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NEOLITHIC MASSACRES: LOCAL SKIRMISHES OR GENERAL WARFARE IN EUROPE?

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ABSTRACT. The Neolithic site of Schletz in Lower Austria comprises a fortified settlement from the end of the *Linearbandkeramik* (LBK) culture. Large numbers of human bones were found at the base of the fortification ditches, and many of the excavated bones and skulls showed evidence of trauma, which most likely originate from violence. This remarkable deposit of human remains has been considered evidence for an abrupt end to the Early Neolithic settlement at Schletz. In order to investigate this interpretation, radiocarbon accelerator mass spectrometry (AMS) measurements of human bone samples from this site were performed at VERA. The χ^2 test of the results from specimens with clearly identified lesions suggests that these may be contemporaneous. Further, it may be concluded that all individuals with evidence of trauma from Schletz were probably the victims of a single event: a massacre at the end of the LBK.

Similar evidence is found at Early Neolithic sites at Talheim and Herxheim in the western part of Germany. Analysis of the ^{14}C ages of bones from both sites suggests that the Talheim event may have been coeval with the massacre of Schletz, whereas an event at Herxheim might have happened some time earlier. For Herxheim, the massacre theory is still under discussion, and a change in the burial rite is also considered as an alternative interpretation.

INTRODUCTION

The *Linearbandkeramik* (LBK) is a European culture which developed in the central part of Europe in Early Neolithic times. This culture was spread over a large area of Europe, from the northwestern regions of Germany to the southeastern parts of Europe around the Black Sea. In contrast to all succeeding cultures, the LBK rarely showed local characteristics in ceramic styles. People of the LBK lived in the period after the fundamental transition in human lifestyle from hunter-gathering to farming. Generally, the LBK time is considered to have been a peaceful period (Petrasch 1999). At the end of the LBK, living conditions must have become more violent. This is shown by the occurrence of settlements with fortifications.

THE EARLY NEOLITHIC SITE AT SCHLETZ IN LOWER AUSTRIA

One of the fortified settlements from the end of the LBK period is the archaeological site at Schletz in eastern Austria. Schletz is located about 50 km north of Vienna in Lower Austria (Figure 1a). A map of the settlement, derived from aerial survey and geophysical investigations, is given in Figure 1b. The two oval fortification ditches of the settlement are indicated. Systematic excavations at the site started in 1983 and are still on-going (Windl 1996, 2001).

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Figure 1 (a) Map of the northeastern part of Austria showing the location of Schletz, north of Vienna.

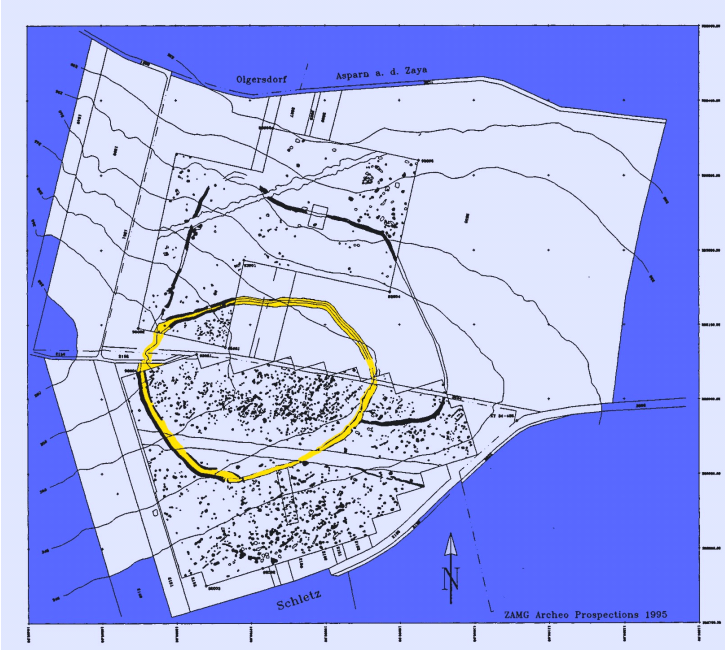

Figure 1 b) Map of the Early Neolithic site of Schletz derived from aerial survey and geophysical prospection (Windl 1996).

Anthropologic Investigations of Human Remains from Schletz

In the course of the excavations at Schletz, large numbers of human remains were found at the base of the outer ditch. It is estimated from the number of cranial and postcranial remains that approximately 200 individuals were deposited in the ditches. Up to now, about 100 individuals have been excavated. The skeletons were found mainly in strange positions, and often several skeletons were grouped together (see Figure 2). The bodies were deposited prone and many skeletons were incomplete with extremities missing.

Figure 2 Photograph from the Early Neolithic excavation area at Schletz showing human remains as found in the fortification trenches.

A subsample of 67 individuals has been investigated by osteologists. This investigation showed that all the skulls were lethally fractured (Figure 3), and many of the postcranial remains exhibit unusual features, too. A large number of the bones showed carnivore gnawing marks. The age and the sex distribution of the individuals was also determined, and it is evident that the occurrence of females among the young adult population is significantly reduced. From these results, it has been suggested that the traumatic lesions originate from inter-human aggressive acts. It was also suggested that the carnivore bite marks, which are definitely post-mortem alterations of the bones, indicate that the individuals were left unburied for some time. The reduced abundance of females amongst the young adults was interpreted as an indication of the abduction of women of child-bearing age. It was further deduced that these humans were probably the victims of a massacre which led to the abrupt end of the LBK settlement at Schletz (Teschler-Nicola et al. 1999).

Other European Early Neolithic Sites with Evidence of Massacre

A similar situation as in Schletz is also found at two Neolithic sites from the LBK period in Germany: at Herxheim in Rheinland–Pfalz and in Talheim near Heilbronn in Baden-Württemberg. These two sites are located approximately 750 km to the northwest and 660 km to the west from Schletz, respectively.

Talheim

The remains of 34 human individuals were excavated from a mass grave found at Talheim in 1983/84. This mass grave was located outside the (assumed) settlement area, which was detected by a surveying project more than 50 yr ago. In contrast to Schletz, no fortifications have yet been found. The position of the skeletons indicated that these human remains were not buried according to usual LBK burial rites. Many bodies were lying face down, others in a very unusual twisted posture, and

Figure 3 Human skull excavated at Schletz with a typical bending fracture.

several skeletons were mixed together. In contrast to the Schletz remains described above, animal gnawing marks were not found. The whole assemblage was interpreted as a mass grave, with bodies quickly thrown into a pit and covered. Anthropological investigation of the bones showed that several skulls were lethally fractured. This again suggests that the humans found in the mass grave were the victims of a massacre. A possible deficit of infants in the age group of 0 to 4 yr was suggested from the age and sex profile of the burial assemblage. It was calculated from the number of women of child-bearing age that no more than 4 additional children should have been present in the grave. Three reasons were considered for the possibility of missing infants: the new-born children may have died of natural causes before the mass grave and been buried according to usual custom; the average time between pregnancies could have been almost doubled by nutrition deficiencies and/or physical, plus psychological stress of the women; and third, that these children were kidnapped by the attackers.

Generally, a deficit of female individuals was suggested for the Talheim population. This deficit was explained by the high mortality in childbirth at this period (Wahl and König 1987).

Herxheim

In the Herxheim area, archaeological finds are known since 1900. Up to now, more than 75 sites have been detected. Early excavations showed that they date from the Hallstatt and the La Tène periods and also from the Neolithic. In a big excavation campaign in 1996–1999, a large LBK settlement was excavated. The settlement was equipped with an outer and an inner fortification ditch—similar

to Schletz—where a huge amount of human remains was found. It has been estimated from the excavated bones that more than 500 individuals are buried/deposited in the excavation area, most of them in the ditches (Häußer 1998). Many skeletons were incomplete and were not lying in a correct anatomical position. Several bones were fragmented and deposited together with animal bones, pottery, and other waste material from the settlement. The most extraordinary findings at Herxheim are calottes from human skulls which at some places appeared to be grouped together. Also, cut marks have been detected on some skulls and bones. For the Herxheim site, a massacre is not the only reason put forward for the atypical burial of the human remains. It is also suggested that these remains may be the result of a change in burial rite at the end of the LBK (Orschiedt 2003; Häußer 1998).

^{14}C DATING AND DATA EVALUATION

In order to test the hypothesis that people were killed at the same time, 15 human bone samples from Schletz were ^{14}C dated at the Vienna Environmental Research Accelerator (VERA).

The dated bones originated from the fortification ditches as well as from regular graves within the settlement. Our standard procedures for the preparation of bone samples and the ^{14}C measurement protocol which we use for archaeological samples were also applied for the Schletz samples (Wild et al. 1998, 2001).

The age determinations are listed in Table 1, together with information on whether the sample originates from a massacred individual or an individual buried in a grave. Two bone samples from Schletz, excavated from the ditches, were dated some years ago at ETH Zurich. The ^{14}C ages of 6145 ± 55 BP (ETH 14373) and 6025 ± 55 BP (ETH 14374) were determined by accelerator mass spectrometry (AMS). From the entire data set (VERA plus ETH data), the unrounded results from samples with clearly identified trauma were combined. The sample from the ditch with the anthropological assessment "massacre not proved" was not included. A χ^2 test of the selected data was performed to check whether the distribution of the results is in agreement with the hypothesis that all samples are of the same age (e.g. Geyh and Schleicher 1990). After the removal of one outlier (VERA-2020/VERA-2738, see Table1), a χ^2 value of 15.4 at 10 degrees of freedom (df) was calculated. The age determination of sample VERA-2020 was repeated (VERA-2738) and the age is in agreement with the result of the first measurement. The outlying of this sample is unexplained. Usually, for the rejection of the "Null hypothesis" (in the present case: all dated samples are coeval), a 5% significance level is used. For a data set with 10 df, a χ^2 value of 18.3 corresponds to the 5% significance level. As the χ^2 value determined for the measured data set is smaller than this, the Null hypothesis (H_0 in statistical textbooks) can be accepted, i.e., no significant differences between the sample ages have been detected. The Schletz data suggest that the samples may originate from the same time. This result seems to support the massacre theory. In addition, no regular grave was dated (see Table 1) to be younger than the time of the massacre. Thus, the massacre could have been the cause of the end of the Neolithic settlement at Schletz.

Human bones from the two German sites were also dated at VERA: 4 samples from Herxheim and 7 samples from Talheim (Table 2). The respective data sets were combined and again χ^2 tests were performed. Two samples from Talheim were ^{14}C dated in the 1980s by GPC (gas proportional counting) at Heidelberg. For sample HD 8606-8827, a ^{14}C age of 5960 ± 80 BP, and for the sample HD 8607-8828, a ^{14}C age of 6045 ± 80 BP was determined. Although consistent with the AMS ^{14}C ages determined at VERA, these results were not included in the present study because of the relatively large uncertainty on these ages. Adding these data to the AMS data set does not have a significant effect on the result of the weighted mean or on the result of the χ^2 test.

Table 1 ^{14}C data (rounded off according to Stuiver and Pollach 1977) of all bone samples from Schletz measured at VERA and ETH Zurich.

Lab nr	Sample material	Find inventory nr, provenance, and anthroplogical assessment	Individual nr	$\delta^{13}C$[a] [‰]	^{14}C age[a] [BP]	Calibrated time range[b] 2 σ confidence interval
VERA-2007	human bone	4470 4224[c], ditch, probably massacred	1993/12	–21.7 ± 0.4	6175 ± 35	5260 BC (95.4%) 4990 BC
VERA-2008	human bone	4518, ditch, massacred	1993/5	–23.9 ± 0.5	6145 ± 35	5260 BC (25.0%) 5160 BC 5150 BC (70.4%) 4940 BC
VERA-2009	human bone	4518, ditch, massacred	1993/4	–21.5 ± 0.6	6055 ± 35	5050 BC (93.1%) 4840 BC 4820 BC (2.3%) 4800 BC
VERA-2010	human bone	4520[d], ditch, massacred	1993/2	–20.5 ± 0.5	6130 ± 35	5230 BC (18.4%) 5160 BC 5150 BC (75.7%) 4940 BC 4870 BC (1.2%) 4860 BC
VERA-2011	human bone	4520[d], ditch, massacred	1993/17	–21.1 ± 0.5	6100 ± 35	5210 BC (7.0%) 5170 BC 5140 BC (1.8%) 5120 BC 5080 BC (81.2%) 4900 BC 4880 BC (5.4%) 4850 BC
VERA-2012	human bone	5076, ditch, massacred	1996/3	–22.4 ± 0.6	6075 ± 35	5200 BC (1.2%) 5180 BC 5070 BC (81.1%) 4900 BC 4890 BC (13.1%) 4840 BC
VERA-2737	human bone	5839 6072 6076[c], ditch, massacred	1997/4	–19.3 ± 0.4	6175 ± 30	5260 BC (93.7%) 5030 BC 5020 BC (1.7%) 5000 BC
VERA-2014	human bone	685/S11, ditch, massacred	Ind. 41	–21.1 ± 0.5	6125 ± 35	5230 BC (16.4%) 5160 BC 5150 BC (77.2%) 4930 BC 4880 BC (1.8%) 4850 BC
VERA-2015	human bone	302/S6-7, ditch, massacred	Ind. 61	–20.9 ± 0.4	6160 ± 35	5260 BC (95.4%) 4960 BC
VERA-2016	human bone	374/S7, regular grave	Ind. 24	–18.9 ± 0.5	6210 ± 40	5300 BC (95.4%) 5050 BC
VERA-2017	human bone	264/S4-6, ditch, massacre not proofed	Ind. 62	–21.8 ± 0.4	6200 ± 35	5300 BC (95.4%) 5040 BC
VERA-2019	human bone	unclear provenance	88/5?	–21.8 ± 0.6	6175 ± 40	5280 BC (95.4%) 4990 BC
VERA-2020	human bone	4455, ditch, massacred	1993/11	–22.4 ± 0.5	6235 ± 40	5310 BC (95.4%) 5060 BC
VERA-2738	human bone	4455, ditch, massacred, VERA-2020 repeated	1993/11	–20.5 ± 0.5	6205 ± 30	5290 BC (95.4%) 5050 BC
VERA-2198	human bone	666, regular grave	—	–18.6 ± 1.6	6210 ± 35	5300 BC (95.4%) 5050 BC
VERA-2441	human bone	692, regular grave	—	–18.7 ± 0.4	6165 ± 35	5260 BC (95.4%) 4990 BC
ETH 14373	human bone	4223, ditch, massacred	n.a.[e]	–19.3 ± 1.1	6025 ± 55	5060 BC (95.4%) 4770 BC
ETH 14374	human bone	4521, ditch, massacred	n.a.	–20.6 ± 1.2	6145 ± 55	5280 BC (93.7%) 4910 BC 4880 BC (1.7%) 4850 BC

[a] 1 σ uncertainty.

[b] The ^{14}C age calibration was performed with the INTCAL98 calibration curve (Stuiver et al. 1998).

[c] One individual can be represented by more find inventory numbers.

[d] A single find inventory number may include more than one individual.

[e] n.a. = not available.

According to the χ^2 value of 1.5 (required value for the rejection of H_0 at a 5% significance level and 3 df: 7.8) determined for the Herxheim data, no deviation from the contemporaneity of the investigated samples is detected. One outlier (VERA-2021, see Table 2) had to be rejected from the Talheim data. We concluded that this sample was probably contaminated by a consolidant. The χ^2 test of the reduced data set (7.5 compared to a value of 11.1 at 5 df for the rejection of the H_0 at the 5% significance level) also indicates that these samples may be of the same age.

In the calculation of the weighted mean, the fact that several samples were measured in one measurement run was taken into account. In routine ^{14}C measurement at VERA, about 30 sputter targets of "unknowns" are mounted in a target wheel together with a set of ^{14}C standards and 1 blank sample ("dead" carbon), which were produced at the same time. The $^{14}C/^{12}C$ ratio determined for each of the measured unknowns present in one wheel is corrected with the same blank value and normalized to the same set of standards. Therefore, in the evaluation of the standard deviation of the weighted mean value of all ^{14}C ages correlated uncertainties had to be taken into account. (For details of the

Table 2 ^{14}C data (rounded off according to Stuiver and Pollach 1977) of the Early Neolithic bone samples from Talheim and Herxheim measured at VERA and at the Academy of Science at Heidelberg.

^{14}C Lab nr	Find inventory nr sample material, location	$\delta^{13}C$[a] [‰]	^{14}C age[a] [BP]	Calibrated time range [b] 2 σ confidence interval
VERA-2021	SK16, human bone, Talheim	–22.9 ± 0.5	5930 ± 35	4910 BC (7.5%) 4870 BC 4860 BC (87.9%) 4710 BC
VERA-2022	83/1, human bone, Talheim	–21.9 ± 0.5	6130 ± 35	5230 BC (18.4%) 5160 BC 5150 BC (75.7%) 4940 BC 4870 BC (1.2%) 4860 BC
VERA-2023	83/10, human bone, Talheim	–22.0 ± 0.4	6085 ± 30	5200 BC (1.7%) 5180 BC 5070 BC (85.1%) 4900 BC 4890 BC (8.6%) 4850 BC
VERA-2025	SK22, human bone, Talheim	–21.5± 0.5	6015 ± 35	5000 BC (95.4%) 4780 BC
VERA-2026	83/13, human bone, Talheim	–21.4 ± 0.3	6095 ± 35	5210 BC (5.6%) 5170 BC 5140 BC (1.2%) 5120 BC 5080 BC (82.3%) 4900 BC 4890 BC (6.3%) 4850 BC
VERA-2046	SK21?, human bone, Talheim	–22.7 ± 1.1	6115 ± 35	5210 BC (11.8%) 5170BC 5150 BC (5.6%) 5110 BC 5100 BC (75.0%) 4910 BC 4880 BC (2.9%) 4850 BC
VERA-2047	83/19, human bone, Talheim	–21.6 ± 0.9	6140 ± 40	5260 BC (22.9%) 5160 BC 5150 BC (72.5%) 4940 BC
HD 8606-8827	Sk4, human bone, Talheim	–21.18[c]	5960 ± 80	5060 BC (94.3%) 4670 BC 4640 BC (1.1%) 4610 BC
HD 8607-8828	Sk 14, human bone, Talheim	–20.59[c]	6045 ± 80	5250 BC (95.4%) 4700 BC
VERA-1826	E96/102 281-14-6 human bone, Herxheim	–19.1 ± 1.3	6145 ± 35	5260 BC (25.0%) 5160 BC 5150 BC (70.4%) 4940 BC
VERA-1827	E96/102 281-117-4 human bone, Herxheim	–20.1 ± 1.2	6165 ± 40	5260 BC (95.4%) 4960 BC
VERA-1828	E96/102 282-7-6 human bone, Herxheim	–20.7 ± 1.3	6190 ± 30	5260 BC (95.4%) 5040 BC
VERA-1830	E96/102 296-16 human bone, Herxheim	–22.5 ± 1.3	6195 ± 35	5290 BC (95.4%) 5040 BC

[a] 1 σ uncertainty.
[b] The ^{14}C age calibration was performed with the INTCAL98 calibration curve (Stuiver et al. 1998).
[c] Determined by isotope ratio mass spectrometry (IRMS) with 1 σ standard deviation smaller than 0.03‰.

routine evaluation procedures, see Steier et al., these proceedings.) The results of the combination of the data and the calibration of the thus derived ^{14}C ages are displayed in Figure 4. The respective χ^2 value of each data set is also indicated in the plot.

DISCUSSION

Although it is known that bone collagen of humans shows a variable turnover time that depends on the biological age of the individual (Wild et al. 1998), it is not expected to detect such an effect in archaeological bone samples with the precision presently achieved in AMS ^{14}C determinations. It must also be noted that variations in the ^{14}C age must be very small due to the relatively short lifetime of people from this time period; for instance, the mean life span of the Neolithic Talheim population was estimated to be about 24 yr (Wahl and König 1987). Thus, it was assumed that the χ^2 test of data from human bone samples should not fail if all the individuals died at the same time, because such samples would be of the same ^{14}C age. This could be shown for the data of each of the LBK sites investigated in this study. The χ^2 tests show no indication that these data sets include samples of different age. Therefore, according to our results, the massacre theory seems plausible for all 3 sites. But once again, it should be noted that the complex Herxheim site is not directly comparable to the others and a different interpretation is under discussion (see above).

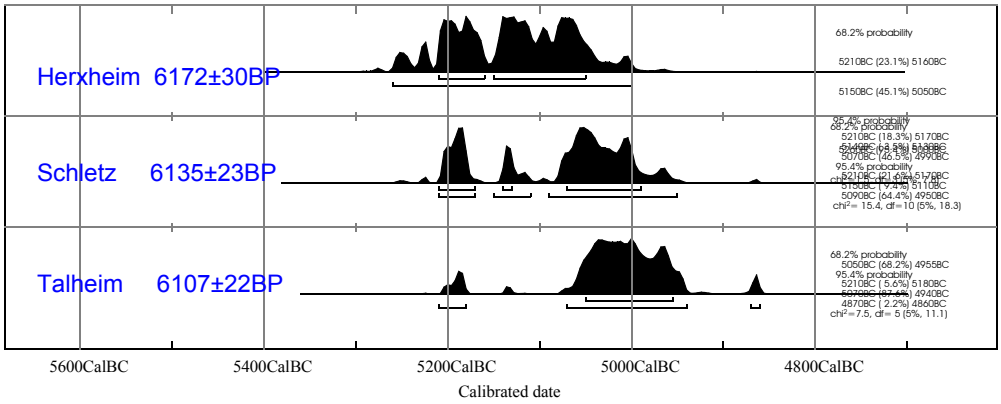

Figure 4 Calibration of the mean ^{14}C age values from the 3 individual sites investigated in this study. The results of the χ^2 are also listed.

From the calibrated date ranges shown in Figure 4, it can be deduced that the events at Talheim and at Schletz may have been contemporary. According to the calibration results, the event at Herxheim may have taken place earlier than the two others, although the possibility that the Herxheim event is coeval with the others cannot be fully excluded.

These results induce further questions about the reasons for increased violence at the end of the LBK period. Obvious aggression is documented by the appearance of fortification ditches at settlements from this time. Three reasons are discussed as possible causes for inter-human attacks and massacres: a) these events were the consequence of the breakdown of local economic systems, leading to local skirmishes between neighbors in isolated regions in Europe; b) these events were triggered by a more general disturbance (e.g. climate) affecting a larger area of Europe; and c) the massacres were caused by a wave of migration that overran Central Europe and may also have been triggered by climatic changes (see Teschler-Nicola et al. 1999).

CONCLUSION

The ^{14}C data of the Early Neolithic site at Schletz described above support the massacre theory derived from the osteological investigation of the human remains. No younger Neolithic material was found at this site, which suggests that this massacre was the end of the Neolithic settlement period. For the two German sites, the ^{14}C data indicate that the human remains may be coeval, and a massacre theory seems to be possible for these sites, although for the Herxheim site another explanation for the atypical burial of the Neolithic human remains is under discussion.

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