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2200 BC – A climatic breakdown as a cause for the collapse of the old world?

7. Mitteldeutscher Archäologentag vom 23. bis 26. Oktober 2014 in Halle (Saale)

Herausgeber Harald Meller, Helge Wolfgang Arz, Reinhard Jung und Roberto Risch

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Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt
LANDESMUSEUM FÜR VORGESCHICHTE

herausgegeben von
Harald Meller,
Helge Wolfgang Arz,
Reinhard Jung und
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Anhang/Appendix

Why we should not ignore the mid-24th century BC when discussing the 2200–2000 BC climate anomaly

Mike Baillie and Jonny McAneney

Zusammenfassung

Warum man in der Diskussion um die Klimaanomalie zwischen 2200–2000 v. Chr. die Mitte des 24. Jhs. v. Chr. nicht außer Acht lassen sollte

Es gibt viele Hinweise auf eine große klimatische Anomalie um 2200–2000 v. Chr. In diesem Beitrag wird aufgezeigt, dass sich dieses Klimaereignis anhand von genau datierten Mooreichen aus Irland nachweisen und in den Zeitraum zwischen 2206–1900 v. Chr. datieren lässt. Allerdings sollte man in diesem Kontext die präzise datierte, plötzliche Klimaverschlechterung rund 150 Jahre früher nicht außer Acht lassen. Irische und englische Jahrringsequenzen von Eichen belegen einen 10-jährigen Wachstumsrückgang zwischen 2354 v. Chr. und 2345 v. Chr. mit Anhaltspunkten für Überschwemmungsereignisse. Genauere Nachforschungen auf Grundlage dieser Hinweise führten zur Entdeckung weltweit überlieferter Geschichten aus einem Zeitraum von zehn Jahren um das Jahr 2350 v. Chr. herum. Die Überlieferungen beziehen sich auf den chinesischen Kaiser Yao (Regierungsantritt traditionell um 2357 v. Chr. datiert), in dessen Regierungszeit, genauer im Jahr 2346 v. Chr., sich eine Reihe von Katastrophen, unter anderem auch Überschwemmungen, ereigneten; auf den Erzbischof Ussher, der die biblische Sintflut in die Jahre 2349–2348 v. Chr. datierte; und letztlich fällt der Überlieferung nach die »Geburt« der drei Mayagottheiten GI, GII und GIII in das Jahr 2360 v. Chr. Man darf sich also fragen, weshalb sich die Menschen der nördlichen Halbkugel Geschichten erzählten, die in ein Zeitfenster von 20 Jahren zwischen 2360 v. Chr. und 2340 v. Chr. fallen. Zudem lässt die geglättete Wachstumskurve des nordeuropäischen Baumbestandes auf einen 37-jährigen Zyklus mit reduziertem Wachstum schließen. Die Wachstumskurve zeigt auch, dass es zwischen den Ereignissen um 2350 v. Chr. und denjenigen zwischen 2200 v. Chr. und 2000 v. Chr. möglicherweise einen Zusammenhang gibt. Eine Erklärungsmöglichkeit für die verschiedenen Beobachtungen ist ein Ereignis am Himmel mit weitreichenden Konsequenzen für die damalige Bevölkerung. Dieses Szenario lässt sich gut mit dem – allerdings umstrittenen – Nachweis einer anormalen Staubablagerung im syrischen Tell Leilan in Übereinstimmung bringen. Vor dem Hintergrund der ungewöhnlichen Anhäufung von Belegen, einschließlich der Ähnlichkeiten in den Erzählungen aus geografisch weit entfernten Gebieten, scheint es gerechtfertigt, diese Interpretationsmöglichkeit als Grundlage für weitere Forschungen ernsthaft in Betracht zu ziehen.

Summary

Much evidence exists for the major climate anomaly c. 2200–2000 BC. In this paper, we demonstrate that precisely dated Irish bog oaks record this climatic event, which appears to begin abruptly in 2206 BC and last until around 1900 BC. However, it might be unwise to ignore the precisely dated, abrupt environmental downturn that occurs some 150 years earlier. Irish and English oak tree rings draw attention to a notable decade-long growth downturn spanning 2354 BC to 2345 BC with hints of inundation. Interest in this apparently localised inundation led to the discovery that traditions from around the world preserve stories specifically dated to within 10 years of 2350 BC. These stories involve the Chinese emperor Yao (traditional reign date 2357 BC), who presided over a series of catastrophes, including floods, in 2346 BC; Archbishop Ussher, who used the dates 2349–2348 BC for the biblical Flood; and the »birth« of three Mayan deities, GI, GII and GIII, in the year 2360 BC. Why, one might ask, should people around the northern hemisphere have generated stories that appear to hark back to a two-decade window between 2360 BC and 2340 BC. Furthermore, a smoothed growth response for North European trees suggests the existence of a 37-year cycle of reduced growth, hinting that the events around 2350 BC and 2200–2000 BC may be related. One possible scenario to account for these various observations is that something happened in the sky around this time with memorable consequences for those on the ground; a scenario highly compatible with controversial evidence for an anomalous dust deposition event observed at Tell Leilan in Syria. Overall, this unusual accumulation of evidence, including similarities in stories from widely separated areas, suggests that the scenario should be treated seriously as a basis for further research.

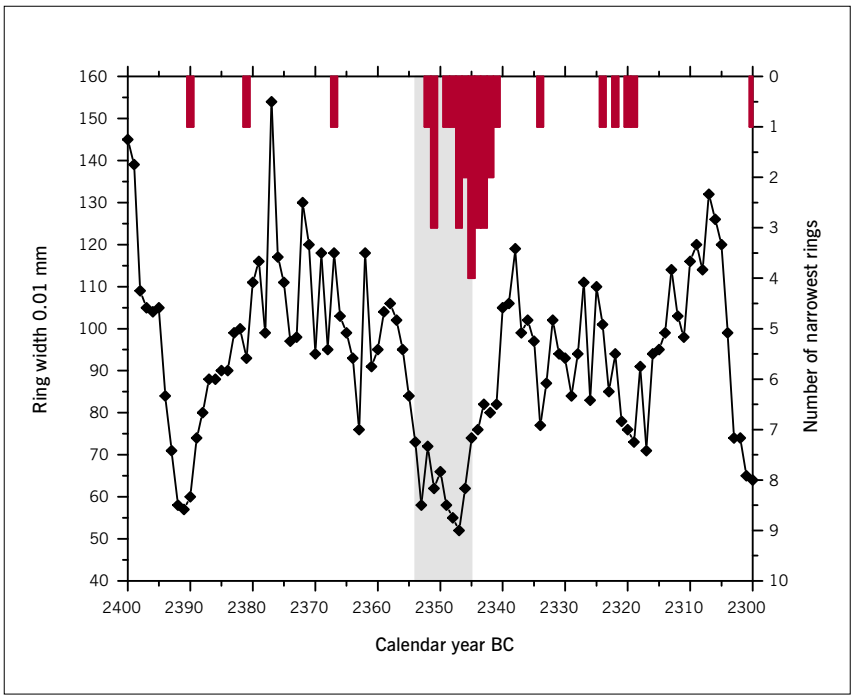

Fig. 1 Irish bog oak ring-width chronology showing significant growth reduction in the period 2354–2345 BC (shaded area). 25 % of trees growing across this episode exhibit their narrowest rings in this interval (the number of narrowest rings given by red bars).

Abb. 1 *Jahrringsequenzen von Mooreichen aus Irland zeigen einen beträchtlichen Wachstumsrückgang zwischen 2354 v. Chr. und 2345 v. Chr. (grau markiert). 25 % der Bäume, die in diesem Zeitraum wuchsen, haben die schmalsten Jahrringe innerhalb dieser Zeitspanne (die roten Balken zeigen die Anzahl der schmalsten Jahrringe).*

Introduction

In 1988 attention was drawn to a series of narrowest ring events in Irish bog oak tree-ring series. These events, which involve numbers of long-lived oaks on different bog sites showing their narrowest growth rings at the same time, were rare, and widely spaced in time; the dates include 3195 BC, 2345 BC, 1628 BC, 1159 BC, 208 BC and AD 540. The initial hypothesis was that most of these environmental downturns were associated with large explosive eruptions, as witnessed by acid layers in the Camp Century and Dye3 ice cores (Baillie/Munro 1988; Hammer et al. 1980). Several of these events, such as those at AD 540 (Larsen et al. 2008; Briffa 2000), 208 BC (Forsyth 1990), and 1628 BC (Friedrich et al. 2006; Wiener 2009) have turned out to be significant. For example, it is now known that the downturn that spans AD 536 to AD 550 is a global phenomenon, showing up in tree-ring chronologies around the world (Baillie 1994). It looks increasingly as though it involved a double environmental downturn, in 536 AD and the early 540s AD, probably caused by two large volcanic events (Larsen et al. 2008; Baillie/McAneney 2015). However, a cosmic component cannot be completely ruled out (Abbott et al. 2013), something compatible with the accumulation of myths involving sky gods around AD 540 (McCafferty/Baillie 2005). This paper looks in some detail at evidence associated with the 2354–2345 BC tree-ring downturn. Figure 1 shows the cluster of narrowest rings in the Irish bog oak ring-width chronology associated with the interval around 2350 BC. It should be noted that there are no equivalent clusters in other decades of the 24th century BC, even where the master chronology exhibits reduced growth e.g. in the 2390s BC. While the evidence is interesting in itself, there is an important underlying scientific question: what was the cause of the decade-long downturn in the Irish and English bog oak chronologies? The abrupt event we are discussing appears notably separate from the c. 2200–2000 BC event. So, before discussing details of the 2350 BC event, we will briefly examine the growth response of Irish oaks to the c. 2200–2000 BC episode.

Tree rings and 2200–2000 BC

In line with current wisdom, Roland et al. (2014,24) noted that the 2200–2000 BC event was probably caused by »complex interactions within the global ocean-atmosphere circulation system«. They investigated Irish peat deposits to ascertain whether or not they could identify signs of the 2200–2000 BC climate change event in Atlantic Europe, in particular looking at records of testate amoebae. Their conclusion was that they could not unequivocally identify any obvious signs of the 4.2 ka BP event, something they state as being consistent with other studies across north-western Europe. However, signs are apparent in the Irish oak tree-ring chronology that forms the basis for this current paper, and which can be viewed as an independent test of environmental alteration through time. The chronology is made up of a robust collection of sub-fossil oaks from different bog contexts and represents a quasi random selection of the Irish oaks growing on peat bogs across the period.

Figure 2 shows the Irish raw ring-width chronology for the period 2450–1650 BC, together with the same data subjected to 100-year smoothing. The 2354–2345 BC event is clearly represented in the raw chronology as a dramatic downturn in ring width (consistent with narrowest rings in some trees). The 100-year smoothed data clearly shows a sustained growth reduction across c. 2200 BC to c. 1900 BC. Comparing the two curves, the extended downturn appears to start abruptly at 2206 BC in the Irish trees. An abrupt start hints that the initiation of the climate change may have been due to some specific vector. This has to be interesting: What can cause a near instantaneous change in the climate

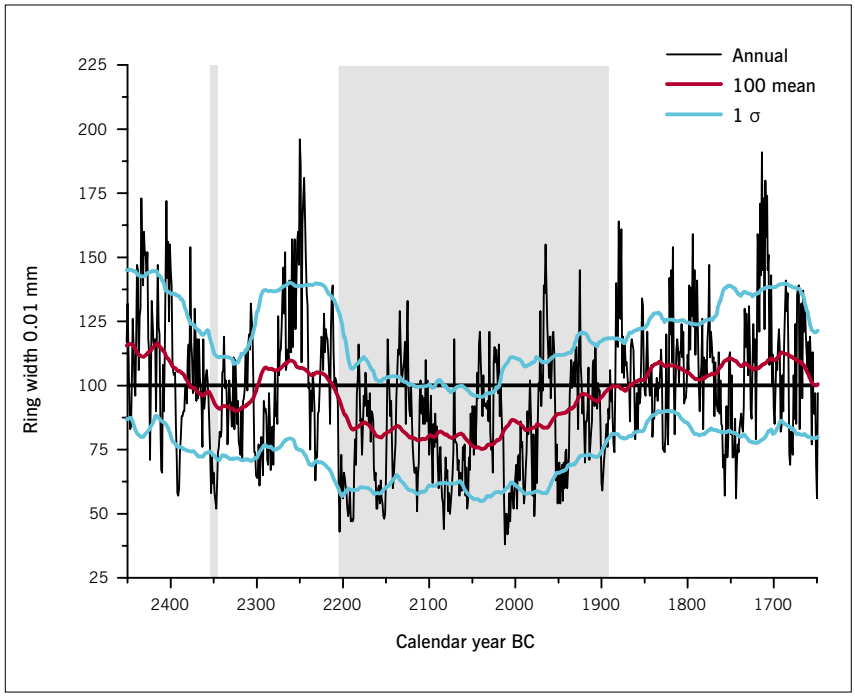

Fig. 2 Irish bog oak chronology across 2450–1650 BC. The black line represents raw tree-ring widths and shows the abrupt 2354–2345 BC event (emphasised by the shaded area). The red line is the same data subjected to a 100-year central moving mean, with standard deviation given in blue. This indicates that Irish bog oaks recorded a notable long term growth reduction, beginning abruptly in 2206 BC and lasting to around 1890 BC (emphasised by the larger shaded area).

Abb. 2 *Jahrringchronologie von Mooreichen aus Irland im Zeitraum zwischen 2450–1650 v. Chr. Die schwarze Kurve gibt die Rohdaten wieder, sie zeigt ein plötzliches Ereignis zwischen 2354 v. Chr. und 2345 v. Chr. (grau hervorgehoben) an. Die rote Kurve zeigt dieselben Daten mit einem 100-jährigen Mittel, die blaue Kurve ist die Standardabweichung. Die Kurven zeigen, dass sich anhand der irischen Mooreichen ein beträchtlicher Wachstumsrückgang innerhalb eines verhältnismäßig langen Zeitraums beobachten lässt, der relativ abrupt im Jahr 2206 v. Chr. einsetzt und bis um 1890 v. Chr. andauert (hervorgehoben durch die graue Schattierung).*

regime? Obvious possibilities involve volcanic activity, though there are no large volcanic signals in the GISP2 Greenland ice core record in the vicinity of 2200 BC (Zielinski et al. 1994). We will return to this issue below.

The 2354–2345 BC tree-ring event

The narrowest ring events in the Irish oak record have been reported extensively[1]. These represent points in time, in the last seven millennia, where numbers of Irish oaks, growing in different locations, showed their narrowest growth rings at the same time. After the events had been identified in numerical data, the original wood samples were examined to ascertain if there were any visible effects, other than simply very narrow rings. It was noted, for example, that around the time of the AD 540 event, some of the trees showed evidence of physical damage (Baillie 2001). In the case of 2354–2345 BC, a very particular phenomenon was observed in two trees that had grown on peat immediately to the south of Lough Neagh (the largest water body in the British Isles). The trees exhibited a decade of what can best be described as diffuse-porous behaviour. Oak is a ring porous wood and in normal conditions puts on a band of large spring vessels at the start of each year's growth, the vessels being hollow vertical tubes some 0.6 mm in diameter. To look diffuse porous it is necessary for the spring vessels to be so small that they cannot be resolved by the naked eye. In the case of the tree Q1764, from beside Lough Neagh, the diffuse band started in 2354 BC and lasted for a decade, with ring widths less than 0.55 mm (Fig. 3). This evidence, coupled with observation of modern parallels, suggested that in and after 2354 BC the level of ancient Lough Neagh rose and remained elevated for some time. A suggestion was therefore published in 1995 that there had been an inundation of Lough Neagh following 2354 BC (Baillie 1995). The Lower Bann River is the only exit from Lough Neagh to the sea. Subsequently another tree, Q9172, was sampled from peat just west of the River Bann, some 10 km north of Lough Neagh. This sample exhibited a severe scar that would have been around 1 m above ground level when the tree was alive (Fig. 4). When dated, the scar was found to have been inflicted in 2354 BC. Given the position, it is a reasonable possibility that the scar was caused by rafting debris. So, two trees at opposite ends of Lough Neagh both exhibit growth anomalies starting in 2354 BC, suggestive of an inundation event.

Hints of a more widespread event around 2350 BC

M. M. Mandelkehr

When the narrowest ring events were first published (Baillie/Munro 1988), it transpired that Mandelkehr (1983) had outlined three volumes of accumulated notes on »an Earthwide event at 2300 BC«. Finally published in 2006, Mandelkehr's thesis »presents a story of devastation that the Earth experienced at about 2300 BC [...]« and places the blame squarely on an extraterrestrial bombardment (Mandelkehr 2006, 1). The problem for Mandelkehr was that most of his evidence, both geological and archaeological, suffered from poor chronological resolution. There is little point in rehearsing Mandelkehr's discussion here. Suffice to say that much of the evidence he accumulated probably relates to the now widely recognised 2200–2000 BC episode. Indeed, if there

1 Baillie/Munro 1988; Baillie 1995; Baillie 1999; Baillie 2010 among others.

were significant environmental events in both 2350 BC and 2200–2000 BC it is highly likely that they were conflated by Mandelkehr into his »2300 BC« horizon. However, we should note the assertion of extraterrestrial bombardment around 2300 BC.

Tell Leilan, Syria

In 1997 a conference was held in Cambridge under the heading of »Coherent Catastrophism«. Numbers of papers were presented by astronomers considering the issue of bombardment by cometary debris and the role which the Taurid meteor stream might have had in causing coherent bombardment events. One paper stood out in the proceedings by M.-A. Courty entitled »Causes and Effects of the 2350 BC Middle East Anomaly Evidenced by Micro-Debris Fallout, Surface Combustion and Soil Explosion« (Courty 1998). Courty, a soil scientist, showed that there was good evidence from the site of Tell Leilan in Syria that something had fallen out of the sky close to 2350 BC, possibly somewhere in the Near East, and spread secondary impact-derived debris across, at least, Northern Syria. The assemblage occurred with widespread archaeological debris and comprised (presumably secondary) tephra along with various glassy spherules and small fragments of »black, vesicular, amorphous material made of silicates« etc. It dates to the transition between the Early Dynastic and the Early Akkadian periods. Again we should note the suggestion of extraterrestrial bombardment around 2350 BC.

The Biblical Flood, Old Testament

When the 2354–2345 BC event was proposed, it was quickly realised that the traditional chronology of the Old Testament (OT) placed the biblical Flood at 2349–2348 BC. This is the chronology that was applied to the OT by Archbishop Ussher (Ussher 1658). Few modern scholars would give any credence to Ussher's dating. However, that does not change the fact that a 17th century cleric arrived at this particular dating for the most catastrophic event in ancient »history«. Strangely, in the Hebrew Talmud, there is a legend associating »cosmic events« with the biblical Flood: »When the Holy One, blessed be He! wished to bring the Deluge upon the world, He took two stars out of Pleiades, and thus let the Deluge loose.« (Maunder 1908; Olcott 2004). Given that both Isaac Newton and Edmond Halley believed the Flood of

Fig. 3 Irish bog oak sample Q1764 that grew on peat south of Lough Neagh, Northern Ireland, showing a decade long diffuse porous band (between 218–220 mm) with ring widths less than 0.55 mm beginning in 2354 BC. This suggests that the water level of Lough Neagh rose for a prolonged period.

Abb. 3 *Probe Q1764 von einer Mooreiche aus der Torflandschaft südlich des Lough Neagh in Nordirland. Zu erkennen ist ein diffus poröser Bereich (zwischen 218–220 mm) über einen Zeitraum von zehn Jahren mit Jahrringen von weniger als 0,55 mm Breite ab 2354 v. Chr. Dies weist darauf hin, dass der Seespiegel des Lough Neagh über eine längere Zeitspanne hinweg erhöht war.*

Fig. 4a–b Irish bog oak sample Q9172 that grew on peat 10 km north of Lough Neagh. a Severe scar dating to 2354 BC that would have been around 1 m above ground level when the tree was alive. b A close up of the scar showing the locally killed sapwood enclosed by scar tissue. The tree's location, and the height of the scar suggest that the damage may have been caused by rafted debris, flowing from an inundated Lough Neagh.

Abb. 4a–b *Probe Q9172 von einer irischen Mooreiche aus der Torflandschaft ca. 10 km nördlich des Lough Neagh. a Starke Vernarbung im Jahr 2354 v. Chr., die Schadstelle befand sich ca. 1 m über dem Boden, als der Baum noch lebte. b Nahaufnahme der Vernarbung mit dem abgestorbenen Splintholz umgeben von Narbengewebe. Der Standort des Baums und die Höhe der Vernarbung weisen darauf hin, dass der Schaden möglicherweise durch Treibgut aus dem über die Ufer getretenen Lough Neagh verursacht wurde.*

2349–2348 BC was due to a comet (Schechner-Genuth 1997), we again see hints of an extraterrestrial event around 2350 BC.

Irish Anno-Mundi Annals

In the Annals of the Four Masters we find under the date AM 2820 (Year of the World 2820 = 2380 BC): »Nine thousand of Parthalon's people died in one week [...] Ireland was thirty years waste till Neimhidh's arrival«, while under the date AM 2850 (Year of the World 2850 = 2350 BC) we find: »Neimhidh came to Ireland [...] with his people [...]«. So, on the basis of tree-ring evidence we are discussing a possible inundation of the area surrounding Lough Neagh in 2354–2345 BC, while ancient Irish literature refers to the island being »waste« for 30 years before the arrival of a new people in 2350 BC. To this can be added the surprising fact that the Annals, under 2341 BC, go on to list the following developments: »These were the forts that were erected, the plains that were cleared, and the lakes that sprang forth, in the time of Neimhidh, but the precise years are not found for them (including) [...] Magh-Lughadh, in Ui-Tuirtre [...]«. J. O'Donovan, in editing the Annals in the 19th century, interpreted this place name as »Magh-Lughadh: i. e. Lughadh's Plain, a district near Lough Neagh« (O'Donovan 1856). How do we explain, in the context of a tree event in 2354–2345 BC, a reference in a mediaeval text to lakes springing forth in 2350–2341 BC, which includes a mention of the plain of Lough Neagh?

Chinese historical/mythological sources

The First Emperor of China, Yao, by tradition came to the throne in 2357 BC to 2256 BC (Legge 1879). Yao was famous for the floods »that overtopped the mountains« during his reign. A strange story is preserved in the literature concerning this premier figure in Chinese history/mythology. E. T. C. Werner (1995) tells us that in the 12th year of his reign – traditionally 2346 BC – Yao meets an archer whose extraordinary skill causes Yao to »name him Shên I, ›the Divine Archer‹ «. The story goes on: »At the time terrible calamities began to lay waste the land. Ten suns appeared in the sky, the heat of which burnt up all the crops; dreadful storms uprooted trees and overturned houses; floods overspread the country. Near the Tung-t'ing Lake a serpent, a thousand feet long, devoured human beings, and wild boars of enormous size did great damage in the eastern part of the kingdom. Shên I took up his post on Mount Ch'ing Ch'iu to study the cause of the devastating storms, and found that these tempests were released by Fei Lien, the Spirit of the Wind, who blew them out of a sack [...]. The ensuing conflict ended in Fei Lien suing for mercy [...] whereupon the storms ceased.« (Werner 1995, 181).

Obviously modern readers would dismiss this as fantasy, given its mention of a thousand foot serpent and a Wind Spirit. Indeed prevailing wisdom suggests »[...] it is no longer acceptable to cite timeworn received chronologies in discussing the pre-imperial history of China [...]« (Pankenier 1998, 188). However, these stories do exist, and it seems unwise to ignore them, given the strange details they supply. For example, here is additional information that elaborates the Shên I story: »After his first victory Shên I [...] discovered that on three neighbouring peaks nine extraordinary birds were blowing out fire and thus forming nine new suns in the sky, Shên I shot nine arrows in succession, piercing the birds, and immediately the nine false suns resolved themselves into red clouds and melted away. Shên I and his soldiers found the nine arrows stuck in nine red stones at the top of the mountain« (Werner 1995, 182).

So in an apparently mythical story, noted purely because of the coincidence of its traditional date with the tree-ring downturn, we find the concept of multiple suns in the sky with stony cores, and the earth being saved by an Apollo-like figure who shoots nine of them down. Given Courty's suggested impact debris around 2350 BC, it is remarkable that an independent Chinese story, traditionally dated to

2346 BC, contains the imagery of multiple suns being shot out of the sky. What would have had to be observed to give rise to such a story, if it were based on actual happenings? Nine sun-like objects in the sky dissolve into red clouds and their stony cores end up on the earth. If observers in China had witnessed a shower of bolides entering the Earth's atmosphere – appearing as bright as suns with cloudy trails – this could well have been how they described the event, particularly if, after their observed arrival, actual meteoritic debris had been found.

Additional Chinese details

Werner (1995) also tells a story that is set »in the reign period I Fêng (AD 676–679) of the emperor Kao Tsung of the T'ang dynasty«. In the story, the hero, Liu I, visits the palace of the Dragon King. At one point the brother of the Dragon King appears and the Dragon King explains: »It was he who, in the reign of Yao caused a nine-years flood«. So in Chinese mythology (or history? or fiction?), it appears that a nine-year flood began at 2346 BC. Importantly, this story describes the Dragon King's brother, Ch'ien T'ang.

»Before he had finished speaking, a red dragon, a thousand feet long, with red scales, mane of fire, and eyes blazing like lightening passed through the air with rapid flight and disappeared« (Werner 1995, 219).

This implies that Chinese story tellers believed that the nine-year flood at the time of Yao was caused by something fiery flying through the air. Another source elaborates the Dragon King's story.

»The great flood that covered the earth for nine years during the reign of the emperor Yao was caused by him (Ch'ien T'ang) in his anger. Because he had a quarrel with a heavenly ruler he caused a great flood which reached to the summits of the five tall mountains Then the lord was angry with him and gave him into my charge. I had to chain him to a column of the palace. Before he could finish a sudden uproar broke out, a noise rending the sky and shaking the earth and causing the whole palace (the sky?) to tremble, and causing smoke and clouds to billow out with a fierce hissing. A red dragon burst in (Ch'ien T'ang) a thousand feet long, with flashing eyes, a blood red tongue, scarlet scales and a fiery beard. The column to which he had been fettered was dragged along by him on a chain through the air. Snow, rain and hail were swirling in wild confusion. There was a thunderclap and the dragon soared up towards the sky and disappeared.« (Osers 1971, 125).

It seems reasonable to ask what natural phenomenon:

Is bright, red and fiery?
Can fly through the air?
Can drag a column (trail) behind it?
Can shake the earth?
Can cause the sky to tremble?
Can produce a fierce hissing?
Can cause snow, rain, and hail (i.e. environmental consequences)?

This is a fairly accurate description of a bolide, i. e. a bright fiery body, arriving from space, traversing the Earth's atmosphere, and leaving a trail in the sky before exploding either in the atmosphere or on hitting the ground, the trembling of the earth being an earthquake caused by the impact in either case. We know that when the modest ~40 m Tunguska object exploded in the atmosphere over Siberia on 30 June 1908, it was first observed as a flying object, as bright as the sun, leaving a smoky trail. It exploded at an altitude of about 10 km, with a force argued to have been anywhere between 5–30 Mt, and flattened some 2000 km^2 of forest. The earthquake caused by the explosion was recorded at Irkutsk 900 km from the point of detonation (Rubtsov 2009).

Anyone reading the Chinese story without the current context would have made little of it. However, we now know of an environmental event spanning 2354–2345 BC and anomalous dust c. 2350 BC. We see hints of extraterrestrial involvement from Mandelkehr, Courty, and the biblical Flood and now an apparent bolide description in an ancient Chinese story traditionally dated to 2346 BC.

Mayan early history

In the 7th century the Maya king, Pacal of Palenque (AD 603–683), ordered the construction of a temple with significant inscriptions. These inform us that the First Mother was born on a day equivalent to December 7th, 3121 BC while the birth of the First Father was June 16th, 3122 BC. The inscription goes on to list the births of three principal gods to the First Mother some 754 years after the first creation, on August 11th, 3114 BC. The three gods were: GI, born October 21st, 2360 BC; GIII, born October 25th, 2360 BC; and GII, born November 8th, 2360 BC.

It is interesting to read some of the attributes of these »G« deities. Attempting to identify them, F. G. Lounsbury (1985) noted that GI was the namesake of the First Father, the latter having strong associations with the Maya Creation date as well as a »sky event« (variously translated as »raising the sky« or »entering the sky« [Milbrath 1999]). Since GI junior is identical to GI senior, the »rebirth« of GI in 2360 BC may suggest that GI junior had the same sky associations. Lounsbury (1985) identifies GIII as the Sun god, and thus argues that the mythological identities of GI and GIII are none other than the Maya hero twins Hunahpu and Xbalanque, and hence representations of the Moon (or Venus) and the Sun, respectively. According to Quiche Popul Vuh, the hero twins were responsible for shooting down the demon Vucub Caquix who was masquerading as the Sun and the Moon (Tedlock 1985). Upon Vucub Caquix's demise, the twins took up the true roles of the Sun and Moon.

There are alternative identifications of gods GI–GIII. K. Baissie-Sweet (2002) has identified the »G-triad« as »lightning gods«, and has this to say in particular about GIII:

»[...] GIII was a fire god with war and meteor association [...]. GIII's weapon of choice appears to have been the flint spear. Given that flint produces sparks when struck, it is likely that this spear was a metaphor for the flaming meteor. In Tzotzil, ch'ob means both torch and falling star, suggesting that GIII's torch title may have been another metaphor

for a meteor (Laughlin 1975, 137). [...] In addition to being flashes of light, big meteors share other characteristics with lightning bolts. Both can be accompanied by a tremendous boom, and both are associated with fire (Taube 2000, 325). Meteors are considered to be omens of death, and lightning bolts usually kill any living being they hit. Both lightning bolts and meteors are associated with obsidian and flint, and both are considered to be weapons of the lightning bolt gods«.

It is interesting how extraterrestrial these GI–GIII gods seem to be, given their dates for »touching the earth« in 2360 BC.

Discussion

Tree rings provide firm evidence of an abrupt, albeit geographically localised, environmental event in the time window 2354–2345 BC (Baillie/Munro 1988). Let us try to rank the associated information in terms of reliability.

Mayan inscriptions take us to the »births« of gods GI–GIII in 2360 BC. These gods have significant sky credentials involving lightening, meteor, and fireball associations, and links to foundation stories of the shooting down of a demon masquerading as the Sun and the Moon. There are no grounds for arguing with the Mayan dates, so we can present this as an independent Mayan source placing meteor-like entities within a few years of the initiation of an apparently catastrophic inundation event in the British Isles.

Turning to Courty's anomalous dust layer at Tell Leilan, it is interesting that analysis of this dust suggests the throwing up of a mixture of possibly old tephra combined with what sounds like secondary (extraterrestrial?) impact debris, including spherules. This deposit, from a horizon between the Early Dynastic and the Early Akkadian periods, could reasonably be dated to somewhere in the vicinity of 2350 BC, certainly well before the 2200–2000 BC horizon. The only question is whether this evidence is well enough dated to be associated with the precisely dated tree ring and Mayan evidence.

In the case of Chinese stories, with traditional dates 2357 BC and 2346 BC, we acknowledge that many scholars would be uneasy with this chronology. However, the fact that the stories, concerning the cause of the floods and calamities attributed to the 2340s BC, were written down in the 7th century AD, does tend to give some credibility to the idea that they may represent a memory of actual events. The alternative involves supposing that a mere piece of fiction could produced startling parallels purely by coincidence; both American and Chinese sources have concepts involving multiple bright objects in the sky being shot down or »touching the earth« at surprisingly similar dates; while a decade long inundation in the British Isles (2354–2345 BC) parallels an alleged nine-year flood in China (2346–2338 BC).

We now come to the weakest evidence. Most scientists would not endorse the chronology, derived by Ussher, that places the biblical Flood in the years 2349–2348 BC. However, we are again confronted with strange coincidences; Newton and Halley believed that the Flood of 2349–2348 BC was due to a comet (Schechner-Genuth 1997), while Hebrew sources attribute the Flood to two displaced stars (Maunder 1908). The question is: how to handle such evidence? Is it wise to dilute the coherent tree ring, Mayan, soil science, and even Chinese evidence, with untestable traditions? If we can dismiss Mandelkehr's thesis on the basis of poor chronological control then surely we should ignore the biblical chronology as well? In turn this raises questions about the dating of the Irish Annals. There is a widespread belief that the events in the Anno-Mundi Annals are merely derivative stories from the Old Testament, composed by Early Medieval monks to provide Ireland with a pseudo history. But are they? Is it possible that Irish story tellers preserved a record of real events? All we can point to are suggestions that other Anno-Mundi stories do seem to have a core of truth (Warner 1990).

Given that our starting point was an earthly event deduced from tree rings, how might we explain the fact that much of the associated »2350 BC« material shares hints of things falling out of the sky? Here it is necessary to look at some science. There exists a body of research by some astronomers suggesting that within the past 20 000 years, a giant comet, possibly many tens of kilometres in size, was injected into the inner solar system and underwent a progressive series of disintegrations, resulting in the broad stream of cometary debris which makes up the Taurid meteor complex observed today (Bailey et al. 1990; Asher et al. 1994). Indeed, these astronomers believe, on the basis of tracking back meteor orbits, that at least one major fragmentation event within this comet complex occurred in the 3rd millennium BC, prior to 2350 BC[2]. They believe it quite likely that the Earth may have been subjected to significant bombardment in the 3rd millennium BC.

Obviously, if the Earth was subjected to a stream of debris from such a break-up, it would be important to gauge the effects on human populations at the time. One cannot rule out the interesting possibility that the effects around 2350 BC, outlined in this article, might have been caused by interactions with cometary debris orbiting in the Taurid complex. Let us go further. While the 2200–2000 BC event can be explained by »complex interactions within the global ocean-atmosphere circulation system« (Roland et al. 2014), no-one seems to know the actual cause of the event; it seems to be regarded as a sort of statistical anomaly in the climate system. What happens if, building on the astronomical suggestions of cometary hazards, we propose that the 2200–2000 BC climate anomaly was also driven by extraterrestrial effects? After all, in order to induce climate change, what better mechanism could there be than to load dust into the upper atmosphere over a period of time? So, the scenario we wish to propose is that the abrupt 2350 BC event and the 2200–2000 BC climate event could be related; the cause of both being merely debris from different stages of a comet break-up.

In 2004 Rigby et al. modelled the effects of a comet fragment exploding high in the atmosphere, in an attempt to

2 Whipple/Hamid 1952; Clube/Napier 1984; Clube/Napier 1990; Steel 1995.

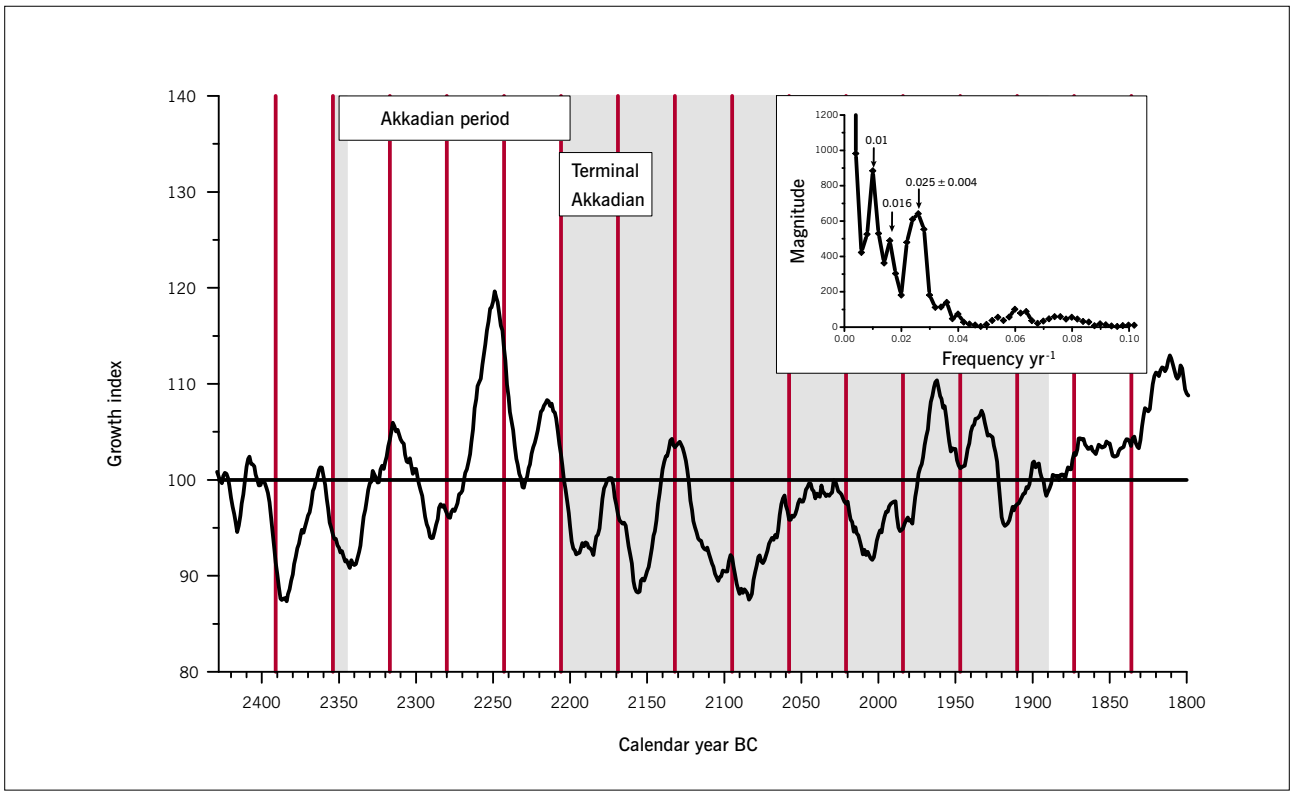

Fig. 5 A mean of six regional European tree-ring chronologies for the period 2400–1800 BC. The 2354–2345 BC and 2206–1890 BC periods observed in Figure 2 are marked by shaded areas. The red lines are spaced 37 years apart, and hint at an underlying cycle of periods of reduced growth linking the 2354 BC and 2206 BC downturns. Fourier analysis of the data (inset) confirms the existence of such a cycle with a frequency of 0.025 +/- 0.004 yr^{-1}, suggesting a period of c. 40 years.

Abb. 5 *Gemittelte Kurve von Daten aus sechs europäischen regionalen Jahrringchronologien für den Zeitraum zwischen 2400–1800 v. Chr. Die in Abbildung 2 beobachteten Perioden 2354–2345 v. Chr. und 2206–1890 v. Chr. sind grau markiert. Die roten Linien im Abstand von jeweils 37 Jahren weisen auf einen zugrunde liegenden Zyklus von Phasen mit reduziertem Wachstum hin, der die beiden Perioden mit verringertem Wachstum um 2354 v. Chr. und um 2206 v. Chr. verbindet. Eine Fourier-Analyse der Daten (oben rechts eingefügt) bestätigt die Existenz dieses Zyklus mit einer Häufigkeit von 0.025 +/- 0.004 yr^{-1}, was auf eine Periode von ca. 40 Jahren hinweist.*

explain the AD 536 environmental event and its historically recorded dust veil. They determined that the plume from the explosion, travelling back along the evacuated atmospheric tube left in the wake of the impactor, would deposit significant amounts of dust at the top of the atmosphere. They determined that an object around 0.6 km in diameter was all that was required to create a dust veil of sufficient optical depth to cause the reconstructed surface cooling occurring in AD 536. While their model relied on atmospheric effects spreading the dust evenly over the top of the atmosphere, satellite observation of the dust plume from the small 2013 airburst over Chelyabinsk, Russia, which occurred at an altitude of 23 km, showed that dust from that impactor was injected to a height of 40 km within the stratosphere, and took only four days to circumnavigate the globe, forming a »dust belt« of material that remained detectable for months (Gorkavyi et al. 2013). While Baillie and McAneney (2015) have shown that the AD 536 event was most probably volcanic in origin, the model of Rigby et al. (2004) is still valid as a means to explain past climatic anomalies.

While the climatic role of sub-micron refractory material such as that detected in cometary comae is uncertain, Bailey et al. (1994) speculate that the cooling effects from significant atmospheric loading of cosmic dust would drastically affect atmosphere/hydrosphere feedbacks. The optical properties of cometary grains depend upon size, composition and surface roughness, with the extinction and scattering of sunlight found to increase strongly with the latter (Lamy/Perrin 1983). Also, as noted by Hoyle (1984) and Hoyle and Wickramasinghe (Hoyle/Wickramasinghe 1978; Hoyle/Wickramasinghe 1991), the scattering angle of particles of ~0.1 µm is about 90°, so if the atmosphere was significantly dusted by very small particles, backscattering of sunlight could cause further cooling effects at the Earth's surface. Furthermore, while a particle of radius 3.0 µm and mean density of 1 g/cm^3 settles through the atmosphere in about a year, a similar particle of 0.3 µm has a stratospheric settling time an order of magnitude larger than that of the 3.0 µm particle (Kasten 1968). Thus, a relatively small admixture of sub-micron grains would have a disproportionate effect upon the temporal opacity of the atmosphere. Observations after the modest 1908 Siberian Tunguska impact are consistent with a highly disturbed atmosphere, including poor optical seeing, anomalous bright nights, ozone depletion, and global cooling of ~0.3° C (Turco et al. 1982; Rubtsov 2009).

It is therefore plausible that atmospheric loading by extraterrestrial dust, with its long atmospheric residence time, could cause extended alteration to global climate and atmospheric circulation patterns, similar to those that may have

occurred between 2200 BC and 2000 BC, particularly if cosmic dusting was spread over time.

It is not possible to make these suggestions without recognising that an extraterrestrial explanation of the 2200 BC event has existed since the 1990s. When the orbit of the 1997 comet, Hale-Bopp, was worked out, the best estimate of its last appearance was around 2215 BC (Marsden 1997). T. Slattery (2001) noted the coincidence of this date with the start of the 2200–2000 BC event and questioned whether Hale-Bopp may have been the cause. However, he could find no evidence to support this idea, which was nonetheless widely discussed at the time. The question is, (ignoring Hale-Bopp), can a scientific case be made for possible extraterrestrial involvement with 2200–2000 BC? Let us try.

Let us accept that astronomers have identified a cosmic threat in the 3rd millennium BC from debris from comet break-ups. Then, if the abrupt environmental event beginning in 2354 BC involved a cosmic vector, one can legitimately ask if an abrupt start of the 2200–2000 BC event at 2206 BC shares that common vector. It is necessary to imagine the orbit of a debris cluster with a node close to 1 AU. To produce effects on Earth, we need the cluster to pass this node when Earth is nearby. If such a scenario occurs, one would expect particularly close encounters with the debris in near integer multiples of the cluster's orbital period. Can we see anything periodic in the tree-ring record that might imply periodic encounters of this kind?

If we examine a smoothed mean growth index of six European tree-ring chronologies[3] (Fig. 5), we observe a hint of a 37-year cycle of reduced growth, which includes both 2354 BC and 2206 BC (downturns starting around 2390 BC, 2354 BC, 2242 BC, 2206 BC, 2170 BC). Indeed, Fourier analysis of this mean chronology between 2450 BC and 1800 BC reveals a strong periodicity with frequency 0.025 +/- 0.004 yr^{-1}, corresponding to period of ~35–47 years, confirming that such a 37-year cycle is real. This is interesting, in that astronomers have suggested that there currently exists a resonant meteoroid swarm within the broad Taurid meteor complex with an orbital period of ~3.39 years (Asher/Clube 1993). Modelling suggests that this swarm exhibits a series of encounters with Earth, many paired 37 years apart (Asher/Clube 1993, Tab. 3). During such encounters with the resonant swarm, the Earth is hit with a greater number (than in average years) of meteors capable of producing fireballs. If such a swarm existed in the late 3rd millennium BC, with an enhanced population density of large bodies from a recent cometary fragmentation event, Earth may have experienced increased risk of bombardment when the swarm made a close approach. An Earth-crossing comet, or its debris, with an orbital period close to 3.36 years could also give rise to a 37-year cycle of risk to Earth. Such objects do exist within the Taurid complex (Asher et al. 1993; Porubčan et al. 2006). The large Taurid complex asteroids 2003 UL_3 (750–1600 m) and 2004 TG_{10} (350–780 m) have orbital periods of 3.36 years, with the latter thought to be a fragment of Comet Encke (Porubčan et al. 2006), which also resides within the Taurid complex. It is a sobering fact that Comet Encke (d = 4.8 km), if broken up, could produce over 500 objects of a size capable of inducing a dust veil similar to that of AD 536 if it were to impact Earth (Rigby et al. 2004). Given all the above, is it possible that European trees are recording a period of »coherent catastrophism« in the latter half of the 3rd millennium BC?

Immediately apparent from examination of the Irish bog oak tree-ring chronologies is the sudden change to a new reduced growth regime at 2206 BC, see Figure 2. It is interesting to compare this with the chronology of Weiss et al. (2012): »[...] the Akkadian Period (c. 2350–2200 BC, EJZ 4a–b phases) in phase EJZ 4c, early post-Akkadian or Terminal-Akkadian (2207–2147 cal BC)«. What are the chances that a cursory examination of an Irish tree-ring chronology should identify events at 2350 BC and 2206 BC that so neatly bracket the Akkadian Period and its end?

Conclusion

Even if we dismiss Mandelkehr, Ussher and the Irish Annals, we are still left with a relatively coherent suite of evidence suggesting that the Earth may have suffered some sort of bombardment event in the middle of the 24th century BC. The physical manifestations are evidence of an inundation in Ireland/England and an anomalous layer of dust in Syria. While that does not sound very significant we still have to explain why characters with surprisingly similar attributes occur in stories, with essentially the same dates, in both China and in the Americas. The Divine Archer in China shoots down nine suns, while in the Americas, GI and GIII touch the Earth as the Sun and Moon. Where do these ideas come from, at essentially the same time, unless something was witnessed in the sky in both areas? There is no need for the events to fall in exactly the same years. If in the interval 2360–2340 BC the Earth was subjected to bombardment by a stream of cometary debris, then different areas may have been affected in different years. If the hazard extended to periodic interactions with cosmic debris, then the demise of the Akkad around 2200 BC might be related to its flowering after 2340 BC.

Hopefully it is now obvious why this paper on 2354 BC is introduced into a proceedings dedicated to the climate change event in 2200–2000 BC? The chronology for the demise of Tell Leilan is well constrained to the end of the 23rd century BC (Arrivabeni 2012), but there is little doubt that something interesting happened a century and a half earlier, around 2350 BC, on that same site (Courty 1998). Our proposal is that the two may be related. Away from the Near East, not all archaeological chronology is so refined as to allow definitive assignment of archaeological phenomena to one or other of these two episodes. Most chronologies are radiocarbon based and are still under detailed construction. Yet the scientific community needs to know, in each regional case, if observed »change« took place because of a) an extra-

3 Leuschner/Delorme 1984; Pilcher et al. 1984; Becker/Schmidt 1990; Brown/Baillie 1992; Jansma 1996 (pers. comm. 26.11.1999); Grudd et al. 2002.

terrestrial bombardment event in the vicinity of 2350 BC or b) a two century climate regime change in 2200–2000 BC, and c) if another cosmic effect occurred close to 2200 BC. Currently most archaeological chronologies in northern Europe are not sufficiently refined to make such distinctions.

One serious problem seems to be that the archaeological and ancient historical communities automatically reject suggestions of extraterrestrial involvement in human affairs. Yet professional astronomers and Earth scientists are comfortable with the possibilities of bombardment in recent millennia as possible causes of disruption on the ground. Courty's soil analysis at Tell Leilan should have been a wake-up call for archaeologists to seek to confirm her findings; the opposite appears to be the case. An open minded approach is needed in the investigation of any and all deposits that span the 24th century BC, and indeed the 23rd to 19th centuries BC, in order to test whether an extraterrestrial hypothesis is tenable to explain the evidence observed in the archaeological record.

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Source of figures

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Bislang erschienene Bände in der Reihe »Tagungsbände des Landesmuseums für Vorgeschichte Halle«

Die Reihe der Tagungsbände des Landesmuseums wurde 2008 ins Leben gerufen. Anlass dazu war die Konferenz »Luthers Lebenswelten«, die im Jahr 2007 in Halle ausgerichtet wurde. Bereits der zweite Tagungsband widmete sich mit dem Thema »Schlachtfeldarchäologie« dem Mitteldeutschen Archäologentag, der seit 2008 jährlich von Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt veranstaltet und zeitnah publiziert wird. Dem großen Anteil internationaler Autorinnen und Autoren entsprechend, erscheinen viele Beiträge dieser Reihe in englischer Sprache mit deutscher Zusammenfassung.

Mit dem bislang zuletzt erschienenen Tagungsband konnten die Vorträge und Posterpräsentationen des 6. Mitteldeutschen Archäologentags »Metalle der Macht – Frühes Gold und Silber« in zahlreichen Artikeln renommierter Forscher verschiedenster Fachdisziplinen vorgelegt werden.

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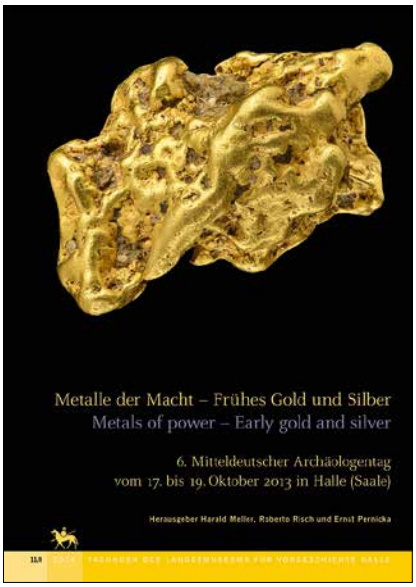

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