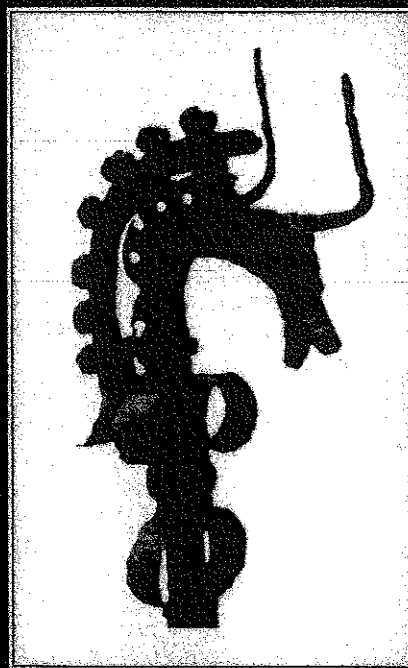


EARLY IRONWORKING IN EUROPE

archaeology and experiment

ABSTRACTS



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ARCHAEOLOGICAL INVESTIGATIONS ON THE BEGINNING OF BLAST FURNACE-TECHNOLOGY IN CENTRAL EUROPE

Albrecht Jockenhövel and Christoph Willms

Westfälische Wilhelms-Universität, Münster, Germany

The first steps of pig iron-technology are still one of the great miracles in the long 3000 year tradition of iron making. It is not yet clear when, where and how the transition from bloomery iron to pig iron-technology was made for the first time. We know, that pig iron was occasionally produced in the Ancient World and on a larger scale in Old China. However, it has still to be explored whether this knowledge was handed down in the technological experience or whether it was re-invented in Medieval Europe.

The early blast furnaces are rooted in the times of the bloomery furnaces. In these small furnaces ("Rennöfen") and in the larger "Stücköfen" iron was produced in a direct, reducing, discontinuous process as low-carbon bloom, "soft-" or wrought-iron. In the "Flußöfen" and "Hochöfen" (both a specific type of blast furnaces, i.e. high furnaces) iron was produced in an indirect process as high-carbon, hard- or pig-iron, later as cast iron. Pig-iron had to be transformed into wrought iron by a separate process ("Frischen"), which required additional technical installations ("Frischherde") and buildings.

Making pig-iron demands a very high temperature (more than c. 1300°C) to smelt the iron ores with charcoal into iron. It is impossible to produce this temperature with the traditional hand- or foot-powered bellows. The new pig-iron technology is based on the use of water-power. Big wooden wheels, powered by water, moved great wooden or leather bellows, mostly a pair of bellows, which forced the air through a hole into the crucible of the furnace.

Therefore the pig-iron industry is embedded in a major system of land-use, i.e. the building of mill-ponds, dams, and mill-races.

In Central Europe water-powered mills became essential elements of the landscape from the Carolingian period onwards. The application of this system in the smelting process represents a younger development in the Middle Ages. It started some centuries later, according to some rare written records in the early 13th century.

It is not yet clear at which time the spread of the use of hydraulic technologies in smelting started and in which regions of Europe the oldest water-powered blast-furnaces were situated. In the early 1990's only two regions were known where the invention of the indirect iron-making process could have started: The Märkische Sauerland, a mountainous region in the West of Germany, and the Norland, a region north of Uppsala in the Middle of Sweden. In the middle of 1990's a new region was added: the Schwäbische Alb in southern Germany. The dating of the archaeological remains in these three regions ranges from the 11th/12th to the 15th century.

In this paper I will give a report on our newest fieldwork in the region of the Märkische Sauerland, a historical ironworking landscape of Germany, the forerunner of the well-known Ruhrgebiet, the major region of iron-making based on the use of the coal.

The Märkische Sauerland is a very mountainous region with large forests, high plateaus and deep valleys. It is an eastern part of the Rheinische Schiefergebirge. In the Middle Ages most of it was part of the Grafschaft Mark. The political power of this dynasty based mainly on the exploitation of the natural resources, especially iron and iron-making. In the region we can distinguish two main periods of iron-making.

The first one is the time of direct iron-making, the period of the Rennöfen (bloomeries) from the 7th-12th/13th cent. AD. All sites were situated on the upper reaches of small rivers, near and on springs and on high plateaus. The second period, the period of the Massenhütten, a local name for the first blast furnaces, has to be dated to the late Middle Ages and the early Modern Age. It is characterised by the removal of the older sites of iron production to the middle and lower reaches of the rivers and the use of water-power. As a consequence this form of iron-making, the water-powered process, was possible only in the form of the manorial system (lords of the manor, monasteries etc.)

Based on large investigations in the last two decades (M. Sönnecken) an interdisciplinary project has been developed and supported by a major grant of the Volkswagen-Stiftung, Hannover. Members of this project are the Seminar für Ur- und Frühgeschichte of the Westfälische Wilhelms-Universität Münster (Albrecht Jockenhövel), Westfälisches Museum für Archäologie, Amt für Bodendenkmalpflege (Bendix Trier, Christoph Willms) and the Max Planck-Institut für Eisenforschung Düsseldorf (the late Dietrich Horstmann). The project is titled "Eisen- und Stahlerzeugung im märkischen Sauerland. Eine Produktionskette von der Rennfeuerverhüttung bis zum Beginn des Osemundfrischens (ca. 800-1600 n. Chr.)."

My report is a preliminary review of our latest excavations of two blast-furnaces in the valley of the Kerspe river, southwest of the town of Kierspe, near Meinerzhagen/Lüdenscheid.

During the restoration of the dam of the Kerspe river the water was let out. On the surface at a distance of c. 25 m from each other two sites of iron smelting appeared. Based on geophysical measurements it was possible to locate the remains of two furnaces and some surrounding equipment. The excavation was done in the summer of 1996. The investigated area covered 325 square meters. We found indeed two very well preserved blast furnaces.

Both high furnaces had been erected with their backside towards the slope. They were intact up to a height of 1,25 and 1,75 m. The main building material was loam found on the spot.

Only a few stones had been incorporated in these buildings. The outer diameter of the two furnaces is c. 3 m. On one side of the high furnace No. 1 the hole for the water-powered bellows was totally intact. Another stroke of luck was the fact that the hearth (Gestell) of both blast furnaces was in a very good condition. Unfortunately the front of the breast wall was damaged. Therefore we cannot say whether the breast had been open or closed (Blauofen). But in front of the furnaces we found the hollow for the tapping of the slags and the pig-iron.

Around and under the furnaces some small trenches for the drainage built of stones were situated. Beside the furnaces we found the remains of the Radstube, the place of the wooden wheel, presumably an overshot wheel. Also the mill race was located at a distance of some hundred metres. Above the top of the furnaces we found the charging-platform (Gicht-plattform) from which the crushed iron ores and the charcoal were loaded into the furnace. Some heavy post-holes are the remains of some wooden buildings to protect the furnaces and other working places.

Since any small finds are lacking we cannot date this very important find place. C14-dating is going on. In typological comparison with the well known stone-built rectangular blast-furnace nearby in the Jubach-Dam, which is dated to the 15th century we prefer an earlier dating in the 13th-14th century.

Taking together another blast-furnace which we partly excavated in 1995 on the river Wipper, the older excavation of Haus Rhade from the 1960's, with the Jubach-Dam and the two blast-furnaces of the Kerspe-Dam we now know of five blast-furnaces dating from the 13th-15th century. Outside the Märkische Sauerland only the well known site of Lapphyttan (Sweden) has another preserved high-furnace. Unfortunately from the Schwäbische Alb near Metzingen we don't know the type of the furnace only the slags of the pig iron-process.

In the present state of research it is too early to allow the priority in the invention and use of the pig-iron process only to these three regions. Unfortunately the written records of the High

and Late Middle Ages do not give any information about these subjects. However I think new archaeological investigations have to be started in more "innovative" regions of Europe, like Upper Italy, Burgundy or France, to find comparable sites. We have to consider also the mobility of the late-Medieval society which favoured the spread of new technologies

in an international network of dynastic alliances, the spread of monasteries, warfare, crusades, pilgrimages, international fairs etc. I will not exclude a yet unknown influence from outside Europe, perhaps from the older technology of Old China, transferred during the 12th/13th centuries in the course of migrations from East to West as by the "Goldene Horde".