



# Iconography and optical 3D measurements techniques: a modern view on the megalithic art of the gallery-grave at Züschen/Lohne (Germany)

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## ABSTRACT

*The gallery-grave of Züschen (Federal State of Hesse, Germany) was discovered and excavated as early as 1894. It has become famous for its decoration showing bovines and cart-like signs. Also, a motif known as the "Goddess' Eye" was found on the inside of the wall stones. Thus the grave is one of the most important Neolithic monuments in Germany. As environmental influences such as rain, frost and rising ground water have damaged the grave and especially the ornaments, there is reason enough to re-inspect the grave using modern documentation methods. With the help of optical three-dimensional measuring techniques, such as photogrammetry and optical profilometry, it is proposed to create a new and improved documentation of the decoration, which can give us further insight into the total number of symbols, into the way they were carved onto the stone and into possible ornaments that overlap each other. Thus we hope to learn further details about the signs and symbols of the Megalithic culture in Europe.*

## RIASSUNTO

*La tomba a galleria di Züschen (Stato Federale di Hesse, Germania) è stata scoperta e scavata nel 1894. E' divenuta famosa grazie alle sue decorazioni nelle quali sono rappresentati bovini e simboli a forma di carro. Inoltre, fu scoperta sul lato interno della parete rocciosa una rappresentazione nota con il nome di "occhio della dea", che rese la tomba uno dei più famosi monumenti Neolitici della Germania. Poiché fenomeni naturali quali pioggia, gelo e infiltrazioni d'acqua hanno danneggiato la tomba e in modo particolare le decorazioni, è necessario esaminarla di nuovo utilizzando moderni metodi di documentazione. Con l'ausilio di tecniche ottiche per la misurazione tridimensionale, come la fotogrammetria e la profilometria ottica, ci si è proposti di creare una nuova e più aggiornata documentazione delle decorazioni, che possa fornirci una visione più approfondita del numero totale di simboli, del modo in cui questi ultimi sono stati incisi sulla roccia e sulle varie sovrapposizioni. Speriamo, così, di poter acquisire ulteriori elementi sui segni e sui simboli della cultura megalitica europea.*

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## INTRODUCTION

More than 100 years ago, in 1894, the gallery-grave Züschen in Hesse, Germany, was discovered and excavated by Johannes Boehlau and Felix von Gilsa zu Gilsa. The underground grave is approximately 19 m long and 3.5 m wide. As its ante-chamber is separated by a port-hole-slab to the east, its construction can be categorized as being in line with similar installations of the Wartberg-culture (2<sup>nd</sup> half of the 4<sup>th</sup> millennium).

Already on the occasion of its discovery, miscellaneous symbols could be identified on the insides of individual wall-stones, which is why this grave from the so-called "herzynische group" has been ranked as a historical ground-monument of European importance.

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Stylized motifs of bovines dominate in number among the decoration. They take the form of fork-like figures, which occur individually or in combination with yoke-and-shaft/drawbar-constructions. Also, there are wagon-like structures, that can be regarded as being one of the oldest representations of carts ever found in Europe. Apart from the ornamented wall-stones a red sandstone-plate was salvaged from inside the grave, showing bovine and wagon representations. In addition, geometrical motifs like single or double zigzag-lines and herringbone-patterns could be distinguished.

The familiar image of the Eye-Goddess links the grave of Züschen to the graves in the Paris Basin, in which this image also appears. On the basis of its rich ornamentation, the grave of Züschen, one of the most important Megalithic monuments of Central Europe, also takes a special position among the gallery-graves of France, East-Westphalia and North-Hesse.

#### STATE OF DOCUMENTATION – ORNAMENTED STONES

The current state of documentation of the grave is mainly based on the drawings and photographs of the individual decorated stones, which were published in 1898. In the last century additional monochrome pictures were taken and partially published. Latex-copies were made, and replicas of some stones were produced. The drawings, sketches and photographs which have been the subject of earlier studies will form the basis of this treatment, which is why a concise summary of these resources is given in the next paragraphs.

In their publication “Neolithische Denkmäler aus Hessen” (1898) scientists Boehlau and von Gilsa zu Gilsa, who were the first explorers of the Züschen gravesite, pointed out stones number a1, a5, b1-3, the cap-stone and the port-hole-slab as being “embellished”. A number of excellent drawings of all stones that showed any sign of treatment, except the cap-stone, can be found in this publication. Until 1978 only one monochrome picture of the cap-stone existed. I. Kappel published an exact drawing of this stone with its motifs as part of her paper “Steinkammergräber und Menhire in Nord-Hessen” (1978).

In March 1961 H. Heintel found further picked marks on stones b7, as well as on a3, a7, a8, a10, b5 and b6. In his essay, collected in “Fundberichte aus Hessen” (1965), he only gives a few sample descriptions of individual ornaments, illustrated by some monochrome pictures. There are no further drawings of the newly discovered ornaments.

Considering the extraordinary archaeological significance, an up-to-date and internationally accessible documentation of the grave, and of its ornamentation in particular, is highly desirable. The aim is to bring the Züschen grave into the focus of Western European research, which is particularly interested in ornamented Megalithic graves (such as Newgrange and Knowth). Another reason to carry out this improved modern documentation is given by the fact that due to environmental influences the grave, and the decoration in particular, are subjected to destruction.

It is our plan now to undertake a detailed survey of the grave and its symbols with the help of new methods. The results should give an insight into the exact number of motifs, their distribution pattern and the technique used for the engravings.

#### METHOD

What follows is a short introduction to the methods developed at the Laboratory of Biophysics at Münster University. Using optical 3D coordinate measurement techniques a way has been found to create a digital three-dimensional documentation of the wall-stone-surfaces and their pictographic symbols.

For the 3D acquisition of the surface structures two closely related methods have been applied: photogrammetry and optical profilometry (fringe projection technique). While the latter is particularly suitable for achieving large numbers of 3D data from limited areas (< 1 m<sup>2</sup>) photogrammetry allows a very precise measurement of single points in a wide field. Both techniques are based on stereo photography, i.e. the object is either recorded with two cameras in parallel (profilometry) or two times in sequence with a single camera (photogrammetry) from different viewpoints. The position of a particular object point then is determined by triangulation after identifying it in the two images. In the case of photogrammetry this identification is done manually, while for profilometry this process is automated by image processing techniques based on a sequence of fringe patterns projected onto the object (Fig. 1).

In the current case the surface of each stone was divided into approx. 20 sections which were subsequently scanned with the profilometric system. Beforehand the spatial position of each section had been measured with photogrammetry in such a way that during post processing all sections could be assembled resulting in a complete 3D reconstruction of the surface consisting of circa 20 million data points with a resolution better than 0.5 mm.

As an example the virtual reconstruction of the port-hole-slab is shown in Fig. 2. It has to be pointed out that the 3D model consists of quantitative data which may be subjected to further measurements and evaluations. A tool that turned out to be particularly useful for further processing is the calculation of ima-

ges range. For this purpose a selected sub-set of the 3D data is re-projected into an image. However, the resulting image points are handled in such a way that each pixel represents a height value in respect to a given plane (e. g. the main surface of the wall-stone).

This representation of the 3D data has the advantage that the information range can be visualized in false color (Fig. 3) and e. g. sections can easily be calculated.

#### TREATMENT

The work in progress is carried out with the aim of securing a full documentation of the grave stones. In order to introduce some of the results of our research we will first deal with the question whether the new technique can help in revealing previously undocumented symbols.

Is it possible to find still unknown motifs on the stones? If so, such ornaments should be fully described, i.e. their type as well as the form, their situation on the stone and possibly its orientation. Possible overlaps of individual motifs are of particular interest.

#### EXAMPLES

The following paragraphs deal with some examples of how previously invisible ornaments were discovered. The port-hole-slab turned out to be especially interesting for this. The 1,4 m high and 2 m wide port-hole-slab with its porthole approximately 50 cm in diameter separates the main chamber from a smaller ante-chamber and forms the entrance into the grave (Fig. 2).

On this stone, the right upper area below the big zigzag-line is of special interest. The stone does not only show the vertical lines beside the herringbone-pattern, as they were known from the drawings published earlier, but also representations of oxcarts, which prevail on the other stones in the grave (Fig.3,4). Unfortunately these complex patterns are hardly visible to the eye today. They are described in the following paragraph.

There are two oxcarts, that consist of two forked signs and additional lines.

The left figure (Fig. 4a) consists of two forked signs, that are linked through a cross-line below the half-bows. From this line, usually interpreted as yoke, another line comes off in the right angle. In its course it slightly arches to the left and meets an additional line. This latter line connects an ornament which can best be described as two almost complete rings. Another line comes off from the aforementioned line, running diagonally to the bottom right. Furthermore there is one line between the forked signs and - what has previously been interpreted as - a kind of drawbar. Both lines originate from the link between the "yoke" and the forked signs. They run in a slight arch until they meet the circular shapes on each side.

An almost identical figure can be seen to the right (Fig. 4d). This portion is more difficult to identify, and some parts seem to have vanished completely. Further research is necessary to supply additional information. The examples of forked signs mentioned above put the port-hole-stone and its motifs in line with the other decorated stones of the grave, since there is now proof that the stone has depictions of bovines.

However, some differences from the other representations of oxcarts occur.

The representation of the wheels as circles deviates from those found in other parts of the grave. Each has the form of a so-called cup mark, i.e. a round deep pit. Also, the lines between the drawbar and the forked signs is unique here.

Other representations of bovines linked by additional lines can be seen for example on stone b2.

Probably the best known image of a two-wheeled oxcart with a half-round car-box, drawn by two bovines, can be seen on stone b1.

As mentioned before, a herringbone-pattern can be made out between the fork-shaped figures (Fig. 4b). It is remarkable here that the right half of this pattern partly covers up some elements of the oxcart depicted further to the right (Fig. 4). This observation raises questions about the attachment temporal sequence of the individual ornaments and the possible combination of several signs.

Also in this part of the stone surface, the zig-zag-line which is shown twofold in some parts, intersects some elements of the oxcarts (Fig. 4c). It is also striking notice that the line's alignment seems to have obviously been influenced by the orientation of the herringbone-pattern.

Unfortunately, the part that surrounds the well-known "Eye-Goddess" ornament on stone b2 is problematic. Here, as well as in other parts of the grave, the rock-surface has been severely damaged. The Eye-Goddess can be reproduced quite completely, but some areas around it cannot be interpreted any more, or at least remain rather debatable. However, it seems that there is only one half-circle above the Eye-Goddess, instead of the two circles described in earlier studies.

#### CONCLUSION

The example of the port-hole-stone in this short insight shows that the developed 3D visualization technology, as applied in Züschen, opens up new possibilities in data collection and documentation. Although



some of the ornaments on the rock-surface are in a very bad condition today and are no longer (or only partially) visible to the eye, the new technology allows a rediscovery of seemingly lost or still undiscovered ornaments.

This conclusion may be a basis for further researches on iconography and symbolism of the Megalithic art of farming societies in Central Europe.

#### BIBLIOGRAPHY

BOEHLAU, J.; VON GILSA ZU GILSA, F.

1898 Neolithische Denkmäler aus Hessen. Zeitschrift des Vereins für hessische Geschichte und Landeskunde. Neue Folge. Supplementheft 12.

COOPER, M.A.R.; ROBSON, S.

1996 Theory of close range photogrammetry, in K.B. Atkinson, (ed.), Close range photogrammetry, Caithness.

HEINTEL, H.

1965/66 Weitere Zeichensteine im Steinkammergrab von Züschchen/Lohne (Kr. Fritzlar-Homburg), Fundberichte aus Hessen 5/6, pp. 78–80.

HERRMANN, F.-R.; JOCKENHÖVEL, A. (eds.)

1990 Die Vorgeschichte Hessens, Stuttgart.

JIANG X.; BURKE, H.

1997 Dreidimensionales Computersehen, Berlin.

KAPPEL, I.

1978 Steinkammergräber und Menhire in Nordhessen.

Führer zur Nordhessischen Ur- und Frühgeschichte 5, Kassel.

ZHANG, Z.

1998 A Flexible new Technique for Camera Calibration, in Microsoft Technical Report MSR-TR-98-71.

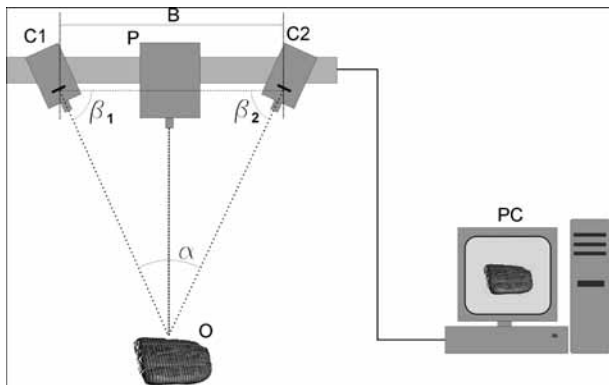


fig. 1

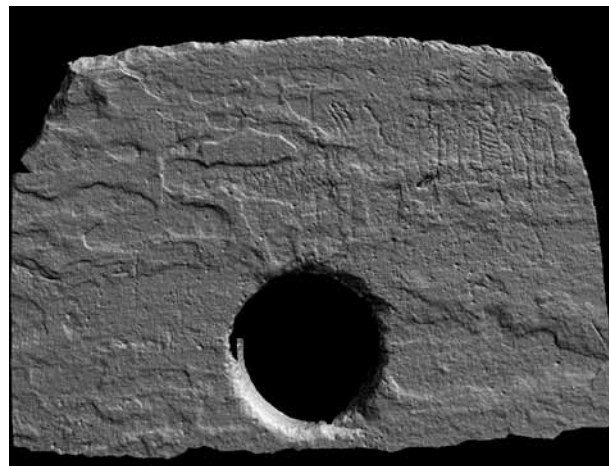


fig. 2

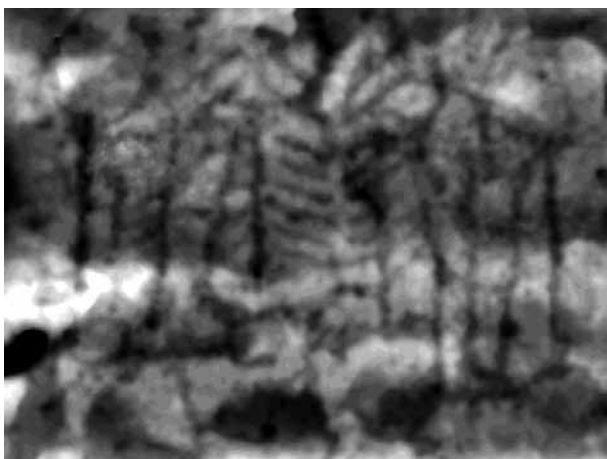


fig. 3 a

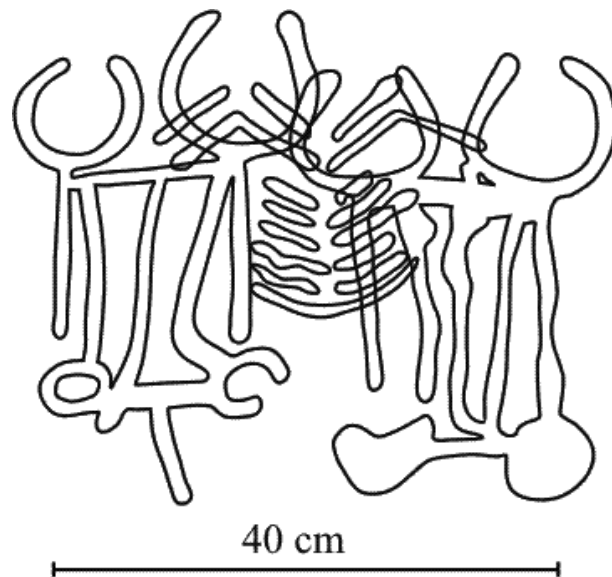


fig. 3b

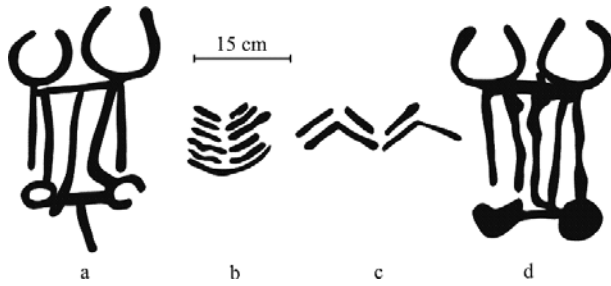


fig. 4

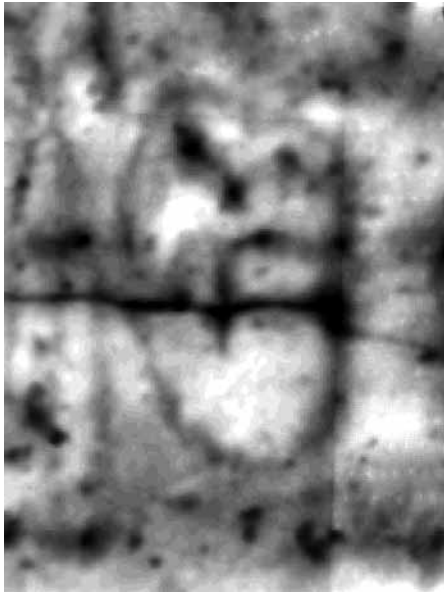


fig. 5 a

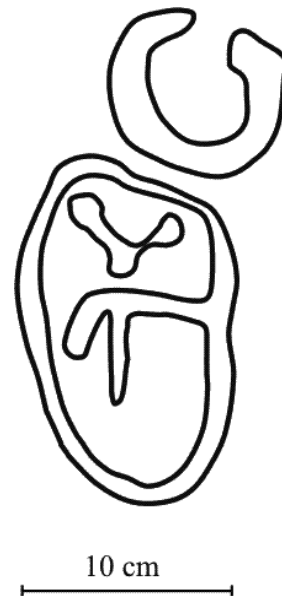


fig. 5 b

**LIST OF CAPTIONS**

*Fig. 1: Setup for optical profilometry consisting of two video cameras (C1, C2) a video projector (P) and a control computer (PC).*

*Fig. 2: 3D-image of the port-hole-slab.*

*Fig. 3: False colour coded range image of the right upper area of the port-hole-slab and drawing of this area.*

*Fig. 4: a) oxcart, b) herringbone-pattern, c) zig-zag-line, d) oxcart.*

*Fig. 5: False colour coded range image of the Eye-Goddess (stone b2) and drawing.*

