of the features. It appears that these were the foundations of a building which preceded the later south wing of the cloister. The discovery of column bases shows that the cloister's west wing must have been built in the decades around 1000. The ground-plan of this part of the abbey complex is thus relatively reliably established, although the functions of the various rooms could only be tentatively assigned. Other sections of buildings can be dated to the Late Middle Ages, while an extensive rebuilding programme took place in the 17th and 18th centuries (pp. 306–308).

Lammers' analysis lives up to the expectations mentioned at the beginning of this review: he has succeeded in making evident both his approach to the analysis of the old excavations and the quality of the modern redocumentation. It is also clear that a successful balance has been maintained between the planned academic excavations and the emergency excavations determined by building activity. Of course, it is still too early to expect a comprehensive reinterpretation of the structure of the abbey precincts. For that, we must await the analysis of the excavations from 1998 to 2008 and a comprehensive correlation with the older excavations and, in particular, with architectural research on the *Torhalle* and the church. The book ends, therefore, somewhat abruptly. Nevertheless, only two years after the end of this complex fieldwork, we have an initial survey which goes much further than a preliminary report. A complete analysis of all the excavations is not possible; that goal may still be a long way off. But the first steps have been taken!

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Ulrich Lehmann, Wurmbunte Klingen: Studien zur Konstruktion, Herstellung und Wertigkeit der frühmittelalterlichen Spatha in Westfalen. Veröffentlichungen der Altertumskommission für Westfalen, Landschaftsverband Westfalen-Lippe volume 21. Aschendorff Verlag, Münster 2016. € 39.00. ISBN 978-3-402-15009-2. 539 pages with 269 figures, 5 tables, 112 plates, and 1 map.

This very comprehensive volume is divided into 333 pages of text and a catalogue of 170 pages which, in turn, consists of text and corresponding plates. The subject matter of the book is the analysis and comparative presentation of 32 early medieval spathae; 28 of these were found in Westphalia, the other four in the immediate vicinity. They date from the period between the 6th and early 9th centuries AD. The book is based on Ulrich Lehmann's doctoral thesis, which was submitted to the Ruhr University of Bochum in 2014. The work was carried out and published with support from the *Altertumskommission Westfalen* (Antiquities Commission of Westphalia) and the *Landschaftsverband Westfalen-Lippe LWL-Archäologie für Westfalen* (Regional Authority of Westphalia-Lippe, LWL Archaeology for Westphalia). In 2016, Ulrich Lehman won an award from the LWL regional authority for making a significant contribution to the exploration of Westphalia's regional history without substantial state support.

The book comprises eleven chapters whose contents shall be summarised here. The first three chapters (pp. 1–44) present the spatha as a weapon, its research history, and the available methods of scientific analysis. Unfortunately, this section lacks an illustration of a double-edged sword with the technical terms for all the component parts, which would have saved the reader from scratching their head over what a *Hilze* (sword grip) might be.

Chapter 4 (pp. 45–50) outlines the research concept, whilst chapter 5 (pp. 51–86) is devoted to presenting the graves from which the swords were recovered, their find assemblages, and the associated chronological framework. Lehman distinguishes between an earlier (6th/7th centuries AD) and a later group (8th and early 9th centuries AD).

The results of an analysis of the construction of the spathae, based mostly on computed-tomography, are discussed in chapter 6 (pp. 87–168). The section begins with a discussion of the scabbard, followed by the hilt and, finally, the blade. The CT analyses allowed Lehman to identify numerous details of the construction of the scabbards and hilts. However, it would have been helpful to mark these details on the pictures using arrows or colours.

Chapter 6.3 (pp. 138–168), finally, deals with the blades. The width of the pattern-welded or composite rods is discussed on the basis of the CT scans (see Tab. 4), and both their thickness and whether whole or half-rods were used is deduced from the welding patterns. The number of layers in the individual rods, usually seven, can be observed in the areas that have not been twisted. The construction of the body of the blade, in a single mass, in two layers, or with a central (third) layer running through it, is then discussed. Although no pictures are provided to prove these different construction methods, they are probably correct, since they correspond with other technical publications of early medieval spathae.

The patterning on the body of the blade is formed, on one hand, by S-shaped structures and semi-circles, a pattern found in the centre of the twisted rods, and on the other, by parallel layers in the untwisted areas. V-patterns can also occur, though these are quite rare. Unfortunately, it has to be said that many of the reconstructed patterns presented in the plates cannot be confirmed from the tomographic scans provided. The figures in the text are the only clues as to how the author arrived at the reconstructions he proposes.

The cutting edges were welded onto the twisted central part. Only in three cases can the core material be seen to continue into the cutting edges.

One of the blades was metallographically analysed (pp. 161–163 cat. no. 5). Despite containing more carbon than the central parts, the cutting edges are not particularly hard in this example. The analysis identified a reversed sequence in the central part, which consists of up to seven layers. The chemical analyses show that the coarse-grained, hard ferritic areas contain high levels of phosphorus, which means that the layers of the twisted rods consist of phosphorus-rich iron and low-carbon steel.

Chapter 7 (pp. 169–245) puts individual components of the spathae into a broader context and discusses whether they were made at the same time and by the same craftsman. A list of criteria for the judgement of quality is also established. Although Lehman gives a detailed description, in chapter 7.3.5 (pp. 221–226), of how he imagines a blank workpiece was created, this whole section remains somewhat theoretical in nature. Blanks were forged from three to eight sections, or four to ten sections if one includes the cutting edges. Most difficult to make were the two-layered cores consisting of eight sections. The feat seems almost impossible, given that one would begin with rods 70 cm long and 5 mm thick. The difficulty lies not so much in the loss of material due to the heating process, but rather in the length and number of welding seams which had to be created with as few faults as possible. Chapter 7.3.10 (pp. 234–245), finally, compiles a list of criteria by which to judge the quality of the craftsmanship involved in creating the spatha blades. These are based on the structure of the core of the blade and on the principle that the greater the number of layers and individual rods visible in the body of a blade, the greater the technical skill required to produce it. Almost all the blades are made from four to eight half-rods, sometimes attached to a

central layer. The centre of each twisted rod, with its semi-circle patterns, is visible. Twisted and untwisted areas alternate in some of the rods, creating alternating patterns of semi-circles and lines, which can be arranged in parallel or offset. The patterns show hardly any faults or irregularities. There is a wide range of blade types, from simple pieces made from one rod, with a central pattern of chevrons, to highly complex examples with a central part forged from eight half-rods welded together, with the same or alternating patterns. The complex pieces are more numerous.

Chapter 8 (pp. 247–273) deals mainly with questions of chronology. The first step was to ascertain whether the swords had been used before they were placed in the graves. Various traces of wear on the parts made of copper alloys and precious metals, in particular, suggest that the spathae were used over long periods of time. The same applies to a spatha which was remodelled into a scramasax and to one which was turned into a weaving sword.

From a chronological point of view, it can be shown that the more complex spathae, whose central parts consist of six or more composite rods, mainly date from the earlier phase, i. e. from the 6th to mid-7th centuries, whilst the simpler specimens, composed of four composite rods, more often occur in the later phase, i. e. the second half of the 8th and early 9th centuries AD. The alternating twisted and untwisted patterns are also typical of the earlier phase. This trend has not just been seen in spathae from Westphalia; the same observation has been made in the rest of Germany, in England, and also in the Netherlands.

Chapter 9 (pp. 275–285) is devoted to the provenance and distribution of the swords. Lehman believes that they were probably forged by highly specialised craftsmen whose workshops were located outside of Westphalia. He bases this assumption on the weapons' long periods of use and the rather clumsy repairs. Lehman presumes that the elaborately worked hilts and scabbard fittings made of non-ferrous and precious metals were created by workshops in centres close to the royal household. Research has shown that ring-swords were used as gifts for royal followers and members of the upper class with links to the Frankish royal dynasty.

The tenth chapter (pp. 287–311) is devoted to the symbolic imagery on the different components of a spatha. The main topic in this section are the so-called "wyrm" ornamentations or serpent motifs on the middle of the blade. Because the spatha was worn in a scabbard and the decorations were only seen in battle or when the blade was drawn, they were probably intended to protect and safeguard the bearer of the sword.

The final chapter 11 (pp. 313–329) deals with the sword bearers' social status. In the earlier phase, the graves of the spatha bearers stand out, partly due to their construction (chambered tombs, tombs of the *Absatzgrab* type) and partly due to their rich inventories, comprising more than five weapons or the remains of horses. Grave 1782 from Krefeld-Gellep, referred to here by way of comparison, yielded the richest such assemblage. The identification of higher-status graves in the later period is somewhat more difficult, due to the fact that higher status was by that stage only represented by the presence of a spatha and a chambered grave construction.

Early medieval spathae served three functions: they were weapons, status symbols, and magical artefacts, though the author puts the greatest emphasis on their purpose as a status symbol.

About the work as a whole, it can be said that "less would have been more". Many illustrations should have been bigger, so as to make the details discussed more visible. The CT scans in the plates section are of no use, since the technical details generally cannot be made out. A good example of how such pictures could be used is a publication on the spathae from a cemetery at Lauchheim, Ostalb District, Baden-Württemberg, which was published almost at the same time and which presents 100 spathae, 30 of which were analysed by means of computed tomography

(J. Stelzner et al., X-ray computed tomography for non-destructive analysis of early Medieval swords. Stud. Conservation 61,2, 2016, 86–101). In this work, all the details described in the text are marked in the figures by arrows and numbers or coloured outlines. This significantly enhances the paper's readability. The digital publication is another advantage, making it possible to enlarge the pictures and see them in greater detail.

A substantial weakness of the work is apparent whenever the author speaks about the production and manufacturing of iron.

– In chapter 1.2 on the early medieval forging techniques, the author states: "Prior to the actual process of forging, the metal that had been extracted from the ore had to be prepared for further working. This was done mainly by refining" (p. 9). Refining is a modern-era technique where bundles of steel rods are welded together in order to homogenise the material. (Information on the process can be found in the "Grammatisch-kritisches Wörterbuch der hochdeutschen Mundart" by Johann Christoph Adelung [Leipzig 1796].) Once welded, the rods are then hammered and drawn out. Repeated folding and beating refines the end product. Steel made using this technique exhibits a characteristic line texture running in the direction of the forged rods. The pattern distinguishes it from steel that was made in a bloomery furnace, which has a less pronounced texture.

– Chapter 1.2.1 describes the bloomery process, p. 9: The bloomery process does not result in a loup but in a bloom. Loup in metallurgy is a product of refining of the pig iron from a blast furnace. Blooms form on top of the liquid slag and not below it. Moreover, in a bloomery furnace, metal and slag cannot be separated by tapping. Only the liquid slag can run off – depending on the furnace model. A bloomery furnace does not produce pig iron; pig iron is in the product of a blast furnace and consists of cast iron with a carbon content of well over 2 %. Lehmann then goes on to suggest that the bloom or sponge iron was shattered, sorted, welded together, and refined. Although we cannot exclude the possibility that some blooms were shattered, studies of Iron Age bipyramidal ingots and Roman bar ingots paint a completely different picture (P. Fluzin et al., An archaeological and archaeometrical approach of ferrous semi-product: a diachronic qualitative typology [VIIth cent. BC – IInd cent. AD.]. In: C. Cucini, Acta mineraria et metallurgica. Studi in onore di Marco Tizzoni. Not. Arch. Bergamensi 20, 2012, 195–204; https://halshs.archives-ouvertes.fr/halshs-00870717/document). These ingots usually consist of one or several iron blooms which were manufactured as a whole. The roughly purified metal, in the form of a half-finished product or ingot, was worked directly into a usable artefact. Finished artefacts are therefore often heterogeneous in structure, though certain properties predominate. For his description of the process, Lehman refers to a work by J. Emmerling (Technologische Untersuchungen an eisernen Bodenfunden. Alt-Thüringen 12, 1972, 267–320), which is now, however, outdated.

– Chapter 1.2.2 is concerning materials that are welded together in the pattern-welding technique. Iron and phosphorous-rich iron are mentioned, but not steel. Differences in colouration, however, can also be achieved using steel with varying contents of carbon. In fact, this is what composite rods are usually understood to be made of, phosphorous-rich iron being an additional component.

– Metallographic analysis of the spatha cat. no. 5: The decarburisation of the cutting edges (p. 161) cannot be observed looking at the pictures provided (Pl. 104–105). Oberhoffer's reagent was not used, though this would have made the tiniest differences in phosphorous content visible and would have facilitated the identification of welding seams or phosphorous-rich areas. Strong distortion does not generate more slag inclusion (p. 163). Inclusions can only be proved to have

been created during the working of a piece of iron if they are deposited along the welding seams. Some of the chemical compositions of metal which are given are open to doubt. It would be unlikely for the metal to contain 0.1 % chromium (p. 165). In the bloomery process, chromium is only deposited in metal in ppm amounts and is only reduced into the metal by smelting it in a blast furnace. A phosphorous content of between 0.1 and 0.7 % can always be seen as raised because anything more than 0.1 % changes the properties of the alloy with regard to its segregation behaviour, microstructure, and hardness. Unfortunately, Table 6 with the results obtained from the microprobe analyses is missing from the appendix.

– In the context of chapter 7.3.1 (pp. 208–212) about the blades, there is a discussion of the production of the metal in a bloomery furnace and the resulting alloys. With reference to the smelting process, temperatures and products are mentioned which were probably taken from an iron-carbon phase diagram, which is neither provided nor cited, and which cannot be interpreted in this way (an example of an iron-carbon phase diagram can be found in H. Schumann, Metallographie [Leipzig 1991] Chapter 4.3). Iron-carbon phase diagrams show the conditions under which liquid metal crystallises out as a solid metal, which is a process that is unlikely to occur in a bloomery furnace. In order to describe the processes that take place in a bloomery furnace, more complex conditions must be taken into account. The reduction process depends on the partial pressure of oxygen, the liquefaction of the slag, and the carburisation by CO (H. Straube, Kritische Gegenüberstellung der Theorien über die Metallurgie des Rennfeuers. Ferrum 57, 1986, 20–28). Next, Lehmann deals with the iron alloys. Here it should be stated that hardly any sulphur is present in the ores used and that phosphorous metal is formed, not just from bog iron ore but also from all other phosphorous rich iron ores. To use the term 'pure iron' when referring to steel with a carbon content of up to 0.2 % is technically incorrect. Instead of pig iron, Lehman should have used the term 'cast iron'. When discussing forgeability he mentions steel with a carbon content of up to 2 %, which is, in fact, cast iron. However, there is no evidence to prove that such raw materials were forged in the Early Middle Ages. It is also most unlikely that steel was strongly decarburised during forging, only to be re-carburised subsequently. The rate of diffusion of carbon during carburisation at 900 °C is 1.5 mm after 10 hours or 4.5 mm after 60 hours (H. Schumann, Metallographie [Leipzig 1991] esp. 535). Any craftsman would, in fact, have ensured that the steel was not decarburised. As well as carbon, phosphorous also has a strong impact on the properties of iron. However, one can exclude the possibility that phosphorous accumulated in the metal during reheating of the bloom.

Ulrich Lehmann's work would have benefited greatly from the passages mentioned being reviewed by a person familiar with the archaeometallurgy of iron prior to the book's publication.

The book deals with much the same subject matter as the other work which appeared at the same time and which was mentioned above: the publication of a third of all the swords recovered from the cemetery at Lauchheim, Ostalb District in Baden Württemberg (J. Stelzner et al. 2016). In contrast to Lehmann's publication, however, the latter presents only an unsystematic overview of preliminary results. Ulrich Lehman has successfully reviewed an entire region in respect of a significant period with several phases. On the basis of the results from the computed tomographic analyses, Lehmann's reconstructions of the forging patterns on the blades are different from those presented, for instance, by Westphal. He has been able to very clearly ascertain that half-rods were mostly used and that the original surface is generally missing. This has resulted in numerous reconstructions of semi-circle patterns. As well as confirming the structure of the blades, the computed tomography has also allowed him to introduce new criteria such as a better assessment of the actual level of patterning, of the number of twists in a given area and the degree of distortion, the number of layers, and the construction of the welded rods. In doing so, he has set a new standard for future publications.

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Wolf-Rüdiger Teegen / Michael Schultz, Starigard / Oldenburg: Hauptburg der Slawen in Wagrien VII. Die menschlichen Skeletreste. With contributions from Karl-Georg Beck and Thomas Roth. Offa Bücher volume 86. Wachholtz Verlag, Kiel, Hamburg 2017. € 50.00. ISBN 978-3-529-01186-3. 608 pages with numerous illustrations, tables, and 164 plates.

The voluminous monograph by Wolf-Rüdiger Teegen and Michael Schultz presents the full results of the anthropological and palaeopathological investigation of skeletal human remains from the population of Starigard / Oldenburg, the main gord of the north-west Slavonic tribe of the Wagri. This publication not only stands out by the rather large number and excellent preservation of the skeletal remains but also by the extent of the anthropological investigation including macroscopy, radiology, endoscopy, scanning electron, and light microscopy. Considering the importance of this site within the framework of medieval northern German archaeology, this book has been expected for a long time.

In the preface, the editor, Ralf Bleile, states that the text of the publication was already finished and submitted to the editorial office in 1996 (p. 11). However, he does not further explain the long delay in production of the publication. Unfortunately, the main part of this publication remained on the scientific level of the mid-1990s. Even though current approaches in anthropological and palaeopathological research are accounted for in the epilogue (pp. 226–231) and the bibliography (pp. 232–240), they are lacking in the overall interpretation and discussion of the particular cases and pathological conditions in the main text. Despite the disappointing fact that it took more than 20 years from finishing the manuscript to its publication, it is nevertheless gladly welcomed to have it finally in print. This publication has the potential to become a palaeopathological standard work for research, with full-scale osteoanthropological investigation of skeletal remains from an archaeological context. This is acknowledged even more considering such complex publications are rare to find in the 21st century. In the current, rather ephemeral world of science, which often pants after short-lived projects that have limited hypotheses and little understanding of the big picture of the interdependency of different cultural, social, and biological aspects of a human population, a work as this stands out. Because of this nowadays common, self-induced reduction of research to isolated aspects, the holistic approach of Wolf-Rüdiger Teegen and Michael Schultz, in a way, appears to be fallen out of time. The question is whether this current development is really any improvement to science, or only just a setback.

Following the prefaces of the editor and the authors, the actual text comprises 145 pages, including schemas and graphs. The material of the investigation includes about 150 individuals from the graveyard of the gord and the settlement area as well as another approximately 140 scattered finds of human remains. The age of the manuscript is reflected by the methods used for palaeopathology and the assessment of individual data such as sex, age at death, stature, robusticity, epigenetic traits, and anatomical varieties. However, these methods are nowadays still common. Furthermore, standard palaeodemographic parameters were employed as well as statistical tests concerning significances and possible relations between different traits. These tests are still not regularly employed as part of an anthropological and palaeopathological investigation today and were, without