

Reconstructions of the Excavations of Two Iron Age Chariot Burials from Belgium

Applying Virtual Reality to Old Excavation Data

Geoff Avern

Bramble Cottage

Winkfield Row

Bracknell

Berkshire, RG42 6NE, UK

Phone: +44 01344 885535 - E-mail: oxynoe@madasafish.com

Abstract: While Virtual Reality modelling in archaeology is commonly used for creating, visualising and interpreting hypothetical reconstructions of buildings or complexes, the author has applied the technique to the excavation records of two Iron Age chariot burials, or tombes-à-char, from Belgium.

A number of Iron Age chariot burials have been excavated near the town of Neufchâteau in the Ardennes region of southern Belgium but, unlike the hundreds of excavated chariot burials from the Marne region of France, the two considered below contained many small pieces of mineralised wood which may provide clues to the form of the wooden superstructure of the vehicle.

The aims of the following reconstructions are, firstly, to demonstrate the potential of applying current 3D modelling techniques to old excavation records and, secondly, to exploit the enhanced visualisation capabilities to search for information which may shed new light on the construction of La Tène chariots.

Key words: Virtual Reality, VR, chariot burial, tombe-à-char, modelling, excavations.

Introduction

The author's doctoral research (Avern, 2001 - unpubl. thesis) concentrates on the creation of better excavation records by use of high resolution digital recording methods. One of the numerous benefits of having a 3D model as a record of an excavation is the comparative ease by which even complex 3D arrays of features and finds may be visually interpreted. This point was demonstrated over a decade ago in the pioneering work by IBM UK Scientific Centre and Southampton University on the Hamwic pit project (Reilly, 1989) where a model of a Saxon rubbish pit and its contents allowed researchers to peruse and manipulate the visual data, helping them to draw conclusions on the formation of the deposits.

This paper deals with 3D modelling, but not from a current or recent excavation. Instead, we aim to demonstrate its applicability to old excavations by simple 3D modelling based on old excavation records. Our second aim is to exploit the advantages of visualisation in 3D to search for answers to a specific archaeological question. We used 3DStudioMax to create 3D models of two Iron Age chariot burials from southern Belgium which were excavated in 1967 (Bonenfant, 1967) and 1969 (unpublished) by Professeur P.-P. Bonenfant (Service des Fouilles, Université Libre de Bruxelles, Belgium).

Iron Age Belgium

The Ardennes, in south-eastern Belgium, lies between the two major La Tène centres of western Europe, viz. the Marne (Champagne), France, and the Hunsrück-Eifel, Germany. Grave goods excavated from cemeteries around Neufchâteau are typically Marnian, while those from burials near Houffalize display stylistic affinities with the Hunsrück-Eifel (as described by Cahen-Delhay, 1974a). Thus the Belgian Ardennes seems to be a frontier zone in the early La Tène (fig. 1).

At least nine chariot burials from the Belgian Ardennes have been discovered and excavated, all in the vicinity of Neufchâteau, that is, from the Marnian sector, and all display typically Marnian characteristics.

Of the more than 130 La Tène chariot burials excavated in the Marne proper, the author knows of none which have yielded any wood finds. Attempts at physical reconstructions of La Tène chariots, such as Furger-Gunti (1991), have been based largely on metal finds which, while helpful for interpreting wheels, axles, articulations and even suggestions of suspension, shed very little light on the nature of the superstructure of the chariots.

The chariot burials from southern Belgium, however, have frequently contained fragments of wood, either carbonised (Cahen-Delahye, 1974b) or, in the case of the two burials considered here, mineralised by the oxidation products of the iron to which they are attached. Bonenfant (pers. comm.) recorded the 3D coordinates of all finds of his 1967 and 1969 excavations with the idea that a 3D reconstruction might be possible in the future, enabling a visual interpretation of the spatial relationships between the small finds, which might shed light on the wooden structure, particularly the superstructure, of Marnian La Tène chariots.

This presentation, then, shows the author's 3D reconstructions made from Bonenfant's plans, profiles and finds registers.

The Method of Reconstruction

It should be noted that the two models created in this exercise differ from the more typical Virtual Reality reconstructions in that "realism", in terms of complex morphologies and naturalistic colours and textures, has not been pursued. Consequently, the modelling process was relatively simple and fast, making it, in the author's opinion, a valuable tool for visualisation and interpretation of the original excavations. The procedure is given below in a series of steps.

1. The plans were scanned and the resultant files were "cleaned-up" using various image processing routines, annotated (some colour-coding, scale bars, etc) and saved as TIFF files (fig.2). (In the case of the 1969 excavation, the 5 plans from different levels of the excavation were also registered and merged into a single image.)
2. In 3DStudioMax a box was created whose top surface had the same aspect ratio as the TIFF image of the scanned plan. The scanned plan is then mapped onto the top surface of the box (fig.3). In the "Top" viewport (there are various "viewports" in this software which allow you to display different views of the model simultaneously) the box simply looks like the scanned plan. Simple objects were created from the software's range of primitives; cylinders (squat, like hockey pucks) for small finds, boxes (elongate and thin) for the iron wheel hoops, pyramids (long and flat) for spearheads, etc and then were colour-coded (purple for wheel hoops, blue for other iron, ochre for ceramics, green for wood, yellow for bronze). In the Top viewport each object, as it is created, is placed over the relevant small find on the plan, i.e. in its correct X/Y position (fig.4).
3. With multiple viewports open on screen, objects can be tilted/rotated to their correct orientation, or bent to their correct shape (e.g. the fragments of the wheel hoops). More complex shapes are created, such as pots (by creating a profile and "lathing" it at the appropriate radius) and the fragmented ring from a horse bridle (creating a torus and cutting it into pieces).
4. With all objects in their correct X/Y positions, the Front viewport is chosen, and a box is ticked to restrict subsequent movement of objects to the Z-axis. Each object is, in turn, selected and raised to its correct elevation (fig.5).

5. The top surface of the box is "sculpted" to the shape of the burial pit. When the box was constructed, for simplicity we nominated that it should have only one segment in X, Y and Z, giving it only 4 vertices per face. At this point in the modelling, we modify the box by increasing the number of segments in the X and Y directions to 30, i.e. the top and bottom surfaces of the box are defined by 31 x 31 (= 961) vertices. After changing to wireframe model and restricting movement to the X/Y plane, many of the vertices are repositioned along the boundary and contours of the grave cut (fig. 6a, b). In the Top viewport all vertices along one contour are selected and in the Front viewport, after confining movement to the Z-direction, they are moved, *en masse*, to their appropriate elevation (fig.6c). The process is repeated for all contours.
7. Changing back to the rendered model, the mapping of the plan onto the top surface of the box is disabled and a colour or texture chosen to replace it. Lights are created and positioned to illuminate the model.
8. While the software permits us to navigate around the model, we may also choose to create an animation for presentation as an .avi file.

Results

The accompanying images are taken from the .avi files made for presentation at CAA2001. The animation sequences 1967.avi and 1969.avi can be found on the accompanying CD-ROM.

1967 excavation

Figure 7 shows the model in plan view. Figure 8 shows the model in perspective view.

1969 excavation

Figures 9, 10 & 11 show the model in plan, front elevation and perspective views.

Interpretations

On viewing elevations from the rear of the chariot burials (with surrounding soil base made semi-transparent) (figs 12 & 13) it is, unfortunately, immediately apparent that we will not be able to deduce anything of the superstructure of the chariots. For the 1969 excavation (fig. 13), we are able to judge the height of the chariot axle from the remains of the left wheel hoop (in purple). It is then quite apparent that the finds of mineralised wood (in green) are either from this level or immediately above it, probably corresponding to the axle and platform of the chariot. Only one piece of wood, possibly two, is found at a higher level which might be attributed to the superstructure.

Similarly, for the 1967 excavation, all wood finds are restricted to levels which are lower than where we would expect to find *in situ* superstructure.

We can, however, make some other observations. In figure 13 the remains of both iron wheel hoops are slightly skewed to the left (except for the most elevated piece of the left wheel). The

right example of the paired iron rods (in front of ceramic vessel) is angled instead of lying flat (as is its opposite), and the left bias of the scatter of small iron and ceramic pieces all suggest that the chariot is not in its original position but has been "pushed" to the left.

Close examination of the models reveal that a number of small finds form "alignments". In the 1967 excavation model (fig. 14) we can see 3 fragments of wood in a line and lying obliquely on the curved edge of that part of the grave cut which accepts the right wheel.

In the 1969 excavation model (fig. 15) we can see a similar alignment of 3 wood fragments and an adjacent cluster of a number of iron remains which appear to form either a couple of alignments in close proximity or which perhaps belonged to a larger discrete mass.

Conclusions

By foregoing realism, the models shown here were simple and relatively quick to create in 3DStudioMax.

Both the 3D models and the ability to easily manipulate their orientation permit excellent visualisation of the spatial relationships between the finds, themselves, and the grave cut. They quickly and clearly showed that we would not be able to answer our specific questions on the nature of the superstructure of La Tène chariots.

Alignments and clusters of finds which did not follow the normal drawing axes may well have been apparent in the original excavation but are difficult to perceive from subsequent plans and elevations. A number of such alignments were easily identified from our models.

The use of 3D modelling on these old excavation data have allowed us to "revisit" the excavation and view it as the excavator was originally able to and further, in ways and orientations that were impossible at the time of the excavation. The benefits of such visualisation are strikingly evident when a final model is viewed side-by-side with the original plans from which it was

constructed. Given the relative simplicity and speed of the modelling we recommend this technique for reviewing and reinterpreting old excavation data whenever elevation or height data accompanies the plan drawings.

References

- Avern, G.J. 2001. *High-resolution computer imaging in 2D and 3D for recording and interpreting archaeological excavations*. Unpublished doctoral thesis, Université Libre de Bruxelles, Belgium.
- Bonenfant, P. 1967. Langlier (Massul): Tombe à char de La Tène I. *Archéologie*. 2: 74-76.
- Cahen-Delhay, A. 1974a. Fouilles dans les Tombelles de La Tène en Ardenne (1970-1972). *Archaeologia Belgica*. No.166: 7-23.
- Cahen-Delhay, A. 1974b. Necropole de La Tène I à Hamipre, Offaing. I. Trois Tombes à Char. *Archaeologia Belgica*. No.162: 5-48.
- Cahen-Delhay, A. 1978. Tombelles de l'Age du Fer en Ardenne. *Archaeologicum Belgii Speculum*. VIII. Bruxelles. p.18, fig.10.
- Cahen-Delhay, A. 1984. Fouilles récentes dans les fortifications de l'Age du Fer en Belgique. (in) *Les Celtes en Belgique et dans le Nord de la France: Les fortifications de l'Age du Fer*. Eds A. Cahen-Delhay, A. Duval, G. Leman-Deliver, P. Leman. Actes du sixième colloque tenu à Bavay et Mons. Association Française d'Etude de l'Age du Fer. p.152, fig;1.
- Furger-Gunti, A. 1991. The Celtic War Chariot: the Experimental Reconstruction in the Schweizerisches Landesmuseum. (in) *The Celts*. Ed. Bompiani. Milan. pp.356-359.
- Reilly, P. 1989. Data visualisation in archaeology. *IBM Systems Journal*, 28 (4): 569-79.

Figures

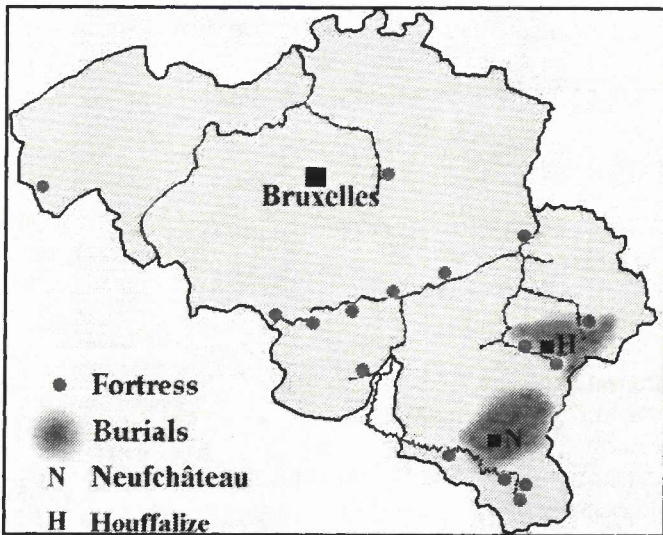


Figure 1. Belgium in the Iron Age (modified after Cahen-Delhaye, 1978 and 1984).

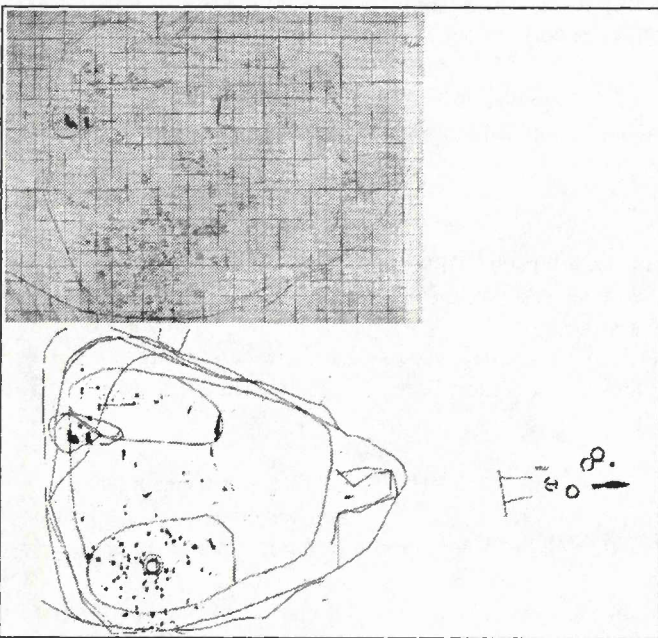


Figure 2. (above) part of the original plan of the 1967 excavation and (below) the plan after image processing, merging of multiple plans and saving as a TIFF file.

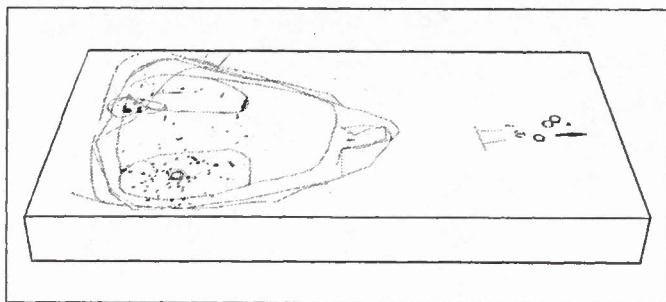


Figure 3. Box created in 3DStudioMax and textured with TIFF file of the 1967 excavation plan.

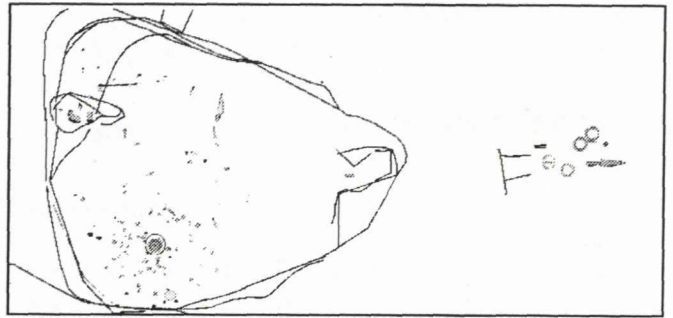


Figure 4. Box (with excavation plan as texture) viewed from above with modelled finds in correct X/Y positions.

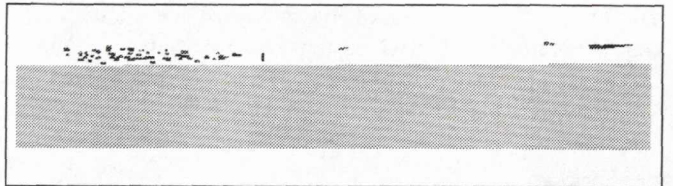


Figure 5. Front view of box showing finds lifted to their correct elevation.

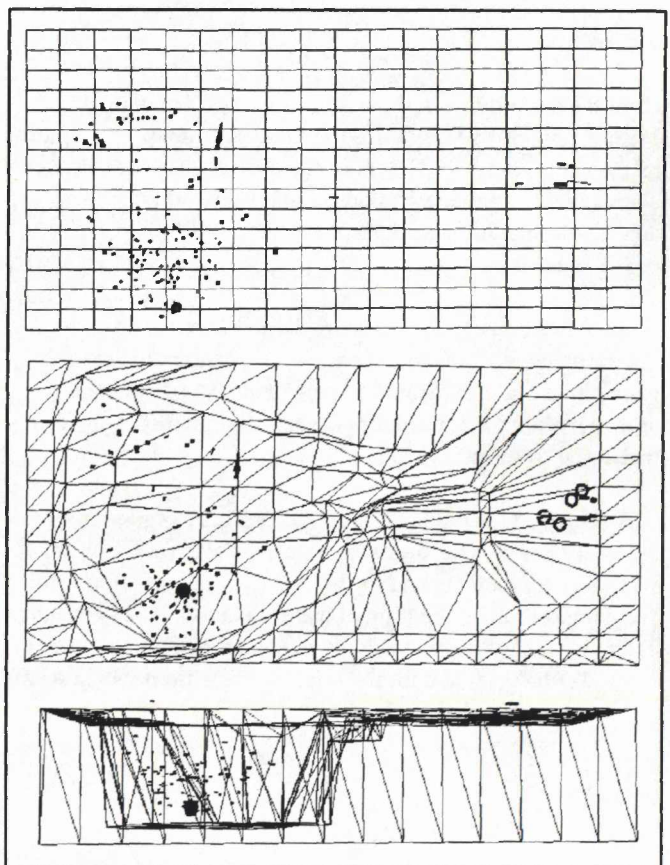


Figure 6. Wireframe models - (above) Top view, vertices in normal position; (centre) top view, vertices repositioned to follow contour lines on excavation plan; (below) front view, vertices lowered to correct elevation, creating the grave cut. (Note: these figures are from an early attempt using fewer segments than in the final models)

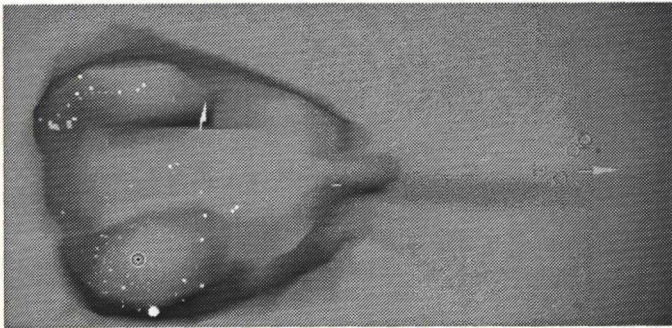


Figure 7. Top view of the final rendered model of the 1967 excavation.

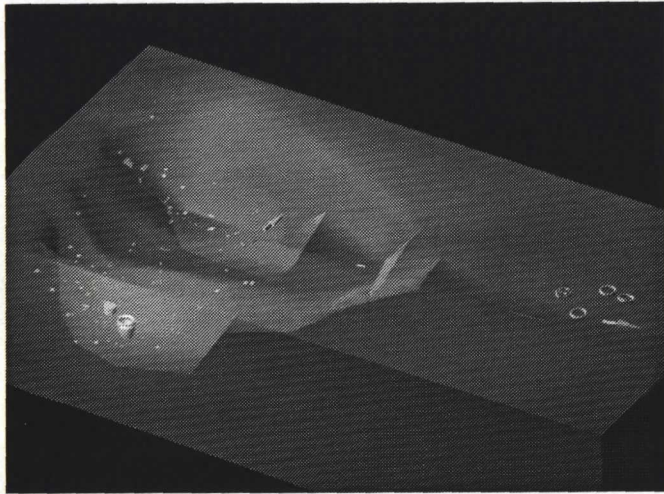


Figure 8. Perspective view of 1967 excavation with "soil" base made 30% opaque.

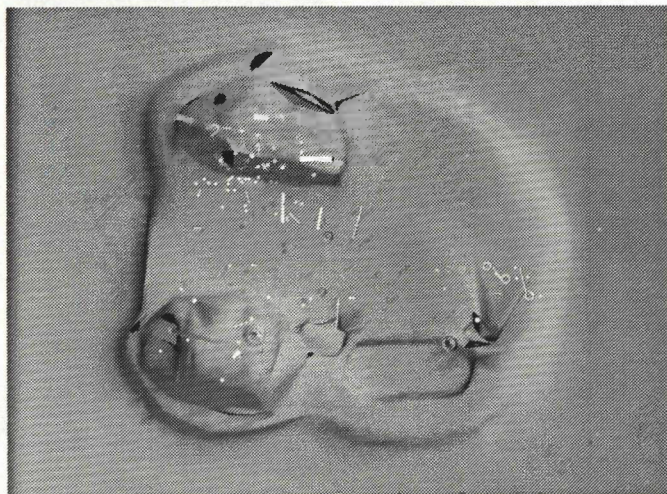


Figure 9. Top view of the final model of the 1969 excavation.



Figure 10. Front view, 1969 excavation, "soil" is 20% opaque.

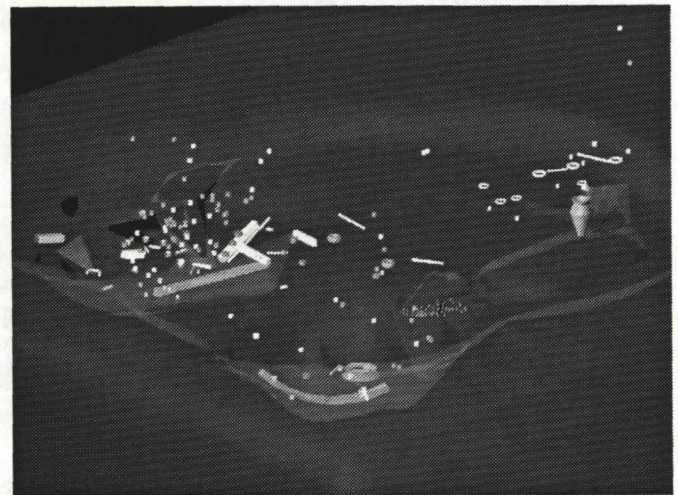


Figure 11. Perspective view (elevated, rear, right), 1969 excavation, "soil" 20% opaque.



Figure 12. Left view (= rear elevation), 1967 excavation.



Figure 13. Left view (= rear elevation), 1969 excavation.

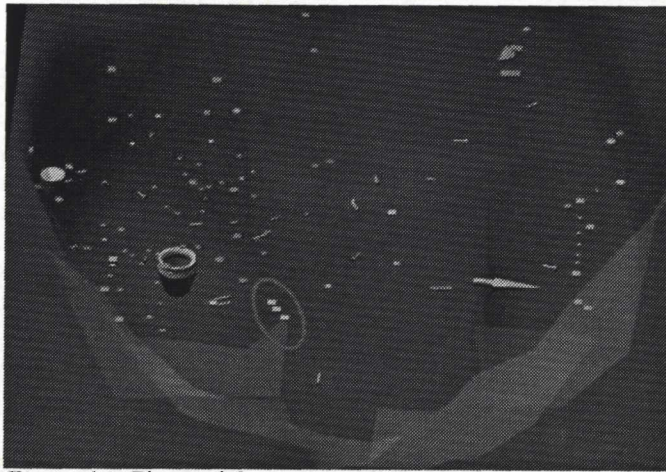
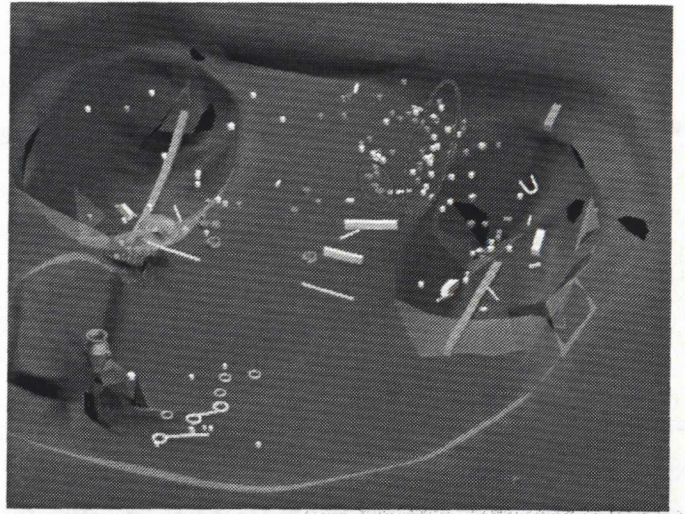


Figure 14. Elevated front view, 1967 excavation; red circle indicates alignment of wood fragments.

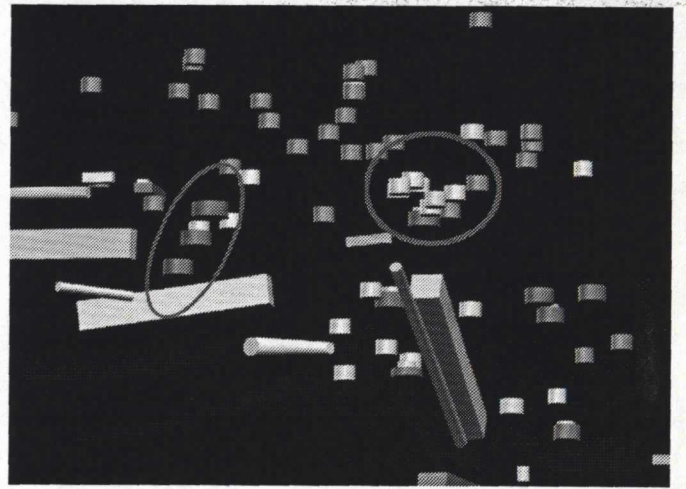


Figure 15. 1969 excavation; (above) right-of-front, elevated view with alignments of wood fragments and iron remains circled; (below) close, right-of-front, low view showing circled wood and iron alignments.