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Logbook

Eva Hjärthner-Holdar, Lena Grandin, Katarina Sköld & Andreas Svensson,
By Who, for Whom? Landscape, Process and Economy in the Bloomery Iron Production AD 400–1000

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Reviewers' comments

Referee 1

By Who, for Whom? – Landscape, Process and Economy in the Bloomery Iron Production AD 400–1000

Referee: Bernt Rundberget
General: *This is a very solid work showing detailed knowledge of relevant background material, the data generated by fieldwork as well as the role of the bloomery iron production in the landscape and society - the manuscript can be published.*

Comments:

- The manuscript is an extensive work in which bloomery iron production in Sweden is presented in a broad and good way. The background for the publication is the excavation in Motala, and both technology and landscape are put in a wide context. The first half of the manuscript is devoted to introduction in bloomery iron technology and research status for the region. The text, which is highly interesting, is very detailed and contains many references (almost 25% of the total text is the reference list). This part of the manuscript is partly characterized by being a book chapter rather than a text in a journal article. For the highly interested, this information will be important, but for a common reader, the introduction will be somewhat too detailed. Therefore, it should be considered whether there are opportunities to shorten the text a bit and draw up some general points.

- Archaeological periods: It should be explained what the Swedish periods of Iron Age represents in year. Not everyone is familiar with Vendel Period etc.

- Proximity to raw materials: It is argued that proximity to resources is central to the placement of the bloomery iron sites and the use of the landscape. On page 7 it appears that it is around10 km to the nearest limonite ore source used at the site. I have some trouble seeing that 10 km can be argued to be very close. Here the authors should argue better why the bloomery smelters did not place production nearer the ore sources.

- Economical model: The focus on levels of operators is very welcome. The role of the three levels; producers, distributors and consumers are important to discuss in order to get a better understanding of the bloomery iron production in an economical perspective. This grip is not new but not used much in the context of bloomery iron production, and have to be seen as the most important contribution in the manuscript.

- Manganese ore: This is also a very important topic that has only been briefly discussed before. The benefit of manganese for enabling carbon into iron, and for producing of steel, is important when discussing quality and choose of ore.

- The Motala site: dates points to a continuous use of the site for 400 years, and different types of iron were produced. The four documented furnaces were used several times. On the other hand, the amount of slag only amounts to 60 kg. It is argued that the slag from the site can have been reused elsewhere, that a new road has destroyed parts of the site and that that some of the slag can have been deposited in the water. Still, there is a

weakness in the argument that this site has been a place for an extensive production important in a regional distributive network. The authors point out that there are several small production units, but based on the slag amount, it is still difficult to follow the argumentation. Maybe the authors' point regarding production of steel out of manganese ore could be an even better argument of the importance of this production.

- Figures: Figure 7 – Should be some information in the text about what the places represent.

Referee 2

Eva Hjärthner-Holdar, Lena Grandin, Katarina Sköld & Andreas Svensson: By Who, for Whom? – Landscape, Process and Economy in the Bloomery Iron Production AD 400–1000

Referee: Jan Henning Larsen

50 years ago, when modern, scientific research of bloomery iron extraction started with Inga Serning in Sweden (and Olfert Voss in Denmark and Irmelin Martens in Norway), iron production was a theme only for specialists, and the publications were so technical that they were only read by a few people in Scandinavia. The research focused on typology, especially of furnaces and technical development. From the 1970s, it has also been focused on relation to settlement and the economic importance for the society. Now many archaeologists have participated in excavations and all the experimental work calls the attention of many people. However, many of the publications are still reports of new finds.

As a whole, the article is a very thorough and interesting paper that deserves to be published. It is gratifying that the authors have made a very broad review of the iron extraction, both of process and of the economic and social importance of this extensive work with a presentation of the site at Motala as well as of the material from Östergötland and the neighbouring areas. Iron production has left so many traces, not only in Sweden, but also in large parts of Europe.

Landscape, process and economy in the bloomery iron production during AD 400–1000 are all integrated in this paper initiated by an archaeological excavation of the bloomery site in Motala. Together with different colleagues, Eva Hjärthner-Holdar has over the past years brought research of Swedish iron production archaeology to colleagues, especially in Scandinavia, but also in a large number of conferences in Europe. She is one of leading experts in Northern Europe with great knowledge of both iron extraction archaeology and archaeometallurgy.

In the introduction to the chapter "The background of the bloomer production", there are many claims I have seen to be better substantiated elsewhere, for example the surplus production as early in the Pre-Roman Iron Age and earlier. In Norway, it seems that the production in the settlement areas may have been limited to self-sufficiency up to the first century AD; the production subsequently moved to the large outfield areas, and there are finds of sites with huge slag heaps already in the Early Roman Iron Age.
The discussions of the importance of the organization, the economic point of view, as well as quality and trade are of great interest and value, and the authors succeed with this part of their presentation. The article will give a good background to further discussions, but these discussions will not be begun here.
The questions by whom for whom are old, and new answers can be given according to new excavations and the development of theory and method within iron extraction research.

The questions "by whom", "for whom" are essential in Scandinavian research, together with "where" and "when", as well as "How much iron was produced". The authors provide a detailed description of the iron extractions in the landscapes surrounding Motala and Östergötland. This description is too detailed and could well be shorted down and be more summarizing.

The weakest part is the question of "when" – the chronology is sparsely treated. The period 400-1000 is important in Sweden, and I think it is a good idea to have an article of iron extraction in this period when Sweden became a kingdom.

The authors use the excavated site at Motala to illustrate the iron production in the area. The excavation and the site are only briefly presented. A couple of reports are referred to, but a detailed publication is missing. I had problems finding these reports. In particular, I had would have wanted a better discussion of the chronology. The paper states that the site has been in use from AD 260-to AD 690, and that there was continuity in the production. It is not described how the site is dated and why the production was continuous. If the chronology is based on C14-datings, the number of dating is essential, as is a presentation and discussion of the results, such as the ones by Bernt Rundberget in his publications from 2013 and 2017.

Only 60 kilos of slag have been recovered, which is very little for over 400 years with large furnaces. Normally, such small amounts of slag suggest a small production for only one household. The explanations are not credible, and the discussions should be sharper. Additionally, a plan of the site is necessary in this part of the article.

It is interesting is that the authors focus on communication routes and the richly furnished graves in the region and their relation to the contemporary settlement.
Many of the subchapters give much information and valuable discussions. One example is the discussion of use of wood or charcoal in the bloomery iron production. The subchapter "The socio-economic framework of bloomery production" is another part of the article I enjoyed. I will also draw attention to "Increase in size, efficiency and capacity - …". The discussion of the use of manganese-rich ores is of great interest and shows the iron producers' vast knowledge. "The routes of the iron" is too often forgotten in the research. Further parts of the article could be mentioned. In the presentation of raw material, maybe something should be told of building material for the furnaces.

The figures with the reconstruction drawings have a very good quality, but I have never seen a frame such as the one at fig. 1bb and fig 3c. This should be better explained.

I have only checked a few of the references, and I note the large amount of reports in the list. Rundberget 2013 should be replaced or supplied by the published book (*Tales of the Iron Bloomery. Ironmaking in Southeastern Norway – Foundation of Statehood c. AD 700-1300*. Brill 2017).

The authors succeed with the major focus on the importance of the organization, the economic point of view, as well as quality and trade. The image of the importance of the bloomery iron production is very well described. I think the article will be of great interest for many scholars, and I recommend that JAAH publish the article when the authors have made some corrections and additions.

Authors' comments

We would like to extend our gratitude to the reviewers for investing their time to read our lengthy draft and providing constructive and insightful suggestions and comments.

We have considered the comments and suggestions made by the two reviewers and have made corrections and additions in order to improve and strengthen the arguments. This is valid for e.g. general comments regarding Iron Age Periods (added table), discussions regarding proximity to raw materials, and furnace construction materials. Furthermore the potential of how, and in what way, slag volumes can be applied for production estimations or not, is further developed. In line with that, iron quality –along with quantity – is discussed as a factor also affecting the definition of surplus production.

For the bloomery site in focus in this paper, Motala, we have added more detailed information, as suggested by the referees. The recently excavated site has, as explained in the paper, despite the comparatively small amount of slag, initiated the current integrated study of iron production and economy. Similar trends have indeed been indicated previously, but this site provided the opportunity to analyze the subject more thoroughly.

The two referees presented partly divergent suggestions regarding the length and details in the background information; one suggested it being too detailed, the other that it was informative. In order to respond to this we have considered it in relation to the complexity of the manuscript comprising production technology, economic models and the archaeological record. Due to this, we anticipate various readers from respective fields of specialty that can be favoured by a general background in order to fully value the integrated assessment. However, in some parts the text is now more condensed.

Numerous corresponding bloomery iron production sites, from various regions, are vital for comparison and the conclusions made in the paper. Many of these have previously only been presented in archaeological reports that might be difficult to access for every reader; or information is dispersed in larger publications. In order to highlight the most important information from these sites in relation to the subjects covered in the paper, we prefer to present these details although one of the referees suggested this part should be less extensive.

Finally, we welcome further discussions regarding organization and economic applications as well as quality and trade as mentioned by the referees, also in relation to chronology. We are glad that we have contributed to such a dialogue and look forward to its continuation.