



# Visualising Danebury: Modelled Approaches to Spatial Theory

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## Abstract

Danebury Iron Age hillfort is examined via spatial modelling in an attempt to answer explicit theoretical questions surrounding the function of altered spaces. Within the confines of a small-scale research project, interpretation is placed as the driving force behind methodology, with high-order theoretical arguments approached via modelled spaces constructed in 3d Studio, animation packages, VRML, bubble worlds and Grass, linked via AutoCAD. Military and defensive interpretations in Iron Age work are challenged by the identification of spatial orders, via modelling, which lack defensive function, and seem to conform to ideas of 'liminality' discussed in detail in the Neolithic. These conclusions are then used to assess the role computer models play in 'archaeological fictions' at Danebury, and the extent to which limited technology can pursue experiential goals.

## 1 The site

The Iron Age hillfort of Danebury lies on chalk downland south of Andover in the county of Hampshire. Its hilltop landscape is at a maximum elevation of 143m, with steep slopes in all directions, apart from at the eastern approach (Cunliffe 1984, 1). The site was excavated to a high standard and presents us with a well-documented, complex Iron Age resource. It is defined by three sets of earthworks, enclosing a total of 16 hectares and excavation of these has revealed a series of major developments, characterised by significant alterations to the landscape (Lock 1989). The focus of the changes to the site, and indeed of the site itself, is the elaborate eastern entrance. The research described thus concentrates on this entrance and attempts to look at it from the standpoint of recent Iron Age work, and proceeds from questions regarding the role of computer modelling in archaeological theory.

## 2 Space in the Iron Age

The current Iron Age hypotheses considered have examined in particular the use of landscape for the development, attribution, conveyance and embodiment of symbolic meaning. Entrance spaces, defining movement through manufactured landscapes, are frequently seen as powerful means of both demonstrating and orchestrating social behaviour (Hillier and Hanson 1984; Parker-Pearson and Richards 1994a and b; Thomas 1993; Tuan 1977). More general theories of spatial function have been augmented in the computing literature by Gillings and Goodrick (1996), who offer a view of the potential for landscape modelling to approach this engagement.

In this study models were produced which could be navigated around, in an attempt to identify the role both of defining features such as banks and ditches at different stages in their use, and the areas thus defined. Localised Iron Age 'landscapes' were to be examined interactively via models rather than assessed in plan or in surviving states. Here concepts of liminality were placed alongside the 'warrior Iron Age' (Sharples 1991) hypothesis of the 1980s,

allowing parallel consideration of the two approaches. This was particularly important given the broad spectrum of opinion regarding entrance function present in the literature.

## 3 The defensive function debate

The traditional interpretation of the Danebury earthworks views the impressive east entrance as a defensive barrier, defining an approach which makes attack very difficult and dangerous. This is a familiar, readily accessible view and can be substantiated on military grounds. However, the Iron Age debate surrounding the concept of a 'different' Iron Age - that is to say, one in which pre-suppositions are deliberately confronted - may suggest such defensive utility to be a byproduct of other aims (Cunliffe 1995 cf. Hill 1993; 1995). Bowden and McOmish (1987) and others have suggested that sites such as Danebury, Maiden Castle and Kerr's Knowe may indicate continuity of social practice, with ritual or other significance attached to places and occasions via manufactured divisions such as ramparts.

## 4 Modelling processes

In the completed stage of the project the construction of Danebury's past and present landscape was approached via the derivation of a DEM surface, VRML modelling used interpretatively to define areas for concentrated study and interpretation, and the development, rendering and animation of multiple solid elements through AutoCAD, 3d Studio and, most recently, 'bubble worlds'. The computing literature has identified the considerable power exercised by rendered surfaces and the variety of approaches was intended to offer differing perspectives, highlighting both the more obvious subjective factors and robust conclusions and approaching the "non-linear access" to data discussed by Lock (1995, 16). In addition, at every stage an attempt was made to consider the significance of different data types (Miller and Richards 1995). Thus, initial impressions of the site were gained by a number of visits. Photographs and sketches were produced and notes written, prior to the detailed examination of any descriptive texts. These notes were intended to act as a link between the computer



modeller, with component biases regarding the arrangement and 'function' of the site, and the excavated data. Since all data, models, views and animations used in the project followed a set of naming conventions it was possible to link any piece of recorded data, any note written during the initial visits and during the modelling process, to every related part in the final models. This has led to a cyclical process of modelling and adaptation identifying a considerable subjective element to the appearance of 'final' products.

#### 4.1 Terrain surfaces

The basis of the study was a set of AutoCAD digitised plans, sections, sketches, maps, and textual descriptions. The final dataset incorporated over 30 digitised drawings, in addition to a large textual database. These were combined via external links and embedding into a single AutoCAD file. The first modelling exercise involved the production of a series of DEM surfaces in the Grass geographic information system. The final version, created via an algorithm using weighted flood fills between digitised spot heights and isolines, was then sampled by piping output direct from Grass into a separate text file, providing a mesh of point data. Finally, this mesh was used to define a point surface (Autodesk 1992) by writing a DXF file from the ASCII Grass output. This was imported into AutoCAD for the interpretation of topographic variation and viewpoints around the east entrance. Unfortunately, following topographic meshes proved difficult in AutoCAD and as a result only portions of the models produced are snapped to the appropriate topographic positions. However, where terrain surfaces were used, different models were produced to compare the defined spaces produced with differing DEM algorithm surfaces and also with a flat platform. In the comparison of viewpoints the topographic variation was found to effect results at the extremes of modelling — i.e. where the conceptual distance between data and extrapolated spaces was greatest. It was clear that even at this micro scale DEM algorithm choice could play a significant role in conclusions. This echoes Gillings and Goodrick's emphasis on micro as well as macro scale variation in modelled landscapes of any scale (1996).

#### 4.2 Spatial feature models

The next process involved the building of AutoCAD spatial feature models. These were based on composite mesh primitives defined by the digitised data and comparative datasets (see Fig. 1). Surface modelling was used rather than solids for reasons of speed and it was felt that the complex surfaces to be modelled made a surface approach more appropriate. The surfaces themselves were defined by constructing regular rectangular meshes which corresponded to the measurements available. Points within these were then used to define extrapolated surfaces via the AutoCAD `edgesurf` and `rulesurf` commands. Different parameters for these commands were compared for particular modelled areas. This identified considerable variation in the final modelled surfaces, dependent upon choices such as the number of ruled lines, which filtered through to the appreciation of the spaces produced in the final analyses.

Without this comparison conclusions produced would have seemed far more robust.

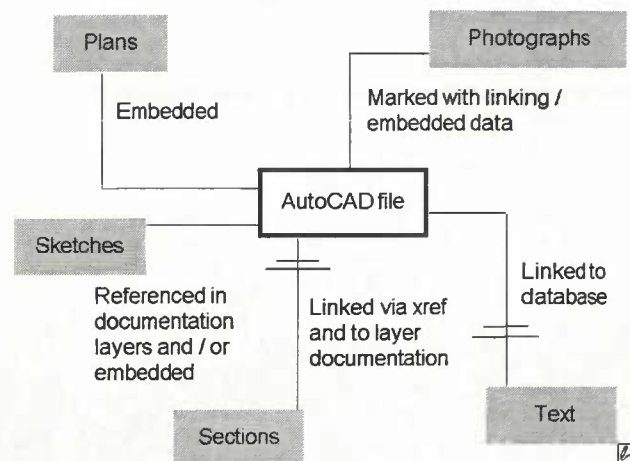


Figure 1. Data types and links to the final AutoCAD surfaces

The visual sparsity of the models produced was a consequence of the background motivations of the project — namely the maintenance of total data integrity, the qualification of extrapolation and the production of readily updatable *different* constructs. Given the limited time and technological resources available, the choice was made to concentrate on producing a number of models which could offer the range of spatial interpretations required by the complexity and ambiguity present in the excavated data. This proved to be at the expense of the 'photorealistic' results defined by Chalmers (Chalmers *et al* 1995) as an enhancing factor in the experience provided by navigable archaeological models.

#### 4.3 Simple VRML

In the third modelling stage Virtual Reality Modelling Language (VRML) was applied to generate a very simple modelled landscape which could be interpreted on an intuitive level (see Fig. 2). The models were engaged with under differing conditions of light and rendered colour. It was this approach which allowed a set of apparent discrete spaces within the Danebury landscape to be viewed. However, it was noted that Hill (pers. comm.) had identified an alignment at the east entrance consistent with the direction of motion *prior* to the construction of any models and it was therefore necessary to subject the models to fairly rigorous testing. Ideally this interrogation should have involved a number of re-interpretations by other parties and more extensive use of the range of different models available. However, the time restraints only allowed for assessment at a mechanical level, with reference to 'objectivity' in comparison. Thus, VRML models derived from variations in the interpretation of excavation data and in the methods of extrapolation were compared.



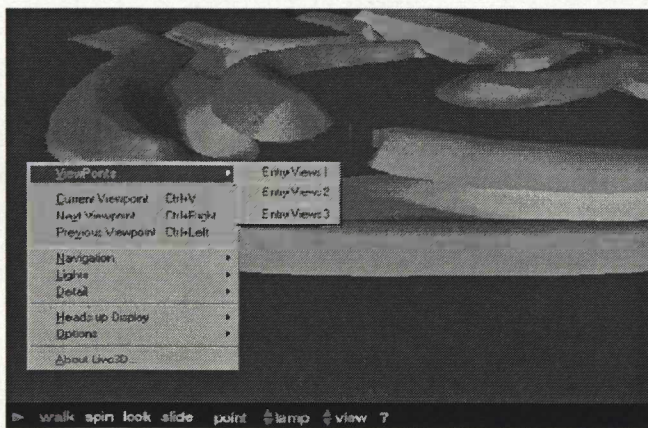


Figure 2. One of the VRML models produced for the east entrance in phase 6

#### 4.4 Rendered views and animation

In the final stage the viewpoints and associated spaces were examined in greater detail via simply rendered and lit models. Viewpoints were set up to correspond with spaces apparently visible in the VRML models, and comparisons between the extrapolated models and the surviving earthworks was made possible using bubble worlds. The defined viewpoints could be adjusted more 'empirically' via the AutoCAD vpoint and dview commands. It was felt that this combination of reactive VRML navigation and controlled AutoCAD viewpoint definition offered a clearer impression of the range of potential viewpoints. Again, the rendered views created followed the naming conventions employed in the digitised and constructed data and could therefore be linked throughout the process from data to model.

To begin with it was hoped to render views with the conventional aim of approaching a modern aesthetic 'realism'. However, given the project's technological limitations and, more significantly the desire to escape a past-as-same, auto-interpretative approach, the views produced are now intended to define simple viewpoints alone. Any absorption will proceed from the imagination of the viewer rather than from definition by the modeller. The viewpoints may therefore be considered analogous to viewshed coverages, with colour serving only as a mental key. In this way it was possible to produce lots of spatial scenarios in a comparatively short time. However, the incorporation of more detailed elements such as variations in rampart construction and illumination to create different Iron Age pasts at Danebury must rely on technology with the potential described by Chalmers and others (Chalmers *et al* 1993, Chalmers and Stoddart 1994, Chalmers *et al* 1994; Chalmers *et al* 1996).

#### 5 Conclusions

Interrogation of the models suggests that discrete spaces seem to be defined within and around the east entrance landscape, with an emphasis on liminal zones of some form (see Fig. 3). Some kind of symbolic emphasis is suggested by a continuity in arrangement and interconnectivity of space which is clearly visible in the models of different phases of the entrance, and much less obviously in plan.

This contradicts other work which has emphasised the alterations to the entrance. For example, additions to the earthworks made towards the end of the fourth century would seem, on the basis of plan, to have altered the east entrance completely. However, the three dimensional model reveals consistencies in the landscape's arrangement - particularly regarding the direction of movement and views.

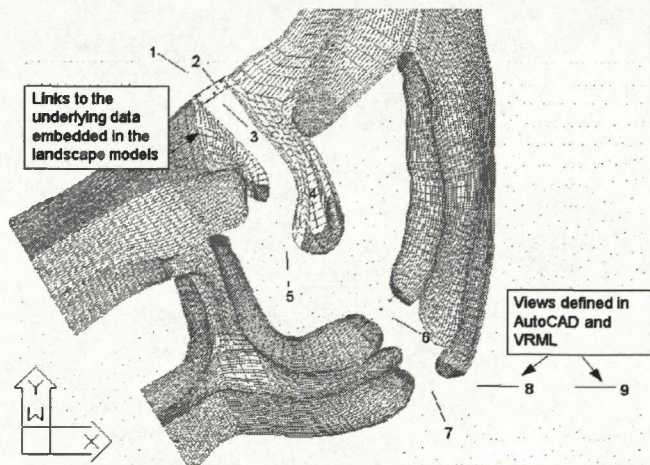


Figure 3. The different spaces - identified in an HTML imagemap, with hotspots to simple animations, VRML files, rendered AutoCAD views and bubble worlds

#### 5.1 Defensive roles

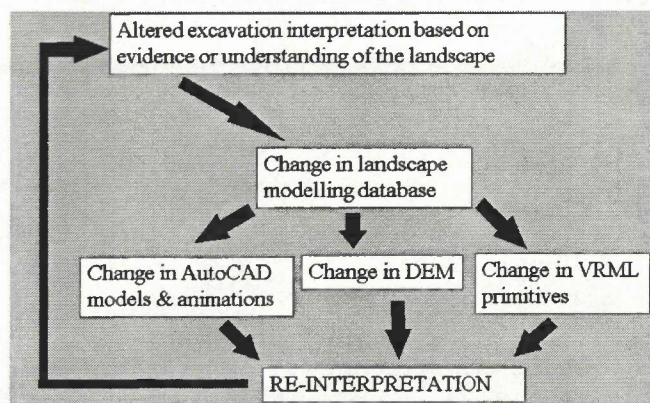
The spaces do not appear to offer any defensive benefits in their early stages and it may be hypothesised that their later embellishment and continuity were similarly a product of symbolic as opposed to defensive requirements. This hypothesis fits with a body of research limiting the bellicose nature of Iron Age societies and with other spatial arrangements noted elsewhere at Danebury and at other 'hillfort' sites. Movement through the spaces, perhaps mediated by social circumscription, leads to the opening of new vistas with access to views of the hypothesised central shrine area closely defined by the earthworks (cf. Chalmers *et al* 1994). The viewpoint analyses identify some defensive utility in the later (phase 6) development of the entrance but modelling of the gateway itself suggests it to serve very little role as a lookout point. Here the models, defined by the views of Cunliffe and others (Avery 1993; Cunliffe 1984) regarding earthwork construction, contradict to a certain extent the impression gained by viewing the surviving earthworks via bubble worlds or in reality.

#### 5.2 Recursive data integration

The modelling itself has supported the emphasis placed by other work on integration of all data types in intuitive ways. This allows for a better critique both of methodology and interpretation. It is also clear that the integration of these different datasets in simple models which allow for rapid change has helped an understanding of Danebury's complexity and suggested both problems and solutions at every modelling stage. For example, the period 5 and period 6 entrance alignments are extremely complex but alternating between layers and re-exporting dxf. files allowed for multiple virtual access to the data, and a better understanding of the possible spatial arrangements. Future



research is intended to maximise this potential for integrated, reactive archaeological landscape data.



**Figure 4: The proposed reactive system of integrated data types for further research at Danebury.**

An awareness of the role of the computer modeller in the construction, rather than the reconstruction, of the past at Danebury and elsewhere has identified a need for recursive approaches to modelling, where each alteration to interpretation of excavated material, explicit application of sketches and personal perspectives, choice of 'correlates' and use of technology would define new spaces to be engaged with (see fig. 4). Such an approach would offer a

great deal to current theory. The work to date at Danebury suggests that where data such as GIS coverages, models, animations and text are combined they provide a useful platform upon which to construct multiple representations of a physical past, whilst retaining some kind of data dependence. In this case, a certain lack of absorption need not be problematic. Indeed, an explicit detachment from Danebury as modelled may allow a great breadth in our recognition of Danebury as excavated and as theorised.

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### Bibliography

- Autodesk, 1992 *AutoCAD Release 12 Reference Manual*, Autodesk BV, Neuchatel
- Avery, M, 1993 *Hillfort defences of Southern Britain - volume one* (British Archaeological Reports, 231), Oxford, British Archaeological Reports
- Bowden, M and McOmish, D, 1987 The required barrier, *Scottish Archaeological Review*, 4, 84-97
- Chalmers, A G, Pattanaik, S N, Biriukov, A and Sharpe, P, 1993 Parallel processing for interactive photo-realistic building walkthroughs, in Strasser, W and Wahl, F (eds.), *Graphics and Robotics*, Schloss Dagstuhl
- Chalmers, A and Stoddart, S, 1994 Photo-realistic graphics for visualising archaeological site reconstructions, Unpublished paper from the International Conference on Imaging the Past, British Museum
- Chalmers, A, Martin, T, Stoddart, S and Wahl, B, 1994 The INSITE project, in Wilcock, J and Lockyear, K (eds.), *Computer Applications and Quantitative Methods in Archaeology 1993* (British Archaeological Reports, International Series 598) Oxford, Tempus Reparatum
- Chalmers, A, Stoddart, S, Tidmus, J and Miles, R, 1995 INSITE: an interactive visualisation system for archaeological sites, in Huggett, J and Ryan, N (eds.), *Computer Applications and Quantitative Methods in Archaeology 1994* (British Archaeological Reports, International Series 600), 225-228, Oxford, Tempus Reparatum
- Chalmers, A, Martin, T, Stoddart, S and Wahl, B, 1996 Investigating southern African archaeology, Unpublished paper from the University of Bristol
- Cunliffe, B, 1984 *Danebury: an Iron Age hillfort in Hampshire - Volume 1, The Excavations, 1969-1978: the site*, Council for British Archaeology Research Report, 52
- Cunliffe, B, 1995 *Danebury: an Iron Age hillfort in Hampshire - Volume 6: A hillfort community in perspective*, Council for British Archaeology Research Report, 102
- Gillings, M, and Goodrick, G T, 1996 Sensuous and Reflexive GIS: exploring visualisation and VRML, *Internet Archaeology*, 1
- Hill, J D, 1993 Can we recognise a different European past?: a contrastive archaeology of later prehistoric settlements in southern England, *Journal of European Archaeology*, 1, 57-75
- Hill, J D, 1995 How should we understand Iron Age societies and hillforts? A contextual study from southern Britain, in Hill, J D and Cumberpatch, C G (eds.), *Different Iron Ages: studies on the Iron Age of Temperate Europe* (British Archaeological Reports, International Series 602) Oxford, Tempus Reparatum
- Hillier, B and Hanson, J, 1984 *The social logic of space*. Cambridge, Cambridge University press
- Lock, G, 1989 Comments on an alternative Danebury, *Scottish Archaeological Review*, 6, 3-5



- Lock, G, 1995 Archaeological computing, archaeological theory and moves towards contextualism, in Huggett, J and Ryan, N (eds.), *Computer Applications and Quantitative Methods in Archaeology 1994* (British Archaeological Reports, International Series 600), 13–18, Oxford, Tempus Reparatum
- Miller, P and Richards 1995 The good, the bad, and the downright misleading: archaeological adoption of computer visualization, in Huggett, J and Ryan, N (eds.), *Computer Applications and Quantitative Methods in Archaeology 1994* (British Archaeological Reports, International Series 600), 19–22, Oxford, Tempus Reparatum
- Parker-Pearson, M and Richards, C, 1994a Ordering the world: perceptions of architecture, space and time', in Parker-Pearson, M. & Richards, C. (eds.). *Architecture and Order: approaches to social space* 1–37 London, Routledge
- Parker-Pearson, M and Richards, C, 1994b Architecture and Order: spatial representation and archaeology, in Parker-Pearson, M and Richards, C (eds.), *Architecture and Order: approaches to social space*, 38–72 London, Routledge
- Sharples, N, 1991 Warfare in the Iron Age of Wessex, *Scottish Archaeological Review*, 8, 79–89
- Thomas, J, 1993 The politics of vision and the archaeologies of landscape, in Bender, B (ed.), *Landscape: politics and perspectives*, 19–48, Providence, R.I., Berg
- Tuan, Y-F, 1977 *Space and Place: the perspective of experience*, London, Edward Arnold

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