	1.07 %	1.04 %	100 %
	Average percentage share	3.57 %	1.03 %	1.79 %	2.10 %	5.58 %	19.70 %	2.74 %	17.10 %	8.38 %	31.54 %	1.02 %	2.17 %	2.31 %	0.96 %	100 %

frequency (%) of these types of rock among the local erratic blocks, they constituted cumulatively 87.29% of the whole of the inventory of erratics in the region. The decisive prevalence of gneiss, granite, quartzitic sandstone and quartzite over other raw materials in the region is fully corroborated by the results providing information on the anticipated – i.e. expected – assortment abundance of raw material (percentage share) among the local erratics, and also by the assessments of the probable and expected frequency (%) for individual types of rock in the petrographic composition of glacial stones available in the sample areas of the region: the late Neolithic settlement concentrations of FBC and GAC population (Chachlikowski 2013: 137-203). Among the stone production implements made by the late Neolithic societies in the Kuyavia region, in turn, products made of gneiss, granite, quartzite and quartzitic sandstone were represented in all by 81.48% of all raw materials used for stone implement production (of the overall number of 3647 products) and, taking into consideration the average percentage share of these raw materials among the products under examination, they constituted 76.70% of all types of rock that were used in the stone production of the inhabitants of late Neolithic FBC and GAC settlements (cf. Table 1; Figs 1, 2).

It is also in the remaining types of rock identified both among the samples of erratic stones from the Kuyavia region and the products of the local late Neolithic stone production that we have a relatively convergent frequency (%) of appropriate raw materials and a comparable, but again alternating, sequence of their percentage share. And so, among the raw materials identified in the local glacial material, the following places, after erratics of gneiss, granite, quartzite and quartzitic sandstone, were occupied by gabbro and porphyry, followed by erratic stones represented by biotite gneiss, basalt and amphibolite, while concretions (nodules) of syenite, pegmatite and diabase were decidedly less frequent. In turn, in the settlements of FBC and GAC societies in the Kuyavia region, less common raw materials, with regard to the intensity of their processing, were: biotite gneiss, gabbro and amphibolite. Stone processing of the remaining raw materials of diorite, porphyry, pegmatite, basalt, diabase and syenite, in descending order, was also less frequent (cf. Table 1; Figs 1, 2).

The conclusions that can be drawn from a comparison of the frequency (%) of the assortment of stone raw materials identified among the erratic blocks glacially deposited in the Kuyavia region (as well in the whole of the Lubusz Land – among the

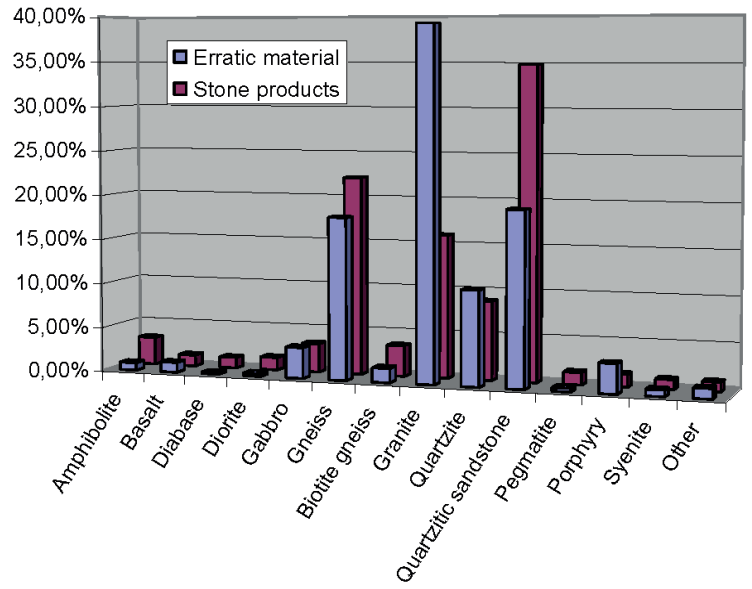

Fig. 1. A comparison of the total percentage share (%) of the rock raw material assortment in the erratic material and among products of the stone tool production of FBC and GAC societies in the Kuyavia region (cf. Table 1).

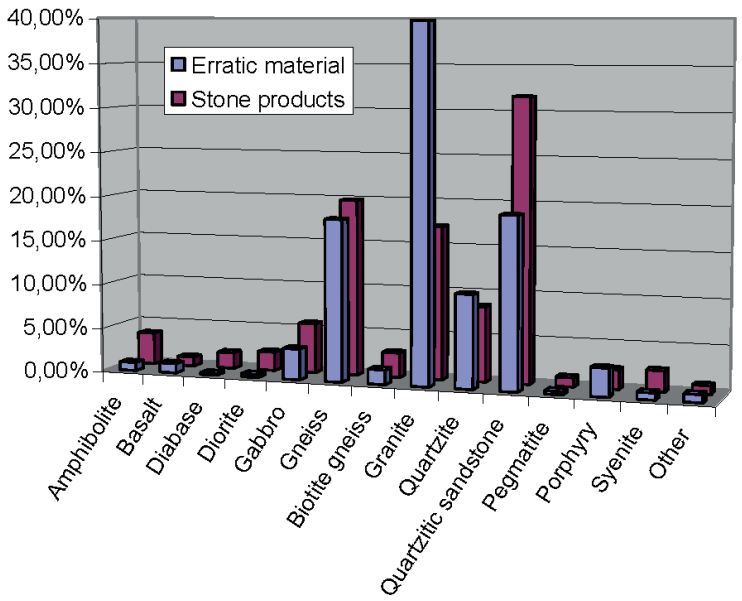

Fig. 2. A comparison of the average percentage share (%) of the rock raw material assortment in the erratic material and among products of the stone tool production of FBC and GAC societies in the Kuyavia region (cf. Table 1).

boulders and pebbles creating the geological residuum at Torzym) and isolated from among the products of the local late Neolithic stone production – suggest that the most frequent rock raw materials to be found among glacial erratics – i.e. gneiss, granite, quartzite and quartzitic sandstone – were commonly used in the stone production of the societies inhabiting the Polish Lowlands areas. Far less common, however, was the processing of the latter types of rock and, therefore, they were used by local stone workers to produce a far lower number of products that were represented among the local erratics to a lower degree – i.e. amphibolite, basalt, diabase, diorite and biotite gneiss, to name but a few.

As logical as it seems, this determination is only superficially accurate. The salient point is this: the common and widespread exploitation of the raw materials that were most frequent among the societies inhabiting the Polish Lowlands in late Neolithic (or in wider perspective in prehistoric times) in their stone implement production should not be interpreted *in extenso* as a manifestation of a determining factor in the structure of the assortment of rocks to be found among the products of local stone production imposed by the structure of the raw material from the local resources of Fennoscandian erratics. It is our opinion then that the popularity or, conversely, the relative lower frequency (%) of certain types of rock

used by the inhabitants of the Polish Lowland for the production of stone implements, did not result from the obvious dependence that appropriate raw materials were decidedly most frequent or less frequent in the glacial erratic material.

The indicated similarities in the petrographic composition and frequency (%) of rock raw materials identified among both Fennoscandian erratic blocs and the stone products made by the societies inhabiting the area in late Neolithic can be well explained by the results provided by the studies on the exploitation of rock raw materials by this society presented in dependence on a typological and functional category for a given product – i.e. the indicated dependencies between the function (dedicated purpose) of a ready-made product and the type of a rock from which this product has been made for its formation (Chachlikowski 1997; 2000; Chachlikowski, Skoczylas 2001a; 2001b; Chachlikowski 2007; 2013: 204-264).

As we know, the stone production of the societies of FBC and GAC was mainly directed towards a production of tools for everyday use to be implemented in typical household works – i.e polishing plates, polishers, hammerstones as well as querns and grinders. In the production of these basic forms of tools, the most frequently used rock raw materials were the following: gneiss, granite, quartzite and quartzitic sandstone. Incidentally, these are the most frequent to occur in the erratic material that sit in the Polish Lowland areas (cf. Table 1; Figs 1, 2). In turn, to produce products that were more rarely used by late Neolithic societies of the Kuyavia region (or more broadly speaking that of the Polish Lowland) – i.e. products that were more culturally or typologically characteristic (in general, forms with cutting edge such as hand axes, adzes or the like) – the raw materials that were used widely and exclusively by stone workers of the time were: amphibolite, basalt, diabase, diorite, gabbro, gneiss and biotite gneiss, in other words the types of rock that were less frequent among local erratic blocs than gneiss, granite, quartzite or quartzitic sandstone (cf. Table 1; Figs 1, 2). What is more, basalt and biotite gneiss were used exclusively for the production of these particular categories of products, while the remaining group of raw materials – i.e. amphibolites, diabase, diorite, gabbro, and gneiss in particular – although they found their more versatile use in the stone production of FBC and GAC societies, they were still decidedly dominant in the forms with cutting edge, while the production of tool implements made from these raw materials was, except for gneiss, relatively narrow as far as the assortment is concerned.

In conclusion, it should be stated that the raw material structure of the products of late Neolithic stone production in the societies inhabiting the Kuyavia region (and in a wider perspective, the Polish Lowland areas) could not, and certainly was not, subordinated to the nature factor – i.e. was not dominated by the abundance of the local environment in glacial lithic material used in the production of stone implements. In other words, the environment, though contributory, did not contribute decisively to the assortment structure of the rock raw materials used for stone production by the then inhabitants of this area. The population that inhabited the areas of early glacial orography in the past had, in general, access to a comparably significantly rich and versified inventory, with regard to the petrographic composition, of Fennoscanndian erratics. This is sufficiently proved and confirmed by both the results of the studies on the probable and expected probable resources of erratic boulders and pebbles available in the glacial deposits of the Kuyavian section of the Polish Lowland (Chachlikowski 2013: 137-203) as well as in exceptionally rich lithic resources available in the Pleistocene residuum at Torzym within its Lubusz section (Chachlikowski 2013: 40-59).

The characteristics of the assortment and frequency (%) structure of erratics from the Lubusz Land and the Kuyavia region clearly prove the existence of an exhaustive and full assortment of raw materials used in the stone production of late Neolithic inhabitants of this particular area in the glacial lithic resources in the Polish Lowland. At the same time, it gives us information on the frequency (%), by no means low, of all raw materials, without any exception, used by the local stone worker, in particular with reference to the surprisingly high percentage share of these types of erratic rocks (from the perspective of the current knowledge on the petrography of the erratics from the Polish Lowland), which until quite recently were believed to have been deposited incidentally or not present at all (such as, for example, amphibolites, basalt, diabase, diorite, gabbro and biotite gneiss).

However, this substantial abundance of the local environment of the Polish Lowland in stone erratic material can be fully confirmed by the assessments that inform us about the probable and expected probable count of the local lithic inventory in rock concretions that were suitable (in terms of their assortment and overall measurements) for Neolithic stone production – with reference to the total number of suitable boulders and pebbles as well as to the count of their particular lithological varieties

(Table 2). The same applies to the resources of suitable rock blocks that formed the glacial pavement at Torzym in the Lubusz Land.

By evaluating the potential abundance of the Kuyavia region in glacial stone material, it has been proved that the probable average count of erratic blocks that might have been useful for the societies inhabiting this part of the Polish Lowland in the past or, more precisely, that were present in the lithic resources of the areas determined by a circle with a 5 km radius around the stone samples from the area (or, alternatively, in the area of 785 ha around each of them) is 1,628,310 boulders and pebbles suitable, due to their assortment composition and their shapes and dimensions, for making all the necessary products of the stone production in the Polish Lowland areas (cf. Table 2). Therefore, it is right to assume that the communities of the Kuyavia region in late Neolithic (or, in the wider perspective, in prehistoric times) – i.e. the inhabitants of the areas near or within the sample areas in the region – had at their disposal an inventory of raw materials that probably amounted to, on average, 1,628,310 rock blocks that were suitable for creating all necessary types of stone tools used in Neolithic times.

By taking into consideration the calculations that give us a good idea of the total probable count of erratic blocks occurring in and around the research sample areas in the Kuyavia region, it has been established that the potential total number of stones obtainable for the inhabitants of the region for the procurement of lithic materials available in the local glacial deposits – i.e. on the areas covering 785 ha – would amount to, depending on a specificity of a particular given area, from at least 1,466,820 to 1,938,950 boulders and pebbles used in the stone production in the Polish Lowland in the Neolithic (cf. Table 2).

The same applies to the estimations of the probable abundant assortment of rocks in lithic inventories to be found in the region – i.e. those that refer to a potential count (total and average) of their particular lithological types among the local erratic blocks – as they all highlight the extremely rich abundance of the local stone resources (from the perspective of the current knowledge on the erratics in the region) in all the raw materials, without any exception, necessary for the prehistoric stone worker in the area (cf. Table 2).

The societies inhabiting the surroundings of the Kuyavian sample areas had at their disposal a potential number of amphibolite erratics that was estimated at a total probable count in the local Pleistocene concretions – i.e. within the area of about 785 ha – of at least 9282 to 15,680 boulders and pebbles (on average: 12,894 concretions) that were suitable, due to their overall measurements, for the production of the whole of products used in

Table 2. The probable and the expected probable frequency (number – items) of erratic raw materials within the area of a 5 km radius around stone samples examined in the Kuyavia region

Raw material	**Frequency (number-items)**				
	Probable			Expected probable	
	min.	max	mean	min.	max
Amphibolite	9282	15,680	12,894	11,231	14,557
Basalt	15,210	23,205	18,013	15,266	20,760
Diabase	1848	5265	3,534	2287	4781
Diorite	2184	13,920	6,024	1927	10,121
Gabbro	46,629	72,072	56,910	47,992	65,828
Gneiss	246,645	370,620	300,012	260,447	339,577
Biotite gneiss	15,288	44,370	25,363	15,488	35,238
Granite	564,837	788,140	633,560	566,469	700,651
Quartzite	131,040	209,440	169,454	145,789	193,119
Quartzitic sandstone	264,915	365,547	318,876	285,070	352,682
Pegmatite	1911	7065	5072	3333	6811
Porphyry	32,175	78,848	49,226	33,625	64,827
Syenite	9555	16,965	12,752	10,363	15,141
Total count of erratic blocks	1,466,820	1,938,950	1,628,310	1,476,575	1,780,045

the Polish Lowland in the Neolithic. The potential resources of the remaining types of rock available for these societies in the local glacial deposits, with the total (minimum and maximum) and the average count of rock blocks suitable for the stone production taken into consideration are presented in Table 2.

The estimates for the expected probable abundance in stone material in the Kuyavia region – i.e. those that refer to both the global number of erratic stones and pebbles as well as to the count of their individual lithological types available for extraction in the local glacial deposits – also show a significant abundance of the local inventories in raw materials for the stone production of the societies inhabiting the area in the past (cf. Table 2).

By taking into account the expected probable count of the whole amount of erratic rocks available in the Kuyavia region, or more precisely in the area amounting to 785 ha that stretches around the examined stone samples, it has been established that the local inhabitants had access to resources of erratics that amounted to at least 1,476,575-1,780,045 boulders and pebbles suitable, due to their appropriate petrographic diversity and their shapes and measurements, for the production of all products of the local Neolithic stone industry and, within a wider perspective, of the prehistoric stone industry (cf. Table 2).

The same applies to the estimates that refer to the expected probable count of the assortment composition of raw materials available in the inventory of erratic stones in the Kuyavia region as they also stress the exceptional abundance (from the perspective of the current knowledge on the petrography of Fennoscandian erratics that has been considered, until quite recently, as firmly established and settled among archeologists) of the local early glacial environments in appropriately lithologically diversified and significantly frequent material necessary for the local stone production in the past (cf. Table 2).

While considering the expected probable frequency of the erratics of amphibolite it has been established that the count of concretions of this particular raw material available in the glacial deposits in the sample areas in the Kuyavia region – i.e. in the lithic resources within the area of 785 ha – would fall within the range of at least 11,231-14,557 boulders and pebbles necessary for the production of all forms of tools used by the inhabitants of the Polish Lowland in the Neolithic. The expected potential count of appropriate stone blocks among the remaining lithological varieties of rocks that were available in the region in the local resources of boulders and pebbles at the time is presented in Table 2.

A particularly abundant source of stone raw material for the societies inhabiting the Polish Lowland in the past were boulders and pebbles deposited as natural assemblages of stones that formed the so-called moraine pavements deposited by the Fennoscandian ice sheet in a variety of lithic formations of the early glacial landscape. The results of the study on the structure and abundance of moraine residues in the Lowland (more precisely in the Lubusz and Kuyavia residuum) give us ample evidence that these local accumulations of lithic material constituted an extremely rich and particularly diversified petrographically reservoir of raw material useful in prehistoric stone production and also finding applications as building material (Chachlikowski 2013: 40-59, 97-106; Tables 2 and 6).

The stone pavements examined at Torzym in Lubusz Land and at Strzelce-Krzyżanna in the Kuyavia region provide ample source material that is important not only in establishing the frequency and assortment of the inventory of erratics in the Lubusz Land and the Kuyavia region. The substantial number of rock blocks and the variety of their lithic variations in their usefulness for the local stone industry in the Neolithic undoubtedly proves that the glacial pavements in the Lowland areas were by no means less frequent in terms of their abundance than those of the outcrops of rock raw materials occurring in the areas of their natural occurrence – i.e. those that are situated south of the Polish Lowland. What is more, it is our belief that the boulders and pebbles to be found among the local moraine pavements constituted not only a comparable but also equally attractive source, in terms of their abundance and assortment variety, used for the procurement of lithic sources necessary for the local societies in the remote past. A brilliant example of this can be illustrated by the erratics that form the moraine pavement at Torzym in the Lubusz Land. Here, in a relatively small area of about 1150 square meters, there were nearly 15,500 boulders and pebbles useful, due to their assortment composition and shapes and dimensions, for the production of all products of the stone industry in the Lowlands in prehistory.

Summary and conclusions

The whole body of the presented material and determinations on the erratic stone reservoirs occurring in the Polish Lowland lead to an inescapable and unequivocal conclusion on the exceptional abundance of local early glacial environments in terms of the

substantially high number of lithologically diversified rock raw material necessary in the stone production and useful as building material. The evaluation of the resources of erratic blocks in the Polish Lowland entirely justifies the assumption that the local glacial 'resources' represent extremely abundant sources for the procurement of raw material by the inhabitants of these areas for stone tool production, both with regard to the overall count of all concretions useful for this production and the substantial abundance of the whole of the assortment of rocks to be found among erratic boulders and pebbles. This significant abundance and lithic richness of rock raw materials available in the Polish Lowland clearly emphasises the attractiveness of the local inventory of erratics, hitherto much underestimated, in satisfying the demand for suitable material for stone production among the inhabitants of late Neolithic FBC and GAC settlements in the areas of their Kuyavian ecumene.

In all, it should be assumed that the populations that inhabited the Polish Lowland in the past had virtually unlimited access to an extremely abundant and very varied – in terms of its assortment – resource of erratic rocks. A hypothesis can reasonably be put forward that the lithic potential of glacial stones in the Lowlands not only fully satisfied the needs of the local stone production, but even surpassed the potential demand, both with regard to the global count of boulders and pebbles accumulated in the local glacial deposits, and with regard to the representation of all, without any exception, lithic varieties of erratic rocks that found application in the stone production in the area in late Neolithic.

The above observations are particularly relevant for an evaluation of the lithic area in the Lowland as they provide ample evidence that the local erratic blocks constituted not only an easily accessible inventory of stone material close at hand and were used by the local societies, but were also the basic and virtually the only source for raw material procurement by these societies in the production of stone implements suitable for the purpose, regardless of the dimension and tool profile (i.e. its application) and regardless of the lithic composition of rock raw materials – i.e. the one that was preferred by the stone worker.

The presented evaluation of the abundance of erratic raw materials in the Lowlands provides at the same time powerful and significant argumentation in support of the concepts that would offer an explanation for an interpretation of the phenomenon of interregional circulation of rock raw materials in the remote past, or more precisely on the manifestations of the practices of importing and exploitation of stone raw materials in the Polish Lowland in the late Neolithic. It is our opinion that this exceptional abundance, as well as the variety of assortment of Pleistocene erratic resources in the material necessary for the stone production, quite successfully levelled the necessity for importing raw materials from the areas of their natural deposits to the areas of the Polish Lowland. The discussed results of the study are convincing enough in that they prove the exceptional abundance of local early glacial environments in stone erratic raw material. In addition, they also provide us with a number of substantive arguments in favour of the hypothesis on the non-economic character of the manifestations of practices of acquisition and use of exogenous raw materials – i.e. those of provenance from beyond the Kuyavia Lowland – among the late Neolithic inhabitants of the area.

Thus, the presented conclusions cast a doubt on the opinion that is relatively well-established among scholars and researchers specialising in the Neolithic period and that points at the necessity to adjust the needs of the late Neolithic stone worker in the Polish Lowland for raw material to the supposedly limited environmental conditions that would imply, as a great number of relevant publications clearly suggest, certain activities aimed at balancing the shortcomings of the local resource of erratic rock blocks by way of the absorption and exploitation of imported raw material of certain types of rock from the rich lithic areas south of the early glacial areas. On the contrary, the conclusions fully validate the hypothesis that the stone glacial material available in the Polish Lowland, exceptionally abundant and versified in terms of its assortment, was not an influential factor that made the local societies supplement the apparent shortcomings in the local environments with appropriate stone material through the acquisition and use of 'imported' raw material.

The presented conclusions fully justify the hypothesis of the non-economic nature of the interregional circulation of rock raw materials in the Polish Lowlands in the late Neolithic. This, in turn, challenges the justifications of the interpretation of the phenomenon of the 'import' as manifestations of practices purely based on economic grounds brought about by supposed shortcomings in the local resources of raw material and related to the procurement of the best lithic material for the purposes of stone production. We already know that the phenomenon of the 'import' was not triggered by actions aimed at balancing shortages

in certain types of rock (i.e. the total absence of a given material or, alternatively, its scant presence) in early glacial reservoirs of erratic blocs. Within a broader perspective, the whole body of conclusions presented hitherto challenges, in my opinion, the traditional explanations and justifications of the bulk of the manifestations of the far-reaching circulation of exogenous raw materials in the Polish Lowland in late Neolithic as *in extenso* economic acts aimed at supplementing the supposed shortages in certain rock raw materials in the glacial erratic resources of the local environments.

The evaluative implications of the thesis in support of the total independence of the stone industry in the Polish Lowland in late Neolithic of lithic raw materials from the south sufficiently substantiates the widespread the claim of increase in the exploitation of the local erratic raw materials to be observed in FBC and GAC societies in the area. In fact, the raw material inventory in the Lowlands represented by the glacial resources of Fennoscandian erratic boulders and pebbles – suitable for stone production and extremely abundant in terms of its number and assortment variety– eliminated the demand of the local stone worker for imported rock raw material. The knowledge on the local erratic raw material as well as the scope of the recognition and identification of the geology of Pleistocene formations that abounded in stone pavements made it possible for the late Neolithic (or more broadly prehistoric) stone worker to widely exploit these extremely abundant local early glacial environments. It appears that these extremely rich and lithologically diversified relics of the glacial past of the Polish Lowland fully satisfied the demand of the local inhabitants for raw material necessary for stone production and, consequently, made this particular sphere of economic activity of the early agrarian societies inhabiting the areas covered by the last continental glaciation totally independent of the lithic resources of raw material from the South.

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Piotr Chachlikowski
Institute of Archaeology,
Adam Mickiewicz University in Poznań, Poland
piocha@amu.edu.pl