

## LATE MEDIEVAL AND EARLY MODERN GLASS FURNACES IN NORTHERN POLAND

Recent dynamic development of studies on late medieval and settlement in Poland has resulted in a growth of various kinds of relics, glassware being of significant importance among them. Richness of forms, their variety in time, aesthetic value and technological variegation have attracted archaeologists' attention to glassware. The complexity of questions to be examined, while analysing glassware, has encouraged creating of a group of specialists who have taken up these problems exclusively. A complex approach to the glassware questions has become the main rule of the Glass History Laboratory in the Institute of Archaeology and Ethnography of the Nicolaus Copernicus University in Torun. Its research program consists not only in analysing glassware coming from different places in Poland but in identification of late medieval and modern glass making in Northern Poland as well. This research has led to 114 glass works having been discovered up to now, the activity of which dates back to the period from between the 14th and 15th centuries to the beginning of the 20th century (OLCZAK 1984a, pp. 51-64; 1984b, pp. 143-151; RUBNIKOWICZ 1984a, pp. 119-129; 1984b, pp. 239-240; 1984c, pp. 152-155; 1986, pp. 190-191; 1987a, pp. 217-218; 1987b, pp. 223-224; in course of issue; JABLONSKI RUBNIKOWICZ, in course of issue; MARKIEWICZ 1988, pp. 209-210).

A small part of this group four glass works, dating back from between the 14th and 15th centuries and the 16th century were situated not far from the main city of the region, which was Gdansk (Fig. 1). Excavations have been carried out on the site of three of them to examine the layout of the objects and production buildings. Remnants of glass furnaces preserved, have had the greatest cognitive value. Situated close to the top or on tops of hills they were the main constructions, centrally positioned.

The common feature occurring in all the remnants of glass furnaces was the building material which had been used. These constructions were erected of pebbles, common in the ground within the Pomeranian phase of Vistulian glaciation. After being polished and bound by clay they created constructions fully meeting the requirements for glass furnaces. Basing on sources occurring in the area of examined furnaces it can be ascertained that bricks can't have been applied as additional building material.

The possibility of a full reconstruction of all the furnaces has been limited by their bad preservation condition. Nevertheless it has not hindered the process of defining general lines and features which distinguish late medieval and early modern furnaces. These data have made it possible to outline the similarities and differences in shape and size of given constructions

Basing on the lowest stories of these furnaces being preserved, the ground plan appears to have been oval or circular. Within two examined sites from this period (Glazica site I and II, commune of Szemud, province of Gdansk, Figs 2, 4, 5). Basing on few remnants of constructional elements of bearing walls suggestions their size we can define their surface.

This value generally amounts to about 10 to 11 sq.m. But we are not able to define the form of the furnace, its zones and stories. At this stage of studies planimetry of movable remnants has played an important role. Indirectly, they show not only the primary function

designation of furnaces. This feature may also be an important factor in finding out the inside design of some constructions, which is the case of agglomerate, glass mass and pot fragments, in particular.

Owing to the location of these groups of relics it has been possible to separate two functional zones in one story which proves that the glass-workers must have been able to carry out two operations at the same time ie. agglomeration of glass raw materials and burning out of pots.

Another of furnace types was an object noted on site II at Gazica, commune of Szemud, province of Gdansk, whose ground plan was close to a circle (Fig. 3, 6), preserved in a much better condition. Compared to furnaces built on oval plan it had a little smaller area (about 9 sq.m.). Due to relics of its construction load-bearing walls of the furnace but the trench occurring inside it and the fire chamber as well. The remnants of four supports which stapled the furnace dome are a specific element noted only in this case. The supports, similarly to load bearing walls, were made of small pebbles. Here again, clay was used to bind all pebble elements.

Completely different types of furnaces were characteristic for early modern period. At the beginning of the 16th century furnaces with the ground plan similar to rectangle (Fig. 7) appeared in Northern Poland. Made of building materials analogous to those applied in late medieval furnaces they were a little smaller constructions (about 6 sq.m) with different technological solutions. The remnants of furnaces in Szemudzka Huta, commune of Szemud, province of Gdansk (Fig. 7) make a classic example of new constructional trends and simultaneously show tendencies which were in force in the late Middle Ages. Among four furnaces examined on this site, only one had a construction according to projects typical for late medieval sites (Fig. 8-9). The other furnaces were erected following different canons (Fig. 10-12) which have not been noticed before. Apart from the shape, changed in some of these furnaces (Fig. 10) new technological developments, like fire trench positioned outside, came into being. In the following centuries this canon of glass furnaces building becomes the main one in the area of Northern Poland and is representative for all glass works examined in this region after unearthing (RUBNIKOWICZ 1989, p. 46). The number of furnaces in early modern glassworks exceeding those from the late Middle Ages shows a clear functional variation of these constructions. The relic materials found in individual furnace objects have confirmed this supposition. Basing of these categories of information we can state that one or two operations of technological line of glass manufacturing were carried out simultaneously in the furnace of the early modern types. This division was particularly distinctly marked in the phase of glass products manufacturing and annealing. Where in late medieval furnaces one construction fulfilled these functions, in early modern glassworks we deal with separate constructions, which must have been designated for not more than one function. The special layout of these furnaces seems to confirm this hypothesis additionally. On this site, the furnaces were located (Fig. 7) approximately in a row, with the exception of one of them (furnace 1, Fig. 7) situated out of this system. All these constructions are characteristically not far from each other. Such a location of furnaces within glassworks ensured smoothness of production in individual functional zones.

There is no doubt that the most difficult task consists in a full reconstruction of furnace shapes and functions. Agrotechnical activity destroyed all of the furnaces to a large extent in result of which only the lowest constructional stories, those below the plough

depth, have been preserved up to now. These ruined rests are the only source material for these furnaces definition. To reconstruct their original shape it is necessary to get to analogous objects, better preserved, excavated in other areas and to take into account written and iconographic sources dealing with glass furnaces at the same time. Furnaces whose ground plan seems to have been oval, occurring at Glazica, on site I and at Szemudzka Huta, are constructions which have never been found in the area of Northern Poland before. An insignificant number of these furnaces results more from the state of research, being still unsatisfactory despite the constant inflow of new information than from their rare occurrence.

Furnaces having similar shape have been known in iconographic sources. Of prime importance is an engraving of glassworks published in Sir J. Mandeville's journey description to Bohemia (acc. to NEPOTI 1978) or to France (acc. to MAURACH 1934; WYROBISZ 1968, p.80, fig. 1; TABACZYNSKA 1987, fig. 20). The furnace in this engraving consists of two, distinctly separated zones, one for glassware melting and manufacturing, the other one for annealing. This construction makes a nearly ideal model of the furnace unearthed by us (object 1, Fig. 2) at Glazica, site I and its variant modification at Szemudzka Huta (object 1, Fig. 7). Only the designation individual chambers was reversed here, hearth opening—in the central part in Glazica furnace, between two chambers—contrary to the engraving, where this opening was located in the gable wall.

The other type of late medieval furnaces, whose ground plan appears to have been close to a circle, although noted only in one case (Glazica, site II, object 6, Fig. 6), is a constructions occurring more often in archaeological sources and iconography. This constructions was designated for melting and manufacturing of glassware.

The highest story might well have been used for manufactured glassware annealing. Similar furnace constructional solutions are known from the area of Northern Bohemia (CERNA 1989, p. 115, fig. 7) and Germany (LAPPE, MOBES 1984, pp. 211-218). Furthermore such constructions, their chronological frames alike, are known among others from Monte Lecco, province of Genoa and Torcello in Italy (FOSSATI-MANNONI 1975; TABACZYNSKA 1987, fig. 1) or from Saint Maxim-La Saint Baum in France (FoY 1989, p.84, fig. 7).

Widespread character of this furnace occurrence was confirmed by iconographic sources too, for constructions of this type are known from woodcuts published in the works by G. Agricola (1929, pp.503,507,505, fig) or by V. Biringuccio (acc. to TABACZYNSKA 1987, fig. 16). Basing on a foregiven sources it can be assumed that the shape of examined furnace remnants could be similar to what was depicted in these woodcuts. The reconstruction of furnace in Monte Lecco province of Genoa, carried out by Fossati and Mannoni (FOSSATI-MANNONI 1975), shows some significant resemblance to the furnace discovered at Glazica, on site II which partly confirms our suppositions. However, a full corroboration of this hypothesis will be possible only after subsequent, better preserved constructions have been examined.

An attempt to reconstruct furnaces from early modern period unearthed at Szemudzka Huta, commune of Szemud, province of Gdansk (Fig. 7) has been equally difficult. Again, we have been obliged to avail ourselves of archaeological materials from other regions and of iconographic sources, whereas in case of some of these constructions we have comparative material, coming from other glassworks we have studied in Northern

Poland. This material refers particularly to furnaces with fire trench situated outside. Such constructions are known, among other things, from sites chronologically later Srednia Huta, commune of Warlubie, province of Bydgoszcz, site I and Huta, commune of Brusy, province of Bydgoszcz, site I (RUBNIKOWICZ 1989, fig. 5; 1986, PP. 190-191).

Objects looking similarly were noted in the region of Wielkopolska (Great Poland) as well (MUCHA 1979, PP. 181-199; 1984, PP. 83-118, 1987, fig. 2). Then, similar furnaces were described, among other countries in Germany (KONIG-STEPHAN 1987) and in the 18th and 19th centuries they were typical even in Estonia (ROOSMA 1969, fig. 3). Furnaces built on a rectangular plan were also found in this glassworks (Figs. 7, 10-12). Constructions with similar shape but generally bigger occur on other sites coming from later periods (RUBNIKOWICZ 1989, fig. 4).

Apart from Northern Poland they are known in the region of Wielkopolska too (MUCHA 1987, fig. 4). Iconographic presentations, published among other works, by R.J. Charleston (1978, PP. 9-33) show that such furnaces were constructions widely used in various modern glasswork centres of Europe.

The above mentioned significant damages of furnaces are the reason why we find it useless to carry out any more detailed analysing of furnace reconstruction. Such attempts would have too general a character which could leave a large margin for misinterpretation. We hope that archaeological research to be continued on other late medieval and early modern sites in Poland and in other areas in Europe will result in collecting sufficient sources to take up such studies in future.

Nevertheless these data have shown individual features in the constructions of late medieval and early modern furnaces. They will come in useful as one of essential elements while defining the genesis of glassworks in Northern Poland.

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## Bibliography

- G. AGRICOLA, 1928, *Zwölf Bucher vom Berg- und Huttenwesen*, Berlin.
- R.J. CHARLESTON, 1978, *Glass furnaces through the ages*, "Journal of Glass Studies", 20, pp. 9-33.
- E. CERNA, 1989, *O počátcích výroby skla v Krusných horách*, *Pamatky, Příroda, Život*, 4, pp. 112-120, Chomutov.
- S. FOSSATI, T. MANNONI, 1975, *Lo scavo della vetrina medievale di Monte Lecco*, "Archeologia Medievale", II, pp. 31-97.
- D. FOY, 1989, *Les veriers, leurs techniques et leurs productions*, "Le Courier du CNRS. Dossiers Scientifiques", 73, Sept. 1989, pp. 83-85.
- Z. JASTONSKI, M. RUBNIKOWICZ, in course of issue, *Topografia nowożytnych hut szkła na Pomorzu Gdarskim (Topography of modern glassworks in Gdarsk Pomerania)*, "Acta Universitatis Nicolai Copernici", Archeologia, XVIII.
- A. KONIG, H.G. STEPHAN, 1987, *Eine franzenzeitliche Glasbutte im Tal der Nieste bei Grolbalmerode*, Wiesbaden.

U. LAPPE, G. MOBES, 1984, *Glasbutten im Eichsfeld*, “ Alt-Thuringen ”, 20, pp. 207232, Weimar.

M. MARKIEWL CZ, 1988, *Sprawozdanie z lhadan wykopalisbowych w Szemudzkiej Hucie, gmina Szemad, województwo gdariskie (Reports from excavation research in Szemadzka Huta, commune of Szemud, province of Gdarísk)*, “ Informator Archeologiczny. Badania 1987 ”, pp. 209-210.

H. MAURACH, 1934, *Glasschmelzofen in alter Zeit*, “ Glastechnische Berichte ”, 12, Heft 8, pp. 265-274.

M. MUCHA, 1979, *Badania archeologiczne na terenie nowozytnej hutyszkia w miejscowosci Bukowe (Archeological Studies at the Site of Modern Glasworks at Bukowe)*, “ Rocznik Koninski ”, 7, pp. 181-199.

M. MUCHA 1984, *Archeologiczna weryfikacja nowozytnych hut szk/a na terenie Wielopolski poudniowo-wschodniej (Archeological Verification of modern glassworks in the south-eastern part of the region of Great Poland)*, “ Acta Universitatis Nicolai Copernici ”, Archeologia, 10, pp. 83-118.

M. MUCHA 1987, *Badania archeologiczne jabo metoda rozpoznania newozytnego hutnictwa szkia w Wielopolsce (Archaeological Studies as metTod of studies on modern glassmabing in Great Poland)*, “ Acta Universitatis Nicolai Copernici ”, Archeologia, 12, pp. 97-108.

S. NEPOTI, 1978 *Per una storia della produzione e del consumo del vetro a Bologna nel tardo Medioevo*, “ Il Carrobbio, Rivista di Studi Bolognesi ”, 4, Bologna, pp. 321-333.

J. OLCZAK, 1984a, *Archeologia badaniach nad s'redniowiecznym i nowozytnym hutnictwem szkia w Polsce (Archeology in studies on medieval and modern glassmabing in Poland)*, “ Acta Universitatis Nicolai Copernici ”, Archeologia, 10, pp. 51-64.

J. OLCZAK, 1984b, *Badania weryfikacyjne s'redniowiecznych i nowozytnych hut szkia na terenie Polski pónocno—zachodniej (Surface—verified studies on Medieval and modern glassworks in north-western Poland)*, in IX Sesja Pomorzoznawcza, Gdansk, 22-23. III. 1984 rok. Materia~y (The nineth session on Pomerania, Gdarisk, March 22-23, 1984. The materials), Gdansk, pp. 143-151.

J. OLCZAK, 1987, *Giowne kierunki badan had historia szk/a Polsce, (Main directions in studies on glass history in Poland)*, “ Acta Universitatis Nicolai Copernici ”, Archeologia, 12, pp. 11-24.

J. OLCZAK, 1988, *The state and prospects of research into glassmabing in Poland in the early and late middle age. An outline*, “ Archaeologia Polona ”, XXV-XXVI, pp. 107-120.

M. ROOSMA, 1969, *The glass industry of Estonia in the 18th and 19th century*, “ Journal of Glass Studies ”, XI, pp. 70-85.

M. RUBNIKOWICZ 1984a, *Archeologiczna weryfikacja nowozytnych hut Szk/a na obszarze województwa bydgoskiego (Archaeological verification of modern glassworks in the Bydgoszcz voivodship)*, “ Acta Universitatis Nicolai Copernici ”, Archeologia, 10, pp. 119-129.

M. RUBNIKOWICZ 1984b, *Sprawozdanie z badan wykopalisbowycn w Sredniej Hucie gmina Warluhie, województwo bydgoskie (stanowisFo I). Drugi Sezon badan (Reports from excavation research in Srednia Huta, commune of Warlulbie, province of Byagoszcz (site I). Secund year of research)*, “ Informator Archeologiczny. Badania 1983 ”, pp. 239-240.

M. RUBNIKOWICZ, 1984c, *Wyniki badani archeologicznych nowożytnych hut szkła w Średniej Hucie, gmina Warlubie, województwo bydgoskie (stanowisko I) (Results of archaeological studies on modern glassworks at Średnia Huta, commune of Warlubie, the Bydgoszcz voivodship (site I))*, in IX Sesja Pomorzoznawcza, Gdańsk 22-23. III. 1984 rok. Materiały /The ninth session on Pomerania, Gdansk, March 22-23, 1984. The materials), Gdansk, pp. 152-155.

M. RUBNIKOWICZ, 1986, *Sprawozdanie z badań wykopaliskowych w Hucie, gmina Brusy województwo bydgoskie (stanowisko I) (Reports from excavation research in Huta, commune of Brusy, province of Bydgoszcz (site I))*, “ Informator Archeologiczny. Badania 1985 ”, pp. 190-191.

M. RUBNIKOWICZ, 1987a, *Sprawozdanie z badań wykopaliskowych w Głazicy gmina Szemud, województwo gdańskie (stanowisko V) (Reports from excavation research in Głazica, commune of Szemud, province of Gdansk (site I))*, “ Informator Archeologiczny. Badania 1986 ”, pp. 217-218.

M. RUBNIKOWICZ, 1987b, *Sprawozdanie z badań wykopaliskowych w Kieleriskiej Hucie, gmina Szemud, województwo gdańskie (stanowisko b) (Reports from excavation in Kieleriska Huta, commune of Szemud, province of Gdansk (site p))*, “ Informator Archeologiczny. Badania 1986 ”, pp. 223-224.

M. RUBNIKOWICZ, 1989, *XVIII-wieczna huta szkła w Średniej Hucie, gmina Warlubie, województwo bydgoskie (The 18th century glassworks in Średnia Huta, commune of Warlubie, province of Bydgoszcz)*, “ Acta Universitatis Nicolai Copernici ”, Archeologia, 14, pp. 39-66.

M. RUBNIKOWICZ, in course of issue, *Topografia nowożytnych hut szkła na Pomorzu Gdańskim w kontekście uwarunkowań środowiskowo-gospodarczych (Topography of modern glassworks in Gdansk Pomerania resulting of environmental and economic conditions)*, in Studie a Zpravy, Praha.

E. TABACZYŃSKA, 1987, *Wczesnośredniowieczna huta szkła na wyspie Torcello Laguny Weneckiej. Interpretacje technologiczne, (The early medieval glass-works on the Torcello Island on the Venetian Lagoon: technological interpretations)*, “ Acta Universitatis Nicolai Copernici ”, Archeologia, 12, pp. 63-88.

A. WYROBISZ, 1968, *Polskie szkło od XIV do XVII wieku (Polish Glass from the 14th up to the 17th Centuries)*, Wrocław.