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Critical comments on the find complex of the so-called Nebra Sky Disk

Rupert Gebhard & Rüdiger Krause

Abstract – The *"Nebra Sky Disk"* was reportedly discovered in 1999 as part of a hoard during an illegal excavation. In elaborate and long-lasting investigations an attempt was made to verify both the reported site location and the affiliation of the objects independently from the information given by the finders. Yet, a critical examination of the published results by the authors does not allow the conclusion that the site investigated in a re-excavation is correct, nor that the ensemble itself fulfils the criteria of a closed find (hoard). On the contrary, according to the excavation findings the ensemble could not have been *in situ* at the site named. The scientific examination of the objects contradicts rather than confirm their belonging together. If the disk is considered – as required by these facts – as a single object, it cannot be integrated into the Early Bronze Age motif world. Instead, a chronological embedment in the first millennium BC seems most likely. On the basis of this overall assessment, all further conclusions and interpretations of the cultural context and the meaning of the Nebra disk that have been made so far will have to be subjected to a critical discussion.

Key words – archaeology; sky disk; star disk; Nebra; hoard; Bronze Age; Pre-Roman Iron Age; Celts; eastern alpine copper; lead isotopes; tin isotopes

Titel – Kritische Anmerkungen zum Fundkomplex der sog. Himmelsscheibe von Nebra

Zusammenfassung – Die *„Himmelsscheibe von Nebra"* wurde 1999 angeblich als Bestandteil eines Hortfundes bei Raubgrabungen entdeckt. In aufwändigen und langjährigen Untersuchungen wurde versucht, sowohl die Zuweisung des angeblichen Fundortes als auch die Zusammengehörigkeit der Objekte unabhängig von den Angaben der Finder zu verifizieren. Eine kritische Betrachtung der publizierten Ergebnisse durch die Autoren lässt derzeit weder den Schluss zu, dass die in einer Nachgrabung untersuchte Fundstelle zutreffend wäre, noch dass das Ensemble selbst die Kriterien eines geschlossenen Fundes erfüllt. Vielmehr kann sich das Ensemble nach dem Grabungsbefund an der Fundstelle dort nicht *in situ* befunden haben. Die naturwissenschaftlichen Untersuchungen an den Objekten widersprechen eher einer Zusammengehörigkeit als dass sie eine solche bestätigen. Betrachtet man die Scheibe – wie dann geboten – als Einzelobjekt, lässt sie sich nicht in die frühbronzezeitliche Motivwelt einfügen, eine zeitliche Einordnung in das erste Jahrtausend v. Chr. erscheint am ehesten wahrscheinlich. Auf Grundlage dieser Gesamteinschätzung müssen sich alle bisherigen weiterführenden kulturgeschichtlichen Schlussfolgerungen und Interpretationen einer künftigen kritischen Diskussion stellen.

Schlagworte – Archäologie; Himmelsscheibe; Sternenscheibe; Nebra; Hortfund; Bronzezeit; Vorrömische Eisenzeit; Kelten; Ostalpines Kupfer; Bleiisotope; Zinnisotope

Anmerkung: Eine identische Fassung des Texts in deutscher Sprache finden Sie unter https://www.dguf.de/fileadmin/AI/ArchInf-EV_Gebhard_Krause_d.pdf

Introduction

The so-called Sky Disk of Nebra (originally Kleinwangen, Unstrut Valley, Burgenland dist.) was already the subject of two controversial articles in the Archäologisches Korrespondenzblatt. An essay by P. Schauer, who in 2005 regarded the object as a fake (Schauer, 2005), was countered in 2008 by a reply from the working group of E. Pernicka and H. Meller as a summary of all research results, with the conclusion that *"The Nebra Sky Disk may be regarded as one of the best investigated archaeological finds in Germany"* (Pernicka et al., 2008, 346). *"The participation of scientists from the different most disciplines in connection with criminal investigations taking all aspects into account resulted in a complete network of indications for the authenticity not only of the Nebra Sky Disk, but also for the affiliation of the accompanying finds and for the unequivocal identification of the site..."*. This article concludes with a tabular overview, which weighs various arguments for the authenticity of the find complex. In the following years, however, the underlying sources were published only insufficiently or not at all. Our following article cannot solve this particular deficit. However, irrespective of the publication situation it is indeed possible, above all on the basis of sources that are more difficult to access, to take up anew and to explain the discussion about the location of the finds and their direct association, a discussion which since 2008 has been regarded as concluded.

Once again to the history and location of the find

The Nebra Sky Disk came into the hands of archaeologists only after a lapse of ca. four years after its discovery. The history of its discovery was reconstructed according to information supplied by the first buyer and the finders of the object as well as to observations of traces of damage on the disc. At the same time, prior to the initial contact with the finders, an excavation was carried out at one of the places designated by the first buyer as

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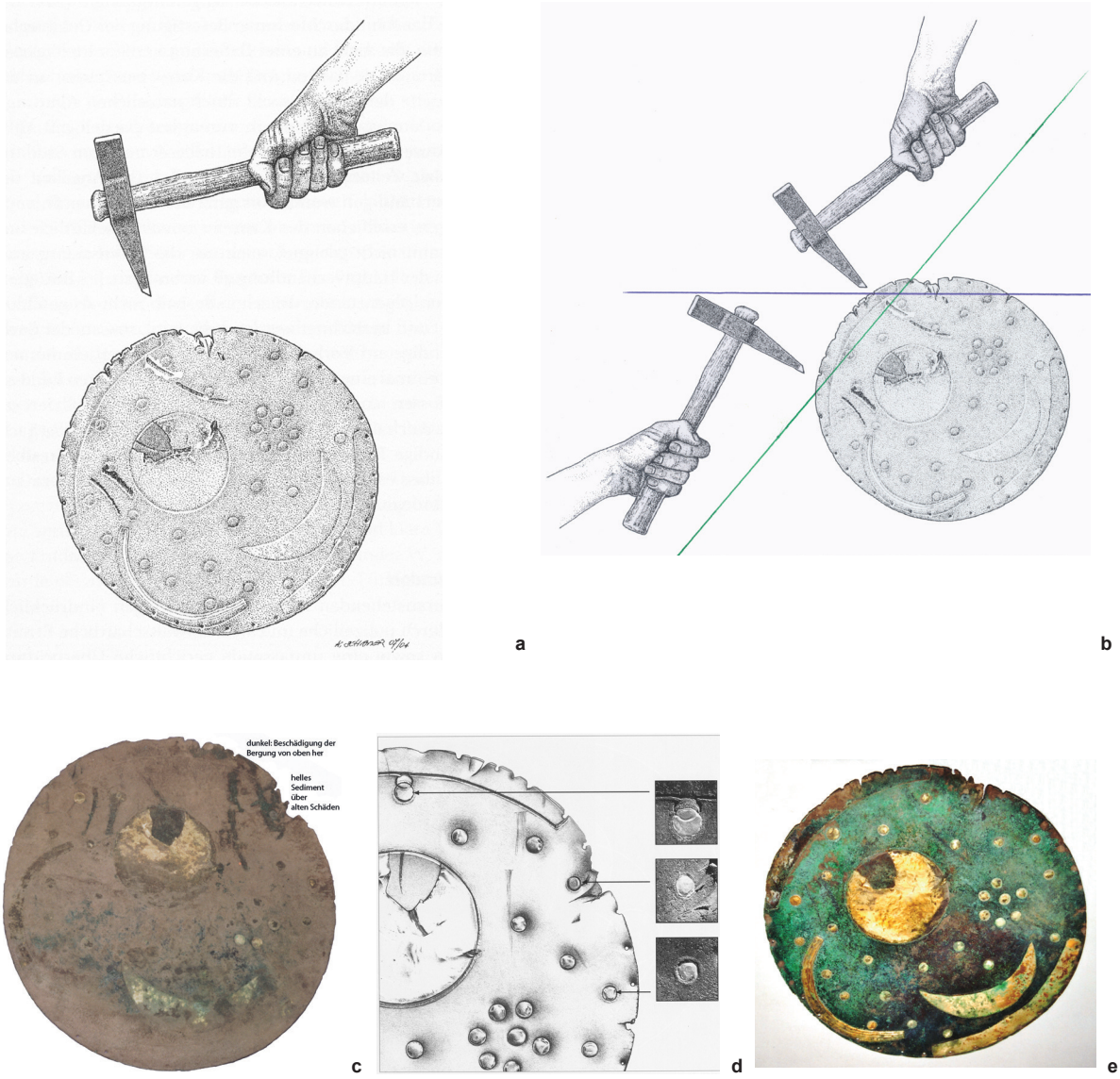


Fig. 1 Illustration of the damage to the disk caused by the illicit diggings. **a)** Interpretation by H. Meller (2004a, Fig. p. 22; 2010 Fig. 5). **b)** Direction of impact is recognisable in the traces of damage on the front side of the plate. The blue line corresponds to the position towards the ground surface, according to by Meller; the green line derives from the traces of damage. **c)** Condition assessed after salvage; alignment of the disk according to description of location (Meller, 2010, Fig. 12). **d)** Redrawing after conservation (Breuer, 2010, Fig. 3). **e)** Condition of the disk before its delivery to the Landesmuseum Halle (Photo H. Burri-Bayer). See also **Fig. 9**.

the discovery site, the Mittelberg. Although only remains of an Iron Age fortification are present on the Mittelberg, no indications of any activity on or use of the mountain during the 2nd millennium BC were detected.[1]

Original traces of diggings and damage to the disk during its retrieval

The disk was thickly encrusted with sediment when it was found (**Fig. 9**). The finder described the condition as follows: *„the green could not be recognised properly. Because there was such a strong layer of dirt – certainly two millimetres thick – on it. Really strongly encrusted“*.[2] In this crust the damages incurred by the digging tool are clearly visible as darker stripes. They are slightly curved due to the type and application of the tool. In his reconstruction of the discovery H. Meller assumes that the severe damage to the edge was at the top and, thus, he aligns the disk accordingly (**Fig. 1a**). And precisely this determined position was maintained for all future illustrations of the object.[3] However, considering

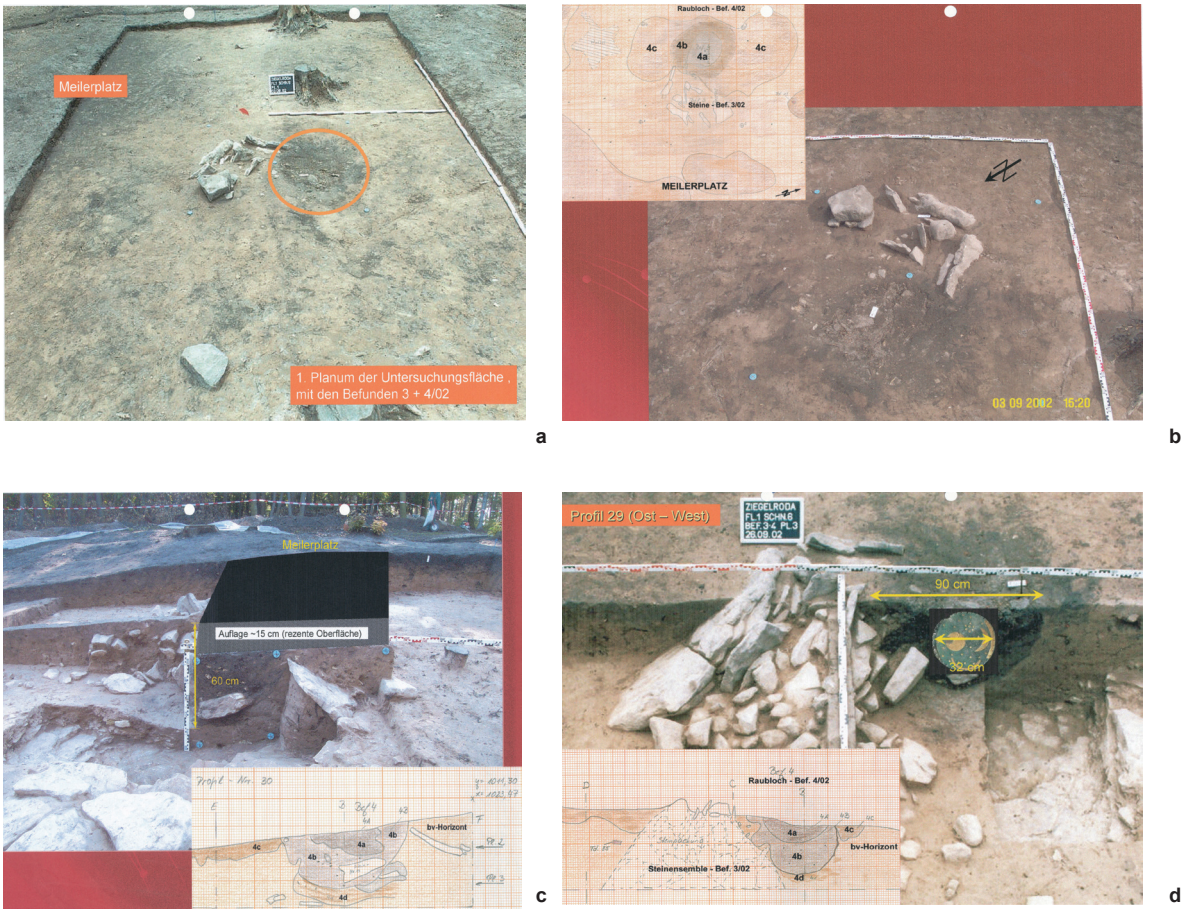


Fig. 2 Excavation of a looters' pit on the Mittelberg near Nebra. Documents for presentation at the court hearing (estate expert opinion Josef Riederer, Archiv Archäologische Staatssammlung Munich). **a)** Investigation area excavated in the first planum. At the cut edge the approx. 15 cm thick humus layer is recognizable. **b)** Planum detail. The looters' pit is clearly demarcated as a limited disturbed zone within a find context. **c)** Representation of the recent surface above the find. **d)** Projection of the sky disk into the deepest point of the find context without consideration of the supportive humus, in which according to the finders the upper part of the disk was located.

the traces left by the tool on the surface of the disk (**Fig. 1c**), this reconstructed position is not possible, because the traces on the left half of the object could only have been created from a position far below the ground surface. If the traces of damage are aligned so that they were created from above and from both sides at an equal distance from the ground surface, the disc's position upon discovery would have to be reconstructed in such a way that the missing horizon arc would be at the top and the strong traces of damage on the sides (**Fig. 1c**). This was also the position that the finders put on record in 2003. The reason for their statement was their hope that their cooperation would mitigate a reduced sentence in the ongoing trial: *„With regard to the technique of excavation, Mr. Westphal said that he had damaged only the „sun". Upon the discovery he had hit the sun with his hoe (the „sun" was at the top, according to his statements) and thereby pulled the gold sheet part diagonally upwards. In response to my question, the „finders" explained that they were sure that the sun and thus the detached horizon had lain on top. They did not find any traces of the missing horizon. It was already lost. The present damage to the edge was on the side. They explain this damage as having been caused by a tree-plough during planting or similar actions. When they removed the disk, the one gold star fell off."*[4] This statement is completely consistent with the traces of damage on the disc. In particular, it should be pointed out that the traces of damage on the edges were still covered with sediment after the disk's discovery (**Fig. 9** above). An autopsy in 2005 revealed that this part was secondarily corroded.[5] That is, the damages to the disk had been caused, on the one hand, by the discovery of the object and, on the other hand, by an unknown earlier event.

It is possible that the horizon arc was lost during that particular event. The state of publication, however, does not allow a conclusive clarification of this question, since the illustrations of the restored disk do not provide sufficient information: only a faint formation of patina can be recognised in parts of the horizon arc.[6]

In their testimonies the two finders made a second noteworthy statement, which had not been taken into account in previous interpretations. In their first statement about the find it was recorded:[7] *„Both declared that they had carefully uncovered the find, which lay about 3-5 cm below the ground surface, with their hands"*. This near-surface location of the disk is further confirmed in the same protocol by the object's rapid exposure: *„Mr. Westphal heard a signal and then began digging up the find, believing that the disk itself was the lid of a bucket, for iron bucket lids had often been found. Mr. Renner, who stood below the slope and therefore had a better view of the find, by then already uncovered a few centimetres, was of the opinion that it was made of another material and helped Mr. Westphal to* „dig up" *the find."*

The position of the disk near the ground surface was always emphasized by the finders, lastly also in a testimony by Westphal in court on June 3, 2005: *„The disk stood vertically in the ground. The upper edge 3-5 cm below the ground. Above it was only little foliage."*[8] In the year 2002 an illegal looters' pit on the Mittelberg, located inside the Old Iron Age fortification complex was investigated. According to the first buyer of the disk, it was the site where the disk had been discovered. Individual details about the excavation can be found in various places; a final excavation report has not been published so far.[9] Therefore, in the following reference must first be made to those documents that were used as illustrative material for the public hearings.[10]

The looters' pit appears as a clear disturbance within a find complex (**Fig. 2a-b**). Both views represent the condition of the first planum, which is already approx. 15 cm below the ground surface. To illustrate this, **Fig. 2c** shows schematically the 'recent' earth surface that was removed. The vertical projection of the sky disk was not 3-5 cm below the ground surface, as would correspond to the finders' description, but – to demonstrate that the disk fit into the pit – at the deepest point of the find complex. If the repeated assertion of the finders is followed, namely that the disk was discovered near the surface, then only one conclusion can be drawn from this excavation situation: one-third of the disk was embedded in a recent layer of soil. Assuming that this location is authentic, the disk would be dated as *„recent"*, like the surrounding soil layer. The second possibility, however, could be that the disk was in a secondary position upon its discovery. During the court hearings Josef Riederer already pointed out that if the disk had been lying partly in humus and partly in completely different soil, then corresponding differences in the patina should be apparent. On the contrary, the evenly thick encrustation of the disk indicates its original location in a uniform soil layer.[11]

H. Meller was knowledgeable of the near-surface position of the disk since August 26, 2003. This position has a key function with regard to both the identification of the site as well as the unity of the entire find complex. The subsequent interrogations of the finders and the scientific investigations must always be seen against the background of this initial situation. During the second court hearing on the Nebra Sky Disc, the statements of the two finders developed into opposite directions.[12] Whereas the participant M. Renner described both the place of discovery and the composition of the hoard as being made up of different finds,[13] in his rendition H. Westphal developed the history of the disc's discovery even further. Here the influence on Westphal of suggestive questions by archaeologists involved is clearly discernible,[14] while at the same time the contradictions that arise in the details cast doubt upon the credibility of the story.[15] The significance of this problem is demonstrated by the fact that in the course of the second hearing an attempt was made to dispel the resulting confusion in court, which had arisen through two very different accounts of the find's discovery and through the large number of assessments – according to H. Meller, 22 scientific expertise reports.[16]

Scientific investigations on soil samples

As is the case with the documentation of the finds, currently there is still a great deficit in the publication of the expertise assessments. The publication of results of the expert investigations on the soil samples that were announced in the *Archäologisches Korrespondenzblatt* in 2008 did not occur to date. The soil assessments[17] carried out by J. Adam, G. Borg and E. Pernicka and mentioned in court are available to the public through the documents of J. Riederer and can be evaluated accordingly. In accordance with Riederer's assessments presented in court, it can be ascertained that the expert opinions are neither suited for providing evidence for the authenticity of the find site, nor, as claimed, the archaeological unity of the ensemble of finds.[18] This

particular result was and still is perceived very diversely. In 2005 the court already went along with this assessment and formulated: "*The Chamber assumes, in accordance with the defence's request, that the soil adhesions on the disk do not prove beyond doubt that the disk actually originates from the Mittelberg*". Nonetheless the analyses remained the central element in Meller's argumentation: „*It is relevant that we can prove scientifically, basing on the soil adhesions, that the swords, the sky disk and the accompanying finds belong together. And that all this fits perfectly with the Mittelberg.*" What is indeed remarkable thereby is that the assessment by J. Adam, which is also central to the argumentation, already determined that in one case an object was not affiliated with the finds. In comparison with a soil sample from the looters' pit (VM 1), Adam examined three samples of soil adhesions on the objects: Sp 1 (0.113 g from the disc), Sp 2 (0.217 g from the tip of the sword II), Sp 3 (0.049 g from the cutting edge of the axe HK 2002:1649C). In the last sample, he found that „*compared to VM1, Sp1 and SP2, some deviations such as the finer grain formation, the absence of phyllite, lower proportions of phyllites, increased contents of garnet and anatase can be explained not only by the small amount of test material (0.049 grams). These results point rather to a neighbouring find site, or at least to a deposition in other soil layers than those of the sky disk and the sword*".

In court Adam explained this information once again, stating that the soil adhesions on the axe „*were completely different, not affiliated*".[19] Hence, on the basis of this statement, one of the axes must be excluded from the alleged find complex.[20] Consequently, all statements concerning a possible underlying „*hoard pattern*",[21] basing on the pairwise occurrence of swords, axes and arm spirals, do not apply. In addition, it should be recalled that the completely different patina on the flanged chisel points against the affiliation of this object with the other finds. Yet, already the recognition that one of the two axes cannot belong to the ensemble raises doubts about the history of the find's discovery, as provided by the finder H. Westphal in 2005 and classified as credible. It is used as an essential argument for the affiliation of the objects. This stands in contrast to the statement made by M. Renner, who was also involved in the discovery. The fact that numerous contradictions can be found in Westphal's history(s) underlines the necessity of a critical attitude towards these statements.

Scientific investigations on the objects

Since it cannot be proven that the finds belong together on the basis of the earth adhesions on the objects, the results of the analyses of the metals gain a certain significance. They indicate at least one tendency, namely, whether they are indicative of a uniform material source, or they are very diverse. The results of the bronze analyses were published by Nickel & Pernicka (2003)[22] and by Pernicka (2008; 2010). Thereby, the lead isotope analysis best identifies the underlying metal. Pernicka points out that the trace-element patterns are similar, whereas the lead isotopes are different. He concludes that the ore is from an East Alpine deposit. The differences between the lead isotopes are interpreted to mean that lead isotopes can also occur within deposits, e.g. Rudna Glava (Serbia) or the Erzgebirge.[23] Further, a very different origin of the objects could be responsible for these differences. In recent years, extensive analysis projects have succeeded in sharpening the focus on the main sources of raw copper. According to the results of the work groups of J. Lutz, Th. Stöllner and E. Pernicka, an ascription is made to the so-called „*Mitterberg copper*" results.[24] Unfortunately, these results cannot be used for the immediate evaluation of the finds from Nebra, neither concerning the question of the production region of the objects nor their dating. This problem is dealt with again below with regard to the question of archaeological interpretation. Due to the high productivity of this particular mining district, the Mitterberg copper became the standard copper in use, mainly from the 17th/16th to the 13th/12th centuries, in a large area between eastern Central Europe and Southern and Central Germany. Moreover, mining was still carried out in this district during the Late Bronze Age and in the 1st millennium BC.[25] This fundamental classification of the copper analyses can neither clarify the question of the archaeological unity of the find nor its provenance.

Nonetheless, some details should be pointed out here, which should be discussed in future investigations. The data used were first published by D. Nickel in 2003. What is striking here is a significantly increased zinc value in the disk (Zn content according to RFA: 0.1–0.2 %; Zn content according to NAA 767 ppm). This increase stands as a first deviation from the other findings (Zn content NAA mean value 35 ppm)[26] and should be discussed in future investigations. It is interesting to take a closer look at the lead isotope analyses, which also show a clear deviation in the metal of the disk (**Table 1**). In the work by Nickel, the

Tabelle A-3-7 Messergebnisse der Multikollektor-Massenspektrometrie mit induktiv gekoppeltem Plasma

Pr_Nr Objekt	Korrigierte Mittelwerte der Bleiisotopenverhältnisse $^{208}Pb/^{206}Pb$	$^{207}Pb/^{206}Pb$	$^{206}Pb/^{204}Pb$
FG-020984 Himmelsscheibe	2,1043	0,86185	18,105
FG-020678 Schwert ohne Griff (Griff mit einem fehlendem Niet)	2,0758	0,83851	18,687
FG-020680 Meißel (Metallprobe)	2,0171	0,8077	19,503
FG-020682 Randleistenbeil I	2,0321	0,80899	19,463
FG-020683 Randleistenbeil II	2,079	0,84399	18,588
FG-020685 Schwert ohne Griff	2,0434	0,82106	19,19
FG-020687 Schwert mit Griff (Griff hinten)	2,0609	0,82595	19,043
FG-020688 Schwert mit Griff (Mittelrippe)	2,0559	0,82644	19,019
FG-020692 Nietdorn I (Niet I)	2,0528	0,82543	19,035
FG-020694 Nietdorn II (Niet II)	2,0525	0,82512	19,051
FG-020695 Nietkopf III (Niet III)	2,0605	0,83122	18,88
FG-020696 Nietdorn III (Niet III)	2,0752	0,83814	18,696
FG-020698 Nietdorn mit langem Niet	2,0578	0,82923	18,934
FG-020699 Nietstift	2,020267	0,80362	19,589
FG-020701 Schwert (Griffdornkopf, Unterseite)	2,0485	0,82191	19,126
FG-020702 Spiralring	2,0734	0,8324	18,881
FG-020703 Spiralring	2,0753	0,83275	18,869

Table 1 Lead isotope values of bronze objects from the Nebra find complex after NICKEL (2003).

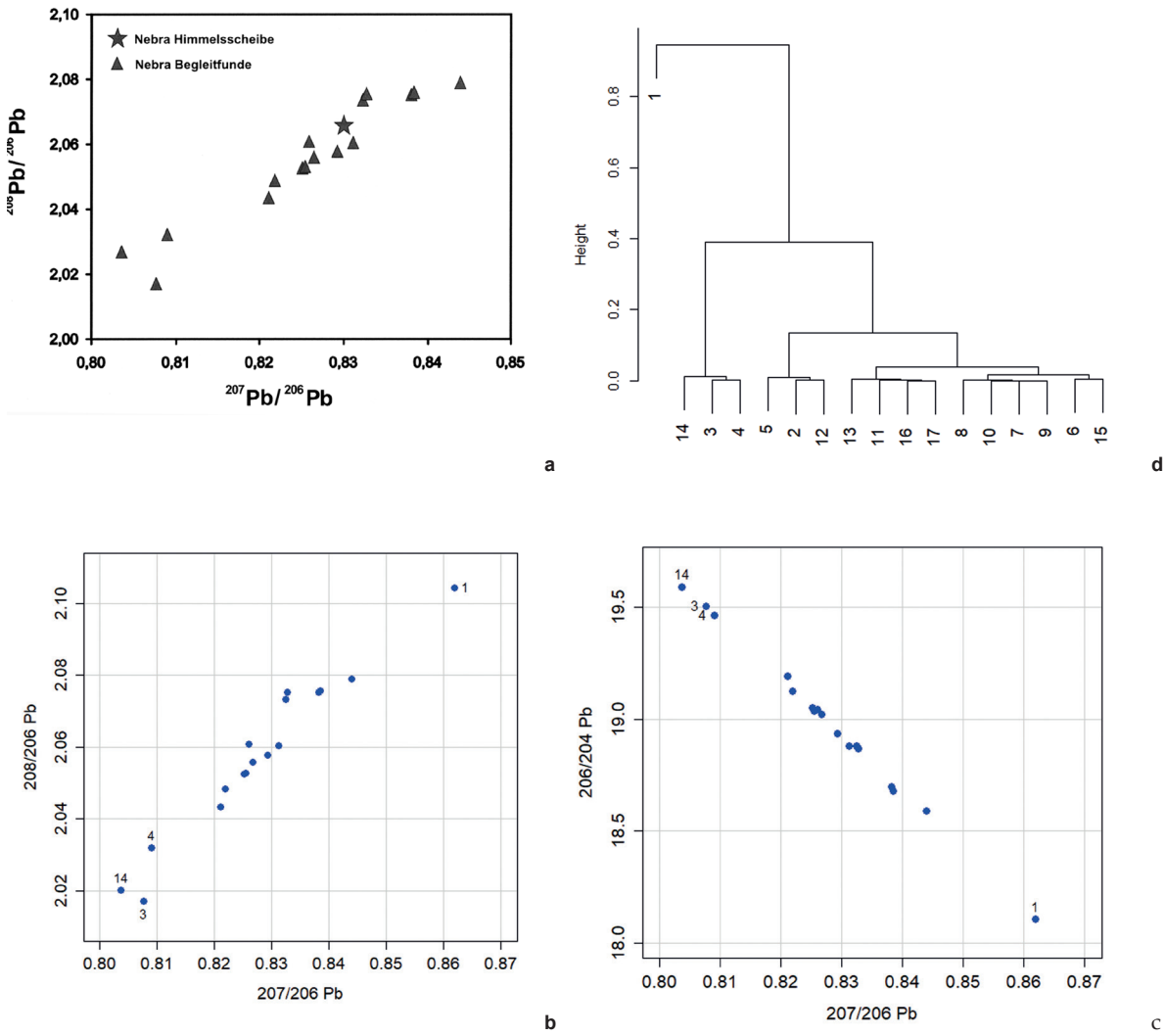


Fig. 3 Presentation of the lead isotope values of objects from the find complex Nebra. **a)** after Pernicka et. al., 2008. **b) + c)** after Nickel, 2003; **d)** dendrogram plot of a hierarchical clustering (average linkage) of the data in **Table 1** (Nickel, 2003).

corrected mean values are given for the sky disc, for the sample taken from the solid metal (sample FG-020984), which differ distinctly from the later publication by Pernicka (**Fig. 3 a, b**). Instead of designating a sample by name, only the term *„mean value"* is used, without further explanation of how this is decided. There is no doubt, of course, that the originally published values are correct, especially since the analysed sample was obtained from the non-corroded metal. Looking at the first publication, then the clear difference between the disk and the other objects is quite remarkable. Yet far more of note is that there is no recognisable connection with the other finds. The two scatter diagrams of the lead isotopes clearly show the exceptional position of the Nebra disk (**Fig. 3 b-c**). The dendrogram of a hierarchical cluster analysis (Average Linkage, Squared-Euclidian distances, n=17)[27] for the three lead isotopes shown in **Table 1**: 208Pb/206Pb, 207Pb/206Pb und 206Pb/204Pb (according to Nickel, 2003) underscores the find contexts in the scatter diagrams and displays two distinctly separate groups (**Fig. 3d**): (a) No. 3, 4 and 14; (b) No. 3, 4, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16 and 17.[28] The sky disk (No. 1) is very dissimilar to both of these groups. This picture also emerges when alternatively other reliable cluster procedures, such as the Centroid Method or Ward's Method, are applied to the analysis data, thus substantiating the stability of the group formation illustrated here (see e.g. Hair et al., 2010, 483-519; Legendre & Legendre, 2012, 337-371).[29] An association with

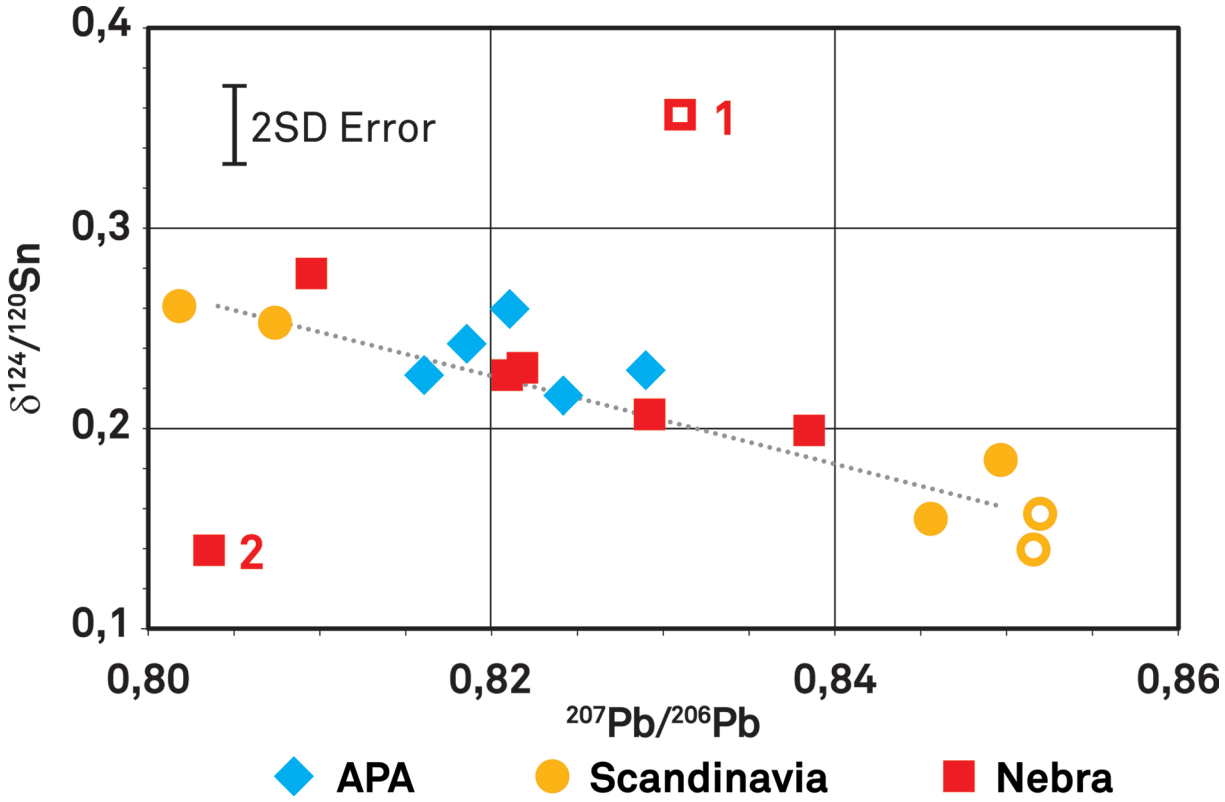


Fig. 4 Presentation of the tin isotope values of objects from Apa, Nebra and Denmark; **1)** sky disk of Nebra, **2)** chisels from the find complex in Nebra (after Brügmann et al., 2018, Fig. 2).

the other finds cannot be recognised. It is also noteworthy, however, that included among the three analyses with the lowest lead isotope values are the aforementioned flanged axe I (2002:1649c), the chisel (2002:1649b) and an unidentifiable rivet (2002:1649ag) (**Fig. 3a; Table 1**).

In addition to the lead isotopes, the use of tin isotopes seems to supply an initial indication for ascribing the alloying component tin to the tin deposits in Cornwall.[30] An extended study of artefacts was published in 2018.[31] The tin isotopes of Apa swords are characteristically negatively correlated with the lead isotopes. The analysis values of the swords from the *„hoard"* of Nebra just like other Bronze Age finds from the vicinity of the Apa swords, especially the swords of this eponymous hoard, show good agreement (**Fig. 4**). In spite of the low total number of samples, there is a tendency that a larger number of samples will be able to distinguish further groups. With regard to the investigation of lead isotopes, both the sky disk and the chisel are clearly out of place in this series of analyses.

These brief references to the results of the bronze analyses show above all that they do not indicate that the disk and the accompanying finds belong together. Likewise, there are no indications for dating. If one compares, for example, the analytical values of Nebra with the Pb isotope data of the bar-hoard from Oberding,[32] i.e. a typical Early Bronze Age hoard of raw copper, it can be seen that the copper of the Nebra disk differs in its concentrations from the variety of Early Bronze Age copper in trade (**Fig. 5**).

In addition to the copper, attempts were also made to typify the gold contents in terms of provenance and dating.[33] The possible tendency of an origin from Cornwall would be tempting from an archaeological point of view, considering the rich Early Bronze Age finds made there. However, this thought must be viewed critically.[34] And since the gold mining in the region is not limited to specific epochs, these investigations do not answer the questions posed here in the beginning.

Archaeological and astronomical interpretations

The origin of interpretations of the disk and the accompanying finds was marked by a rapid pop-

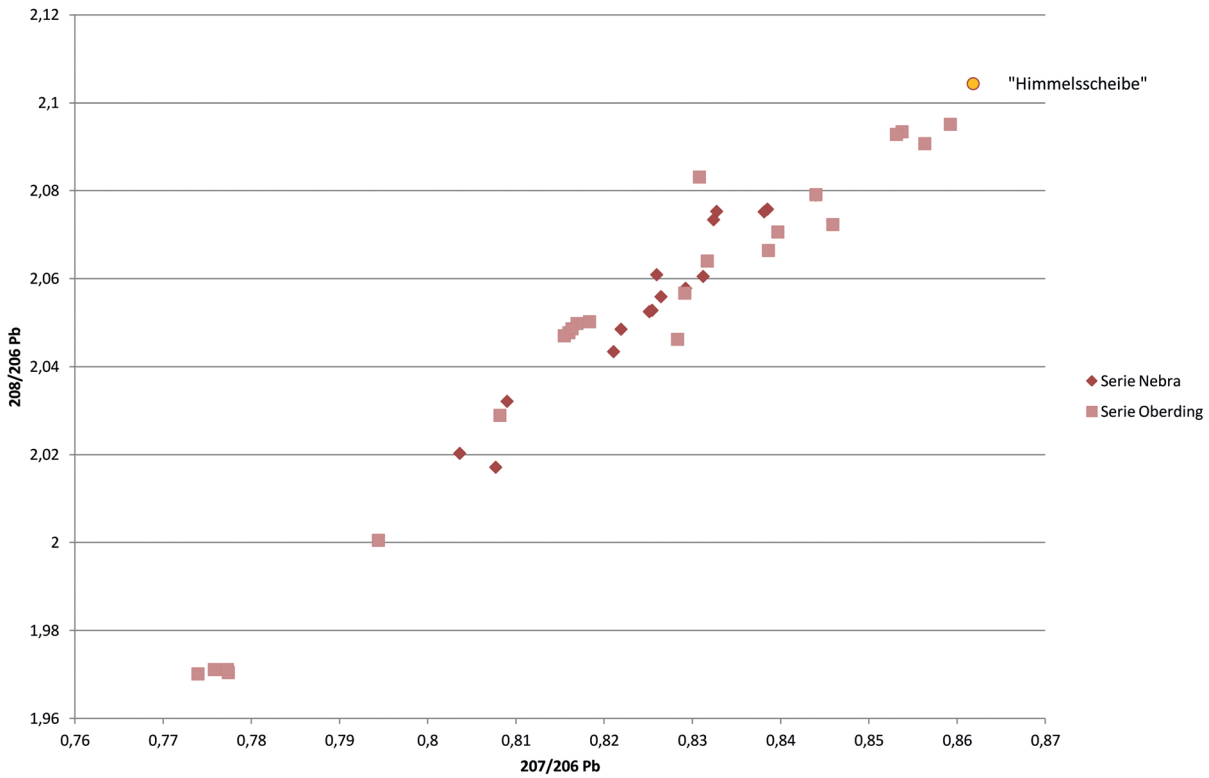


Fig. 5 Presentation of the lead isotope values of objects from the find complex Nebra. After Nickel (2003) and Pernicka (2017).

ular presentation, whereas the underlying scientific analyses and publications took place later. Deficits in publications – for example, the publication of all finds in catalogue form was never carried out – makes critical analysis and evaluation of the objects difficult until today. The first determinations about the affiliation and dating of the finds were already made in 2001, basing upon the photographs that were known at that time, but without an archaeologist having seen the originals beforehand.[35] This was already apparent in 1999, when photographs of the finds were first made known by Prof. W. Menghin, Director of the Museum für Vor- und Frühgeschichte in Berlin.[36] The only person who was actually acquainted with the original finds at that time was an art dealer, who had directly sent his assessments to the Berlin Museum. The decisive factor for this contact was surely that the art dealer had sold the so-called *„Berlin Gold Hat“* to the museum a few years before, and, thus, wished to offer an object with the potential interpretation of being an astronomical calendar.

The succession in which the initially rough estimation was followed by a broadly popular presentation, while an exact scientific analysis was undertaken only in a second step, led to various misinterpretations, some of which still hold today.[37] Obvious errors in the first publication, such as the hasty interpretation of an original deposition of the finds in a stone box, were revised. Of the many aspects about the Nebra disc, only the interpretation concerning the change in its decoration is presented here. The first publication on the production phases of the disk appeared in 2004 in the catalogue of the exhibition *„The Forged Sky“*.[38] Theories on the history of religion already proposed there were presented in detail in 2010, a summary of which is shown here in **Fig. 6**. Thereby, the postulated period of the use of the disk appears to play a central role, serving foremost to establish a reference to known Early Bronze Age social structures, in particular to the formative phases of a central *„elite“*. Since no corresponding structures are known in the region of the discovery of the Nebra disk during the period of its deposition, as suggested by the accompanying finds (around 1600 BC/16th century BC), the earliest plausible time of origin seems to be *„the beginning of the 2nd millennium, the time of the Central German so-called ‘princely graves’. It was in this epoch that for the first time technical and social conditions existed, which enabled the production of a complex piece of work like the sky disc. The maximum length of use-life*

ca. 18. Jh. v. Chr.

Phase I

The initial image on the Sky Disc was crafted by inlaying gold in the lustrous surface of the disc. It consisted of 32 stars, a crescent moon, and the full moon/sun, and is at first glance a deceptively simple composition. The stars are evenly distributed over the disc to represent the firmament. A cluster of seven stars which represent the Pleiades are the exception. These were already known in antiquity as calendar stars. They disappear on 10 March each year and re-emerge on 17 October, making it possible to calibrate the solar year.

ca. erste Hälfte 17. Jh. v. Chr.

Phase II

The Sky Disc fell into new hands and the original image was altered. Its new owners removed two stars and displaced another, while placing two horizon arcs on opposite edges of the disc. The size of the two arcs corresponds to the 82.5° of the horizon traversed by the sun between the summer and winter solstices. The slight shift of the arcs towards the top of the disc allows us to identify the upper rim as north and the lower as south. Thus, the crescent lies in the west, and the firmament is shown as if one was looking upwards, as in modern star maps. All of this points to the existence of the concept of the heaven as a hemispherical dome more than a millennium before Thales of Miletus.

ca. Mitte 17. Jh. v. Chr.

Phase III

A feathered sky ship is fitted to the lower rim of the Disc. Such ships appeared as a religious symbol in the Scandinavian Bronze Age around 1600 BC. Its appearance on the Disc alludes to a new mythology which envisaged a boat transporting the sun by day and night. This iconographic shift indicates a radical change in the role of the Disc. It stopped being the bearer of knowledge and instead became an emblem of a new religion. It may be that the Sky Disc was now viewed by a larger public, but the owner who transformed its iconography must have belonged to the ruling elite.

ca. Ende 17. Jh. v. Chr.

Phase IV

The entire rim of the Disc was crudely perforated, damaging both the boat and the horizon arcs. The perforations were used to mount the Disc on an organic backing, possibly a standard, partially covering the motifs at the edge of the Disc, thus making them unreadable. The new religion had failed, and the Disc now served simply as a solar disc, a motif known in the whole of Bronze Age central Europe. It is probable that like the standards shown on Bronze Age Scandinavian rock art the sun disc standard was paraded in public.

ca. erste Hälfte 16. Jh. v. Chr.

Phase V

In a final ceremonial act, the Disc was irrevocably removed from circulation and deposited in the earth on the summit of the Mittelberg hill. During this process the left horizon arc was ripped off making the Disc unusable. The precious double weapon assemblage which accompanied the Disc is a typical feature of local princely tombs. Thus, the Sky Disc represents the absent body of its last princely owner.

Fig. 6 The five phases of development of the Sky Disc imagery, as published in: Meller, H. (2013). The Sky Disc of Nebra. In H. Fokkens & A. Harding (eds), *The Oxford Handbook of the European Bronze Age.* (p. 266–269, fig. 14.A2). Oxford: Oxford University Press: *"Three types of gold were used for the inlays of the Disc. The horizon arcs and the displaced star (phase II) as well as the boat (phase III) were made of a different type of gold than the original sun, moon, and stars. The perforation of the Disc's rim damaged the earlier inlays. The 'eastern' arc was probably torn off as part of the deposition ritual (phase V). © Landesamt für Denkmalpflege and Archäologie, Sachsen-Anhalt."* The description of the five phases within the figure above is an exact citation from fig. 14:A2 in this article.

The description of phase I is further explained as: *"A far more significant event was probably the conjunction between their springtime disappearance and the 4.5 day-old crescent moon shown on the Disc. If this happened, the specialists who maintained the type of luni-solar calendar that was then current in the Near East inserted a leap month in order to adjust the shorter lunar to the longer solar year. Moreover, if the course of the moon runs above the Pleiades rather than, as usual, below, a lunar eclipse could be predicted in eight days time, something of no inconsiderable value for prehistoric people. The 32 stars probably stand for the 32 days which elapsed from the first light of the previous month and the conjunction of Pleiades and crescent moon. The sophistication necessary to design and understand the Disc's initial imagery was the result of widespread commercial and ideological contacts, and the emergence of a central European elite at the beginning of the Bronze Age. The patron who commissioned the Disc, and those who understood its meaning, must have belonged to the topmost group of this elite, who were buried in ostentatious barrows such as those in nearby Leubingen and Helmsdorf. The East Alpine copper used to make the Disc became available in the mid-eighteenth century BC, thus indicating the earliest period during which the Disc could have been created."*

would therefore have been ca. 400 years, the minimum length – ca. 100 years."[39] The 100 years are postulated in view of the time during which the accompanying finds were in circulation.

In 2010 the first phase of the disk was dated to the beginning of copper mining in the Mitterberg region (Gem. St. Johann im Pongau, Land Salzburg), *„because according to Pernicka's analyses the copper of the sky disk originates from the Mitterberg"*.[40] Thereby, an older age of origin was kept as a possibility: *„According to these considerations, the beginning of the development of the Mitterberg copper and, thus, the production of the sky disk would have to be dated at the earliest to the 18th century BC, i.e. between 1750 and 1700 BC, whereby – as already noted – an earlier beginning of mining cannot be ruled out, in view of the methodical procedure and the current state of research"*.[41]

However, an *„indirect"* dating approach of the disk through metal analysis should be criticized methodically for two reasons. Firstly, as stated above, there are doubts as to whether the copper of the accompanying finds and the disk can be attributed to the same ore source. Progress can perhaps be made here through in-depth studies. Basically, analyses of this so-called East Alpine copper indicate, however, that it will be hardly possible to achieve detailed results here. The designation *"East Alpine copper"* derives from Richard Pittioni's work group,[42] and summarises the many types of fahlerz copper, which contain lower amounts of the trace elements nickel (Ni), arsenic (As) and antimony (Sb). Depending on the proportion or concentration of trace elements, which can vary slightly in an order of magnitude, different groups or variants can be identified which represent a large part of the Stuttgart database[43] and are difficult to classify chronologically, especially the Early Bronze Age. Depending on how the limit values for the individual elements are selected for a search run in this database, quite different groups can be generated. Furthermore, considering the map images of its distribution on the basis of the great variability of this copper,[44] one should become aware of the wide distribution of the groups of the so-called East Alpine copper between southern France and the Carpathian Basin in the South and southern Scandinavia in the North.

The problems related to this wide geographical dispersion lead to the second point, the length of use-life of these alpine ore deposits. An estimation for the Mitterberg area shows that following the initial phase (19th/18th-16th century BC), mining flourished there during the 15th–13th centuries BC, but also mining clearly continued from the 12th century BC into the Early Iron Age.[45] There is a lack of comparable studies on the younger Iron Age. Due to the many hundreds of years of exploitation of the same copper deposits, it is not possible to deduce a dating of the artefacts from the geochemical composition of the copper.

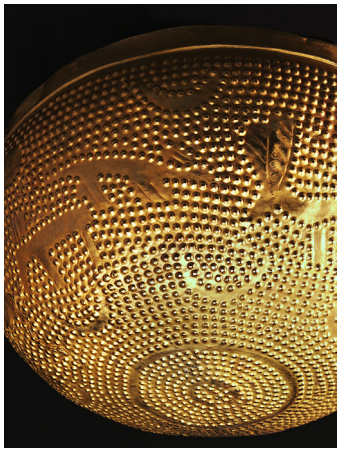
Returning to the history of the object, the changes could have been made by the same craftsman within only a short time or a few years. One could argue that all changes were made employing the same technique. This would be equally possible, but just as little to be necessarily expected.

The example of the history of the Nebra Sky Disk reveals an underlying dilemma. Its postulated astronomical interpretation[46] always raises the question of the social, cultural and scientific environment of the time, a setting that must meet a correspondingly high standard. Since such structures are lacking for the time of its potential deposition, they must be reconstructed by means of long dating ranges, etc. in such a way that they can be used as a basis for recreating an astronomical environment. This idea is already included in the first exhibition catalogue (Meller, 2004b), entitled *„The Body of the King"*. Therein Meller alludes to the princely tomb of Leubingen (ca. 1942 ± 10 BC) with regard to the similar decoration pattern: *„In Nebra, the sky disk takes the place of the corpse with his golden costume. Princely graves are not documented for the time around 1600 BC. Assuming the structural similarity of the finds from Nebra and Leubingen, one comes to the conclusion that the hoard must be regarded as a continuation of the princely tombs"*.[47]

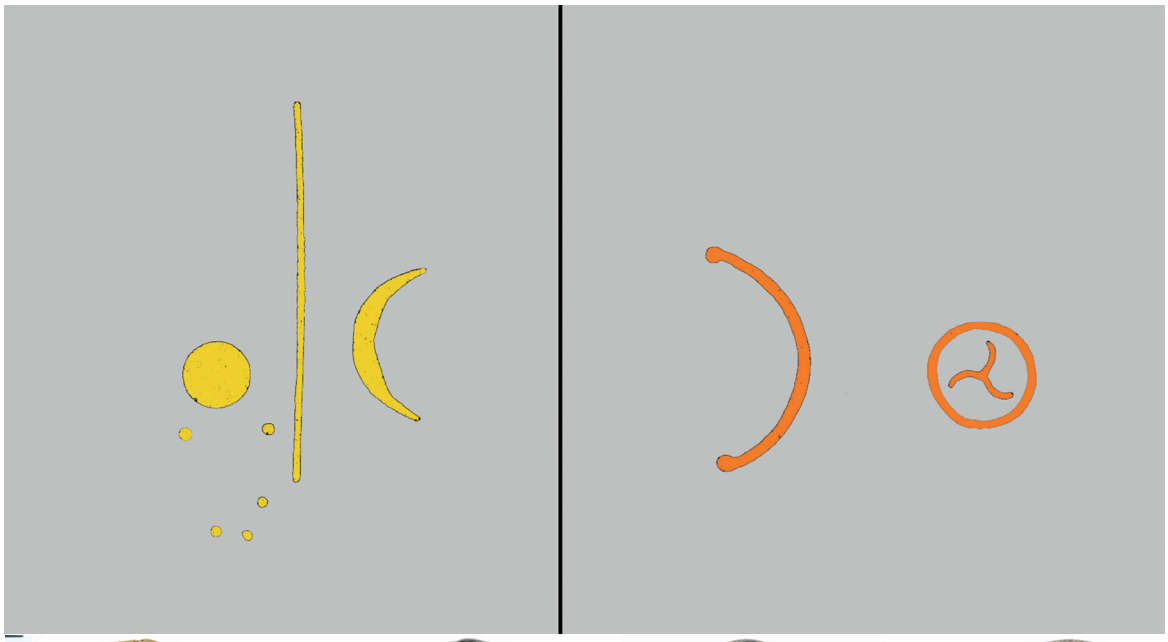
From an archaeological point of view, this construct would be a singular example for which no comparisons could be made. The pattern of funerary furnishings would not be appropriate either, since at this high social level the appropriate equipment, a specially made ensemble of correspondingly outstanding quality, would certainly have been available. Here the two different axes, one of which is conspicuous owing to the severe damage to the cutting edge already in antiquity, and the single chisel (without any other *„metallurgical equipment"*) seem just as randomly chosen as the arm spirals, which as a pair in a grave find would rather be indicative of the burial of a female.

The preceding considerations have concentrated foremost on the archaeological association of the entire find ensemble and come to the result that the existence of a *"closed find"* in the sense of Oskar Montelius can hardly be proven. On this basis, the disk would have to be evaluated and considered as an individual find. As a category of objects, similar large bronze discs are attes-

a



b



c

d e f g

Fig. 7 a)-b) Gold bowl from Zurich Altstetten (photo Swiss National Museum Zurich); **c)** Motifs on the sword of Allach-Untermenzing, 5th century (Gebhard & Krause, 2016 Fig. 4); **d)** Celtic gold coin of the 2nd century BC. Sontheim, dist. Unterallgäu (State Archaeological Collection MK-K3273); **e)** Neuses, quinarius (State Archaeological Collection MK-K 1277); **f)** Neuses, quinarius (State Archaeological Collection MK-K 1245); **g)** Albstadt, rainbow cup (State Archaeological Collection MK-K 1422 d).

ted predominantly in the field of ethnology, for example in Siberia as so-called *"shaman mirrors"* (also with perforations at the edges) or as parts of metal drums (kettle gongs). The two objects of Balkåkra (Gem. Ystads, Skåne, Sweden) and Haschendorf (Gem. Neckenmarkt, Bez. Oberpullendorf, Burgenland) can be named as comparable, possibly musical, instruments in the archaeological collection.[48] This simple basic form, however, does not suffice to make a valid argument here.

Thus, in the omission of a possible classification by means of metal composition analyses, only the iconography remains as an evaluative criterion for culture-historical classification. The common interpretation is that the representation on the disk would reflect complicated astronomical phenomena. Their understanding is based on the existence of a social structure that formed a kind of *„kingdom"* (Meller & Michel, 2018).

The astronomical interpretation of the disk was convincingly contradicted from different sides with good arguments. Since 2007, Emília Pásztor and Curt Roslund have been able to show that the *„stars"* depicted on the disk are evenly distributed and do not represent a concrete image of the sky.[49] Compared with ethnographic examples, the authors emphasize an underlying mythological, shamanistic world of thought, indeed, almost the opposite of a concrete astronomical interpretation.

Iconographically, the type of representation *„Sun, Moon and Stars"* is plenteously attested throughout time, from antiquity to modern times. Especially in the Middle Ages there are some very similar representations, which show the sun and the moon as the divine celestial bodies.[50] In antiquity they were the symbols of power of Roman emperors; in the Middle Ages they underline in this tradition the dominion of Christ over the cosmos by day and by night.[51] At first glance, the depictions seem astonishingly similar to the disk of Nebra. One difference, however, can be seen in the representation of the sun, which is always marked by distinct rays. This characteristic is absent in Nebra. In previous publications the feature is not clearly defined as "sun" or "full moon", which is why the interpretation of the golden circular disk as representing a full moon should be further investigated.[52]

Celestial conceptions in the first millennium BC

It was already pointed out above that in addition to the medieval and the ethnographic examples of mythical representations of celestial bodies and celestial phenomena, the iconography of the first millennium BC offers a directly comparable approach.[53] This world of imagery, which handed down foremost in Celtic settlement areas, is based on complex myths and beliefs, which developed as a multi-layered religion throughout the first millennium in Central Europe and in the Late Iron Age. It can be circumscribed above all by traditions of Gallo-Roman times; yet despite many pertinent studies, it is only rudimentarily understood.[54]

One of the oldest examples of the motif *„sun/full moon and moon"* to name here, is that on the Late Bronze Age bowl from Zurich Altstetten (**Fig. 7 a–b**). In this context the knob decoration on the surface can be interpreted as a *„starry sky"*. Also noteworthy are the *„sun/full moon and moon"* motifs and the single arcs on the bottom of the bowl.

The short sword from Allach, pointed out here as an example for the entire category, shows – aside from the identical pictorial program of *„sun/full moon, crescent moon and stars"* on the reverse side – also the element of a flat arc emphasized at both ends (**Fig. 7c**).[55] The wide opening and flat curvature of this arc – referred to in the following as *„celestial arc"* – eliminate it as being the concrete representation of a *„torque"*.[56] The complex symbolism, which itself deserves an individual study in view of the numerous attestations of these motifs, above all on Celtic coins, will be briefly sketched in the following. Thereby, the question must also be posed as to whether the ambiguity of the motif [sun/full moon] can always be clarified in individual cases. The depiction together with stars and crescent moon render probable, at least in the case of the sword from Allach, that rather the representation of nocturnal events is meant.

The connections become clearer when considering the images on Celtic coins of the second and first century BC. On the small "rainbow cups" there are both wide open arcs with spheres below in the form of the *„Sky Arc"* in Allach (**Fig. 7d**),[57] as well as arcs that are more closed, which could be called the representation of torques. The distinction between *„celestial arc"* and "torque" seems apparent despite the similarity of the motifs, since, for example, in Bohemian coinage, both motifs can appear on the same object.[58] The fact that the interpretation of the abstract motifs is quite complex and often does not permit a clear interpretation in individual cases may be due to the production of the coins. Usually, the motifs on the coins are viewed as an ever more abstract development of the original models, such as the further development of the Biga. Recognisable in coin images is that the *„sky arcs"* do not mean the representation of a *„torque"*. For example, quinarii decorated with a stylised human head (Büschelquinare) contained in the coin treasure from Neuses a.d. Regnitz (Gem. Eggolsheim, Upper Franconia) can be cited here (**Fig. 7e-f**).[59] There the slightly curved arc with spherical ends appears in combination with a large dot below, whereas one variant also displays an arc formed by seven dots. Both variants differ clearly from a *„torque"* representation. The small rainbow

cups in the depot of Albstadt (Gem. Alzenau, Lkr. Aschaffenburg, Lower Franconia) display the peculiarity that the arc is rendered in a zigzag line (**Fig. 7g**).[60] Together with the elements from the interior, the spherical ends form a line, which in turn runs above a serrated baseline. The brief description of these associations shows that the celestial symbols upon the sword of Allach were common knowledge that had been understood over a long period of time.

The fact that motifs of the night with stars and the moon crescent are extremely frequent in the Late Iron Age seems particularly remarkable, and at the same time this is proven by historical sources as well.[61] In essence they describe – in addition to the continuing sun symbolism[62] – above all the symbols of the night, which played a special role in the ancestral history of the Celts and therefore are present in the Celtic lunisolar calendar, too. Accordingly, the representation of time on the calendar of Coligny (Dép. Ain, Reg. Auvergne-Rhône-Alpes) begins with the winter half-year, and the months are divided into a dark and a bright half.[63] It would therefore be logical to view the circular disk on the sword of Allach as a bright full moon rather than a sun. The Celtic celestial symbolism found on numerous everyday objects was for its beholders a well-known part of a very complex mythological world view, which is only vaguely known to us through written sources. It is the result of the manifold cultural history of the first millennium BC, which is characterized by strong Mediterranean influences and shows socio-cultural phenomena similar to advanced civilizations, especially in the Iron Age through the development of settlement centres. The realistic depictions at the end of the 1st millennium BC, outstandingly preserved on the Gundestrup cauldron, also fit into this tradition. Depicted there is a figure with deer antlers, which mark it as not being a human being, who presents a torque in the right hand and a horned serpent (*„ram stroke"*) in the left hand.[64] There is unanimous agreement that the god Cernunnos is depicted here, a deity who is also connected with the narrative of Celtic ancestry of Dis Pater, in analogy to Julius Caesar. This ancestral history of a *„nocturnal/sky"* god corresponds with the choice of the symbol of a snake (*„earth/night"*) and the opposite of the torque (*„arch of heaven"*): that is, "night" from sunset to sunrise and "day" from sunrise to sunset.[65]

Summarizing these brief explanations, *„Sun/Full Moon, Stars, Moon"* in connection with *„Celestial Arcs"* belong to the widespread symbolic material of the first millennium BC, with a clear emphasis in the Late Hallstatt and Latène periods. In view of their frequent occurrence on coins, the motifs seem to be concentrated in the Celtic area, but examples in the zone north of the low mountain range can also be noted, i.e. the discovery area of the Nebra Sky Disc. This zone is characterised by the fact that during the first millennium both the material culture, such as fibula forms, as well as motifs from the *„Celtic"* area were adapted. It should be mentioned, also with regard to the noticeably simple craftsmanship of the *„Himmelsscheibe"*, that there is a remarkable difference in the quality of design throughout. A typical example of the adoption of individual motifs are the decorations on the Holstein belts (**Fig. 8**).[66] These combine most of the aforementioned elements: serpents, arches with spherical ends, arcs with different numbers of dots below, encircled knobs with a corona (sun symbols), as well as half-arches with external dashes. Whether these motifs carried the same meaning in the North as in the *„Celtic"* area cannot be deduced, but the peripheral position of a singular object like the Gundestrup cauldron shows that this cannot be entirely excluded.

Considering this symbolic material, which emerged after the cultural break at the beginning of the Urnfield period, in comparison with the Early Bronze Age trove of motifs, a clear contradiction emerges. Wolfgang David already pointed out that the disk of Nebra would appear as a completely foreign body in the symbolic material of that time.[67] It is also noteworthy that the abstract representation of the sun is in the foreground in the pictorial programmes used from the advanced and late 2nd millennium BC, with motifs such as bird barks with suns, sun chariots and the Nordic *„sun ship"*,[68] or the predominant circle decoration on gold objects.[69] The symbols on the sky disk of Nebra, oppositely, appear as a nocturnal-oriented subject, thus corresponding to the cultural environment of the 1st millennium BC. At this point, the contribution to the discussion of the disk by Paul Gleirscher should be recalled, who in 2007 discussed the arc symbol on the disk as a representation of a sickle and at the same time pointed out that in view of the unclear conditions of the disc's discovery a Late Bronze Age dating is quite conceivable.[70] At the same time Gleirscher reminded of the lunar reference of sickles and quoted B. Hänsel, who viewed these as attributes of a night or moon deity.[71] This closes the circle to the above-mentioned early Latène swords, whose lunar circle reference emphasized by the full and crescent moon[72] directly links the Nebra Sky Disk.

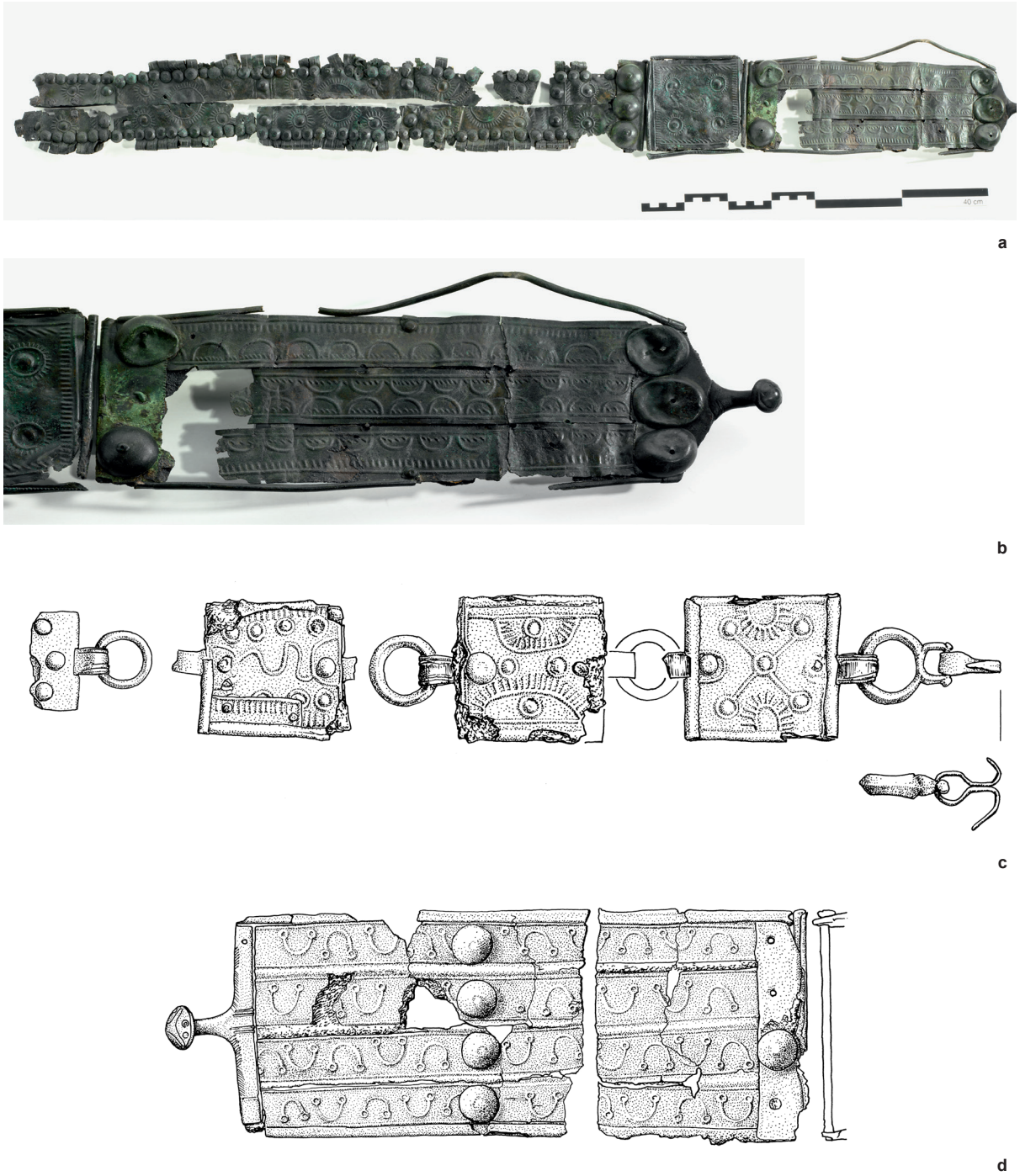


Fig. 8 The symbolic repertoire of the so-called *"Holsteiner Gürtel"* adopts and combines motifs of the Celtic area. **a)-b)** Hamburg-Altengamme, on the right in the picture; **c)** Hornbeck Grave 709, Duchy of Lauenburg. **d)** Malente, Kr. Ostholstein. All photos not in a fixed scale. – (a Photo Archäologisches Museum Hamburg; b Heynowski, 2017, p. 182; c Heynowski 2017, p. 184).

Conclusions

In the previous considerations it could be shown that since the last article in the *Archäologisches Korrespondenzblatt* in 2008 a divergent interpretation of the disk and its accompanying finds can and must be justified. The differences result from the following arguments:

1. The near-surface discovery of the disk speaks against its *in situ* location, which at the same time places the affiliation with the accompanying finds in question.

Fig. 9 Above: The Nebra sky disk. Below: Bronze Age swords, axes and armor allegedly found together with the Nebra Sky Disk. Condition before the finds were handed over to the Landesmuseum Halle. The correspondence of the photos with the originals was notarized on 25.1.2002. Photo: Hildegard Burri-Bayer.

2. Neither the analyses of the remaining soil adhesions nor the geochemical analyses of the metals (copper, gold) support a possible coherence of the finds.
3. According to the court expertise report, in view of the analysis of soil remains, one of the axes should be regarded as not belonging to the find complex. This statement is further confirmed by the metal analyses.
4. The chisel must also be regarded as not belonging to this find complex.

Hence, it must be concluded that the objects involved cannot and do not represent a "*closed find*".

Two conceivable scenarios for the discovery of the Nebra disk result from the analyses of the find situation, as specified in the following:

(A) The disk was found on the Mittelberg in the humus area directly below the ground surface, because it was already there in a secondary position. This complies with the older traces of damage and the description of the discovery of the disk by the finders. A secondary position such as this excludes the unity of the entire find. The disk would thus be a single find within an Iron Age fortification.

(B) The disk was found at a different site than the place investigated, directly below the surface, in a uniform sediment. The older damage occurred *in situ* without the object being displaced substantially from its original location. An affiliation of further finds, insofar as these cannot be excluded (as is the case with the axe), would be possible. Since the archaeological association of the finds cannot be analytically proven, and since this scenario does not correspond to the „*valid*" history of discovery provided by the finders, the unity of the find is not substantiated.

In both scenarios, the disk must be regarded as an individual object in itself with regard to dating, whereby it should be noted that no comparable symbolic material can be drawn forth for its classification in the Central European Early Bronze Age.[73] Far more, if the origin from the Mittelberg could be confirmed, a dating also within the context of the Iron Age fortification as well as in the iconography would be obvious. Thus, the construct presented so far would lack meaning and function on any basis.

These concluding remarks are intended to make clear in summary that the interpretation presented here could only make use of accessible sources. However, the state of documentation is frequently incomplete. Many details could be presented even more precisely if the necessary sources, from the restoration reports to the publication of all scientific analyses, were better accessible. It is to be hoped that this will still take place and that a factual publication of the find will appear for use for further scientific analysis, inasmuch as the meanwhile exuberant interpretative and mythological publication on the disk is already far removed from the principles of serious scientific presentation and optimal communication to the public.[74] The terminology used, such as „*kingdoms*", „*armies*" or „*first state*", has long left the real foundations of archaeological and culture-historical research.[75] In any case, this form of mediation does not serve to convey a consistent historical picture of a prehistoric epoch to the public.

Background of the manuscript until its printing

The manuscript published here was submitted to the journal *Archäologisches Korrespondenzblatt*, RGMZ in Mainz (Germany) on November 8, 2018, where it was initially accepted. We (the authors) chose this journal, because it was the place of the first discussion on this theme in 2005 (Schauer, 2005), and also the place in which was later announced (2008) that in short all natural scientific and archaeological data would be presented there in monographic form (Pernicka et al., 2008). The publication of these data has not occurred to this day. Our (the authors) manuscript has gone through the usual review process and was evaluated by several peer reviewers, who are competent in the areas of the Bronze Age, Iron Age and Archaeometry. The results of the review process were communicated to the authors, considered and applied most of the comments. Thereby, some remarks on natural scientific aspects of the manuscript were quite scientific resembling analytical discourse, which the authors intended to pursue in a research group, but after publication of the manuscript. This reasoning did not meet with complete consensus of reviewers. The final version of the manuscript was submitted to the editor on August 9, 2019; no further action for publication was undertaken. At the same time the directorship of the RGZM changed. A new decision about publication of the manuscript led the new editor to request a further summarising assessment of the manuscript, but to be carried out by members of the RGZM. This group was in favour of publication. Nonetheless, no preparations were initiated; the manuscript was left undone. After months-long waiting the authors decided to withdraw the manuscript from publication in the *Archäologisches Korrespondenzblatt* and instead submit it to *Archäo-*

logische Informationen. The authors are very grateful for all the ideas, suggestions and comments given by peer reviewers. The fact that no general consensus can be drawn from the many reviews lies in the polarising theme itself as well as in the deficit of publications, even after 20 years.

Translation: Emily Schalk, Berlin

Notes

[1] Meller, 2010, 36-39. A final report on the excavation has not been submitted to this day.

[2] Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt (2006). *Fundort Mittelberg: Der Finder sagt aus.* (Video, 13:01 min). http://www.lda-lsa.de/filme/die_himmelsscheibe_von_nebra/fundort_mittelberg/ [14.10.2018].

[3] First maintained by Meller, 2002, S. 9, Fig. 2.

[4] *"In Bezug auf die Technik der Ausgrabung sagte Herr Westphal, er hätte nur die „Sonne" beschädigt. Hier hätte er bei Auffindung (die „Sonne" lag seinen Angaben nach oben) mit der Hacke auf die Sonne geschlagen und das Goldblechteil schräg nach oben weggezogen. Auf meine Nachfrage erklärten die „Finder", dass sie sich sicher seien, dass die Sonne und damit der abgefallene Horizont oben gelegen hätten. Von dem fehlenden Horizont hätten sie keine Spuren gefunden. Er sei schon weg gewesen. Die jetzige Randbeschädigung hätte sich seitlich befunden. Sie erklären sich diese Randbeschädigung aus Verletzungen durch einen Baumpflug beim Anpflanzen oder ähnlichem. Beim Herausnehmen sei der sich dort befindliche lose Goldstern abgefallen"*. Protocol about the site and situation of the discovery of the Sky Disk of Nebra August 26, 2003. Law firm Prof. Dr. Müller. Participant Prof. Dr. Müller, lawyer Buchholz, finders of the disk Mr. Westphal und Mr. Renner, and Dr. H. Meller, A. Flügel. Protocol by Dr. H. Meller, countersigned by A. Flügel.

[5] Investigation protocol by R. Gebhard on June 7-8, 2005 (documentation: Archäologische Staatssammlung München): The damages to the edges do not show 'fresh metal'. Traces of patina are in the darker dents and scratches; crystal is distinctly visible on one raised splinter on the splintered inner side. (*„Die Beschädigungen am Rand sind nicht metallfrisch. In den starken Dellen und Kratzern gibt es Patinaspuren, an einem „abgehobenen"* Span deutlich ausgeprägtes Kristall auf der abgespannten Innenseite.").

[6] This zone is quite recognisable in the lower left page for the month of April in the *Archäologischer Kalender Sachsen Anhalt* 2005 (ISBN 3-910019-79-2). An interpretation basing upon the images is difficult, because in the course of preserving the disk, especially the reverse side, soil residues were hardened as well, and the patina became completely detached in places from the underlying surface.

[7] In this protocol Meller (2010) presented the 'contents', in which he omits the details discussed here.

[8] Gebhard & Krause, 2016, 27. Hearing protocol RA Thommen.

[9] Gebhard & Krause, 2016, 29-31; Pernicka u.a., 2008, 342-346; Meller, 2010, 36-39.

[10] The documentation was given to the author by Prof. Josef Riederer (†) in 2016. They were placed at his disposal for the purpose of making the geological assessment.

[11] Gebhard & Krause, 2016, 40.

[12] Gebhard & Krause, 2016, 27-28.

[13] Renner, 2005, 15-22.

[14] Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt (2006). *Fundort Mittelberg: Der Finder der Himmelsscheibe sagt aus* (Video, 13:01 min). https://www.lda-lsa.de/filme/die_himmelsscheibe_von_nebra/fundort_mittelberg/ [9.6.2020].

[15] Gebhard & Krause, 2016, 29.

[16] J. Riederer, in Gebhard & Krause, 2016, 308.

[17] Pernicka u.a., 2008, 342-349.

[18] Gebhard & Krause, 2016, 32-37.

[19] Assessment J. Adam (Unterlagen J. Riederer); Gebhard & Krause, 2016, 33.

[20] Due to the deficient publication situation, the axe cannot be identified beyond doubt in archaeological publications, as there is no catalogue of the contents with inventory numbers. In the study by Nickel (2003, Fig. 2-1) the axe is designated *"Beil 1 2002:1649c"* (sample no. FG-020682) and is the shorter of the two axes (in Meller, 2010, Fig. 24 upper center, designated *"Beil 2"*).

[21] Meller, 2010, 57.

[22] Until 2016 Nickel's study was also accessible under 'Nickel 2003' in the following list of references in the internet link: http://www.cez-archaeometrie.de/dipl-diss/da-nickel-2003.pdf.

[23] Pernicka, 2010, 731.

[24] Lutz et al., 2010; Lutz, 2016; Pernicka et al., 2016.

[25] Lutz, 2011.

[26] Nickel, 2003, Tab. A-3-1; Tab. A-3-2; Tab. A-3-6. No Zn was detected in 14 samples. The mean value pertains to the 9 samples, in which Zn could be detected. An intarsia inlay shows a divergent higher value (Probe FG-020686).

[27] The calculations were performed using the function *„hclust"* of R 4.0.0.

[28] The numbering follows in the sequence of the analysed samples shown in Table 1, with No. 1 = FG-020984 Himmelscheibe to No. 17 = FG020703 Spiralring.

[29] We would like to take this opportunity to thank the editor Frank Siegmund for further comments.

[30] Haustein et al., 2010.

[31] Brügmann et al., 2018, Fig. 2. The illustration ibid. left corresponds with the illustration here, Fig. 3b (Pernicka et al., 2008 and Pernicka, 2010).

[32] Pernicka, 2017, Fig. 3; Tab. 2.

[33] Ehser et al., 2011.

[34] Gebhard & Krause, 2016, 38.

[35] Cp. Meller, 2010, 24-25: note of May 10, 2001. The extent to which the interpretation applied is shown by the statement that the *"amateur documentation of moderate quality"* (*"Amateuraufnahmen mäßiger Qualität"*) even already met the determination that the disk would be made of bronze with a tin content of 5 %.

[36] Cp. Meller, 2010, 25: Document note Dr. Muhl, December 6, 1999. In addition, photos in this convolute, in which the entire ensemble including the disk can be seen, are still unknown today.

[37] Meller, 2002, 18, Figs. 21.

[38] Meller, 2004a, 28-30.

[39] Meller, 2004a, 30.

[40] Meller, 2010, 62.

[41] Meller, 2010, 62

[42] For the different groups of East Alpine copper and their evaluation, see details in Krause (2003, 166-169).

[43] Krause, 2003, 27-29 with a CD-Rom with all data in the databank.

[44] Krause, 2003, Fig. 136-138.

[45] Pernicka et al., 2016, 25-29 mit 28, Tab. 2; Stöllner, 2015, 103; Stöllner, 2015a; Pernicka & Lutz, 2015, 109.

[46] Rohde, 2014 offers a critical approach to the topic of archaeo-astronomy.

[47] Meller, 2004b, 96.

[48] Zipf, 2004, 74-76.

[49] Pásztor & Roslund, 2007, 270 with Figs. 2-3; Pásztor, 2011; Pásztor, 2014; Pásztor, 2015a; Pásztor, 2015b.

[50] Bönisch, 2007, 164-169.

[51] Bönisch, 2007, 164.

[52] Meller, 2010, 44-48; 59-69. Z

[53] Gebhard & Krause, 2016, 31.

[54] Cf. e.g. Green, 1986; Olmsted, 1979; Olmsted, 1994.

[55] Dannheimer, 1975, 59 f.; Fitzpatrick, 1996, 382 f.; Deutscher, 2012, 283-285. Gebhard & Krause, 2016, 31.

[56] The first detailed analysis by Streber (1862, 640-641). A similar problem in interpretation already arose with the golden *"diadem"* of Vix, whose spherical ends correspond with a torque, but are not clearly identifiable. Noteworthy there is also Mediterranean influence in the details, such as the Pegasus ascending between the spheres and arc (Rolley, 2003; Verger, 2009, 297).

[57] Ziegaus, 1993, 92 No. 274.

[58] Paulsen, 1933, Taf 19,404: front: arc motif; reverse: torques; for the torque images, cp. ebd. Pl. 10, 222-225; for the arc and serpent images as, independent symbols accompanying the horse, cp. ebd. Pl. C, 41; 47-49.

[59] Overbeck, 2016, 68 No. 298; 72 No. 336.

[60] Kellner, 1990, 219 No. 2300.

[61] Caesar, Bell. Gall. 6,14.6: *„multa praeterea de sideribus atque eorum motu […] disputant et iuven tuti tradunt."*

[62] Green, 1986, 39-71.

[63] Mac Neil, l 1928; Olmsted, 1992; Caesar, *Bell. Gall. 6*,18.

[64] High resolution depiction: https://samlinger.natmus.dk/DO/asset/5324 [9.8.2019]. Cp. Olmstedt, 1979.

[65] For the symbolism of serpents, cp also the shield of Auchmaleddie and Coveney: Uckelmann, 2010, 557-560. On the origin of the Late Bronze Age, see Gebhard, 2010.

[66] Heynowski & Ritz, 2010; Heynowski, 2017. Cp. especially Hucke, 1962, Abb. 1,2; Fig. 2,10; Fig. 3,8; Fig. 8,2; Hingst, 1962, Fig. 5,1; Fig. 7,1-3; Hingst, 1989, 57-67.

[67] Cf. also David, 2010.

[68] Kaul, 2010, 532-535; Meller, 2010, 65-66.

[69] Gebhard, 2001, 12-14.

[70] Gleirscher, 2007, 30-32.

[71] Hänsel, 1997, 20.

[72] Fitzpatrik, 1996, 388-389.

[73] David, 2010, 480-481. David already points this out with relation to the Latène period.

[74] Meller & Michel, 2018.

[75] U. Willmann, Hochkultur aus dem Nichts. *Die Zeit*, 19.9.2018. T. Harmsen, Sonne, Mond und Sterne und der Staat. Interview with H. Meller. *Berliner Zeitung*, 22.9.2018. J. Wätzold, Kult mit Menschen-Opfern: Geheimnis um Himmelsscheibe von Nebra gelöst (…Erster Staat in Europa lag in Sachsen-Anhalt), *Bild*, 21.09.2018.

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