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Deconstructing the (Re)Constructed: Issues in Conceptualising the Annotation of Archaeological Virtual Realities

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Abstract: As the virtual reality applications become more and more widely used in archaeological research, a common way to make the documents scientifically credible becomes an imperative. An archaeological virtual reality document has to be documented and annotated in the future in a way, that the information in it can be evaluated and validated according to the same basic principles as research reports and scientific articles. There are however many arguments against using textual metadata schemes proposed for the task. This article explores the issues and premises for introducing a metadata scheme functioning like the virtual reality itself, and points out reasons why an old textual reference might not be enough.

Keywords. Virtual reality, annotation, critical apparatus, metadata, archaeology

1 Introduction: Archaeology and Virtual Realities

Since the late eighties, applications we now tend to call archaeological virtual realities or virtual archaeology in a little broader sense, have been used in scientific research, and its presentation to the public. The term virtual archaeology was first used by Paul Reilly in 1990 (Reilly 1991), but from the present point of view, virtual archaeology in sense of using virtual reality applications in archaeology was already in use during the 1980's (Frischer et al [2001]). The precise moment when archaeological virtual reality was invented, is perhaps of little relevance, but the motivation and expectations for the idea of using digital reconstructions in archaeology are interesting, and do explain the evolution and present ideology behind the virtual modelling done by the archaeologists. Variety and uses of the these applications have grown immensely during the short time period of their existence, but it was not until very recently, that archaeological virtual reality has been proposed as a major media for publishing research results in scientifically credible form (cf. e.g. Barceló 2000, Forte 2000).

The first and foremost motivation for archaeologists and others working with cultural virtual realities, has been from the start the idea of doing something that is impossible, at least in economical sense, in our physical reality (comp. Anstey 2000). The possibility to simulate something non-existent is of interest within a discipline like archaeology, which is destructive by nature. Seeing archaeological sites in three-dimensional form either as excavated data, or as a somewhat interpreted hypothetical reconstruction, is beneficial both from the researcher's and from the everyman's point of view. The potential of digital models for public displays was and is no doubt one of the key attractions of the technique, but the scientific aims were also acknowledged from the beginning by some archaeologists (e.g. Reilly 1989). The possibility to examine a site destroyed by excavations in three dimensions was and is something completely different from restricting the study to mere charts, cross sections and written descriptions.

As it has been generally noticed, while the first virtual archaeology projects were motivated by this same notion, the actual process of building up models and VR simulations lead to results that were at worst only a little more than pure fantasy. The intention was definitely to make something that was the best possible interpretation of available material, but technical restrictions and difficulties in communication between archaeologists and on the other side, programmers and system designers (Frischer et al [2001]).

Apparent technology driven nature of approaches lead at least sometimes to results where the one archaeologist possible involved in the project as an expert consultant, scarcely saw the results before public display. Reasons for this procedure may been searched in a general euphoria of being able to create something as visually impressive as the virtual model, and the obvious pressure from the engineers building the models which was undoubtedly concentrated on the ease of modelling and constraints posed by the software and hardware platform used then. Another aspect was obviously also an uncertainty of what this new media really was. Virtual reality was not considered to be a precise document or a functional tool at the first place (Ryan 2001), but rather an artist's interpretation of the past. Simon James (1997) has referred to academic iconophoby and experiences in archaeological illustrations which probably also effected the speed of unleashing scientific potential of virtual realities in the beginning. General distrust on images and especially visually attractive pictures complimented with the rather unpromising experiences from the early projects lead to the present situation when still in many academic circles the VR is considered to be nothing but a pretty form of art.

From the documentary point of view, in this article the differentiation between illustrative, documentary and functional uses, and between the scientific and the non-up to -standard projects, raises a question on correct terminology. As a young discipline, the virtual archaeology does not have very well established set of common terms to describe itself. Virtual reality is a rather broad term which has however established as a common name for the discipline of multidimensional presentations aiming to at least visual immersion (Heim 1993 comp. Bukatman 1995). While it can be accepted that the general term for the field is called virtual reality, the subcategories such as archaeological virtual reality, virtual archaeology and cultural virtual reality should be determined

to act as usable conventions in the speech (cf. Forte 2000). Unlike the broader terminology, the more specific semantics of the virtual archaeology has risen recently much more debate including terms such as model, modelling, virtual reality document and simulation. Juan Barceló has argued for the term "simulation" when a model is ran as a computer programme with given parameters and it is used to get the results by observation. He defines a model as a computer programme used to power the simulation (Barceló 2001). From the documentation point of view, both the simulations and the models has to be taken into account. Both programmes and simulations have to be described. With both terms the most important fact to be stressed is that both model and simulation has to be understood in rather wide perspective to include non-material attributes and characteristic conception that they are never 1:1 representations of their subjects containing interpretative elements (on representativeness of models cf. Roe 2001).

An accurate term should perhaps consist of sub terms such as "multidimensionality". Probably "representation" could also be a valid substitute for "model". As the apparently promptly widening perspectives of the virtual archaeology leads to even more diverse use of the VR technology in the near future, an inclusive term could be the most representative one. Now however, for the scope of documentation and annotation issues, keeping the existing terms of virtual reality, model and document are enough when understood as a general term for the methodology and technology, as a structural entity of multidimensional data, and as an self-sufficient and self-explaining entity containing both the VR data and the documentation.

2 Virtual Reality in Scientific Communication

Researchers involved in the virtual archaeology have acknowledged the primary role of models as tools for research. This has lead to even tiresome repetitions of researchers arguing after one another for his or her solely scientific aims. These proclamations are of course important to convince those not yet involved in the discipline, but they do not as such contribute anything to the actual definition of scientificity within virtual archaeology, and the fact that the scientific aims are still primarily non-functional, and merely descriptive as Ryan (2001) notes.

Apart from being a digital construct of an archaeological entity, an archaeological virtual reality is first and foremost a media of communication as implied above when discussing the primary audiences of the VR (on the publication aspects of VR cf. Sanders 2000). Apart from containing precise and factual data, to be a sensible document either for research purposes or for public presentation, the virtual model has to be constructed, and especially documented and annotated in a certain way in order to be communicative. Even an attractive looking model of a site without any contextual information or a cue point where to start examining it, makes the whole document useless. This obvious notion underlines the communicative nature of any document which unfortunately seems not always to be the primary goal of academic document producers, that is to say writers in the traditional sense. To be comprehensible, scientific, as well as all other documents including VR models, should be annotated. From the scientific point of view the communication aspect includes the requirement of validation. As it is taught beginning from the academic students' first university seminars on, all documents and premises have to be comprehensible to be credible. To achieve this, the scientific community has to be provided with an apparatus to be able to validate and evaluate the publication and its information content.

Lack of credibility and documentation in the early models was noted first by Nick Ryan in 1996 (Ryan 1996). He pointed out his concerns, that the unsuspecting general public may draw false conclusions from too good reconstructions . As he continued a too polished end product without any mention of the premises for interpretations can lead easily to too optimistic, and even completely false conclusions on the past, and especially on the premises and possibilities of archaeology as a discipline (see also Ryan 2001).

At present, the criticism of projects that giving priority to attractiveness rather than accuracy has lead in some degrees to the other extreme. Visual attractiveness has been considered in some statements, for instance in CAA 2002 conference, as a rather definite drawback. It is self-evident that concentrating solely on the aesthetics is not a valid approach, but definite denial of realism as a means to enhance the communicativeness of the models has also to be considered fallacy. A detailed and attractive, model offers much more comprehensive means to understand the past perception of objects, sites and landscapes than a visually only cursorily representative analysis or sticking into just basic factors - of course within certain limits and only through understanding what the model can not possible tell. As a whole, a way to scientific credibility and usability of a virtual model is not in making ugly models, but rather in a quite different as well as simple concept.

The way to make virtual archaeology scientifically credible is to apply the basic methodological concept of source transparency also in the models, as it has been noted by Maurizio Forte (2000) and Juan Barceló (2000). A standard for applying generally accepted and applied rules for documenting sources in research reports comparable to that used in textual documents, is however needed to achieve this goal. The current most promising experiments made on this field have been done by applying the existing metadata standards such as Dublin Core (DC) and creating special schemes based on them, for archaeological research. Practical experiments for a critical apparatus of virtual reality models has been done, for instance within the UCLA Cultural Virtual Reality Lab (Frischer et al [2001]). From the standardisation point of view, the most far reaching propositions so far which have also been applied in practise, have been made by Franco Niccolucci and Francesca Cantone (in this volume), and by Nick Ryan (2001).[1] Both of the mentioned propositions are based on XML/X3D specifications which seems to be at the

[1] A number of other current metadata initiatives could mentioned from the GeoWeb proposition (Leclerc et al 2001 cf. http://www.ai.sri.com/~reddy/pubs/pdf/icc2001_geoweb.pdf) to educational metadata schemes such as LOM and DC-Ed.

moment, in theory at least, one of the most suitable standard specification platforms for storing and documenting virtual realities, as well for archaeological data in general as it has been demonstrated by a number of instances (e.g. Crescioli et al. 2002). To be fair, inclusion of metadata fields in data storage formats, is not however unique in XML. Metadata has become a standard in nearly all newly introduced specifications. XML however, have advantages because of its dynamic structure, interchangeability, and the control of consistency within the documents (Cantone 2002).

3 What's Wrong with Metadata?

Apart from the fact that precise schemes and relevant data to describe archaeological virtual realities is still to be defined, the overall situation seems to be quite promising. Or is it not? Is it really true, that by including a set of fields reserved for storage of metadata according to a standard scheme, makes the models adequately documented? It seems to be a common agreement that they will, even while there is a number of arguments that suggest quite the opposite. Textual metadata performs to a relatively acceptable degree, but whether this is enough, is questionable.

The first argument is that, as text is by no doubt a reasonable media to document and annotate text, it is quite the opposite, when annotating other media. The difficulties of textual annotation and documentation of static and moving images, and of different kinds of physical objects has been a difficult problem in a number of projects during the last decades (Paquet & Rioux 2000). Image, film, audio, music and physical objects have been catalogued in databases nearly as long as databases have existed. Databases have become more powerful, algorithms and indexes have been developed as well as search and retrieval tools, but the basic characteristics of these media types have effectively prevented the development of, even theoretically, a perfect way to describe non-textual media types as text. This has been the basic reason for experimental approaches to develop alternative methods for effective retrieval of data (e.g. Paquet & Rioux 2001, Salosaari & Järvelin 1998) The fact that all other information apart from textual is perceived and processed to knowledge in a different manner - through different senses and through different kind of reasoning - consequences that there is no perfect way to make any cross-media descriptions. Therefore full annotation of virtual realities by using descriptors and references in textual form, or even in multiple media formats allowed by the most recent standards, is a practical impossibility.

Although I have rejected the possibility to describe or annotate virtual realities in an ideal way by using text, my main point is not to criticise the ongoing initiatives for introducing a set of textual metadata for virtual archaeology. I imagine that it will be possible some day to work out a way to achieve documentary transparency without restricting the annotation to basically unsuitable media types, but in the meantime it is sensible to direct a portion of the concern to minimise the negative effect caused by partial descriptive value of textual metadata and the effect of VR documents not documented and annotated at all. The main concern is however that it is not satisfying in longer perspective to restrict efforts in doing something partial, as Barceló (2001) suggests in connection with Mixed reality systems on concentrating on the new attributes the new media can offer.

The second argument against the present metadata thinking is that the current metadata schemes have been defined, or are being defined, by restricting the documentation only to hierarchies and structures given by the available data and the modeller. Even though it seems reasonable from the perspective of an excavator to build a model based on an archaeological report from the premises of the stratification or structural premises, it is not necessarily the same hierarchy or structure the represented object originally had and even less probably the way the forthcoming examiner of the model perceives it. As this principally communicational issue can not evidently be solved by changing the order of documentation a way should be provided for the forthcoming interpreter to reorganise the documentation so that it should be possible to read starting and ending at practically any point. Even though XML and X3D are modern and very flexible, the basic structure of the documents and therefore the technical backbone of the worlds is as linear as of a traditional narrative texts is, which is quite the opposite from the non-linear nature of the natural world and its virtual counterparts.

Examples can be retrieved from basically any kind of archaeological data. While documenting pottery it is very well known, that the most important areas for identification purposes, are base, rim and handle. In analogous reality, drawing a precise line between different areas is not that important, but as a virtual model is mathematical by its nature, there is always a need to be precise even when considering imprecise matters. In a virtual model of an unidentified sherd or even of a whole vessel, it is not at all clear where to draw a line between the rim and the rest of the vessel to document the characteristics of the identifying features separately which from the communicative point of view would be quite reasonable structuralisation. The difficulty is even more imminent in sherds that could probably be from the very near vicinity of a diagnostic area. The sherds could be connected by close analysis, but in cursory description and catalogisation done after the excavation, it would be rather improbable that the identification would be a correct one. The problem of indefinite areas and their description according to a specific category is even more immanent in landscape models. How to define areas such as coastlands, valleys and mountains consistently?

The previous examples demonstrated some of the difficulties. It may be very well argued that the problems may be solved by implementing fuzziness in structural elements. That is correct, at least in theory, but before giving this simple answer which is not that simple in practise, it may be worth thinking, what is the basis for the mentioned kind of phenomena of the kind of information.

In comparison to the mentioned structural difficulties, interpretative problems do pose even more complex problems. An excavation documentation is already an interpretation before any contentual interpretations are made. The report is based on physical data unearthed and documented as it is, but there are still situations when it is extremely difficult to draw borders between structures, soil types, functional zones and

stratification levels, and to determine whether there are only one or several different entities to be documented. The excavation report gives the required information but also a presupposed interpretation. The value of excavators insight must not be overlooked, but because of the ever changing framework for the interpretations and possible better future understanding of the past there should be means to examine documents according to multiple wholly new structural hierarchies, fuzzy stratification based on coming information, tools to be able to handle probable compositions, several functional groups and entities.

The third argument against traditional metadata ideology is its relatively weak support for the present kind of information usage. In contemporary society, essential information has to be extracted quickly and with relative ease, because of the overwhelming amount of available, potentially relevant information, and because of the ever-growing academic and general public searching independently for information without direct expert aid. A typical virtual model requires often wandering-type of reading and relatively comprehensive browsing of all of its entities to find and extract the essential information content. Impossibility to concentrate only on personal points of interest, and to quickly browse the model to get a comprehensive overview, decreases considerably their usability as documents in comparison to well-abstracted articles, physical objects or hypertexts. Models with critical apparatus implemented only in each separate entity, are extremely complex in practise and take a lot of time to be understood. To counter non-usability caused by cognitive complexity, models have to support browsing kind of examination in the meaning it is understood in connection with texts.

The fourth and the last argument concerns the documentation process with current metadata schemes and their implementations. As even among the archaeologists only a few are interested in documentation itself, it is clear that the amount of required documentation work should not be increased but decreased as fas as it is possible. The process can be automated to some extent by implementing more machine readable and writable schemes, by developing software with more automated features for the documentation work, but also by concentrating the effort of an archaeologist more on the relevant intellectual work than on the routines.

The critique I present against the traditional metadata schemes concerns first and foremost their weak connection to the nature of virtual realities they are supposed to be documenting. Another aspect of the metadata is its relation to practise. The data itself could be better suited for information retrieval, reading and understanding the content, but also for decreasing the amount of manual work needed during the documentation process. These points are no novelty. The father of the virtual reality and hypertextualism, Vannevar Bush, was quite conscious of these both facts while sketching the idea of a "memex" in 1945 (Bush 1945) as well as many others after him. The only curious notion is that we think far too seldom "as we may think".

4 A New Approach?

The need for a new or at least refined approach to archaeological virtual reality models and virtual reality in general has to be adapted through reconsidering the existing forms of documents, and especially through considering the basis for the existing critical apparatuses. Therefore it is a complex task to define what kind the new annotation schemes should be in practise. All the issues cannot be handled solely by defining a new standard for coding and storing information. New functions have to be implemented in retrieval software, and in search tools such as Alexandria, an automatic 3D objects description and search technology presented by Eric Paquet and Marc Rioux (2000). Despite extensive use of advanced technology the most important novelty has to be achieved in the practise of thinking: what would be beneficial and as accessible as possible.[1]

The most radical change has to be a new perception of virtual reality models according to their very own premises, and forgetting the conception that a virtual reality should be inherently comparable to a textual document. A way to approach the problem of the unsuitability of textual annotation of the virtual realities is to try to understand more thoroughly how we perceive the virtual realities. The scientific quality of document cannot be judged according to a formal criteria, but rather to a criteria of transparency and adequate documentation of interpretations and results. As such the concept could be implemented on existing data storage standards such as XML with new syntax specification. In that sense the most important questions are what else, apart from the data currently considered to be important, should be documented, and how to do it to make the process as efficient as possible. The intention of new schemes should not be to increase the amount of work, the cognitive load or consuming of time of the documenting archaeologist.

A plausible conceptual base for an annotation scheme could be described as a general metadata network: a network of descriptors linked but not embedded to the model. Different kinds of meta models has been proposed also for archaeological data (e.g. Madsen 2001, Doerr & Kalomoirakis 2001), but they tend to be based on quite strict hierarchical and relational concept. Within the more open metadata network, apart from describing only one entity in the virtual model, the descriptor nodes should also contain information on the probability of information, its probable, definite and possible relation to other descriptors and entities, characteristics, and information on how to deconstruct the current document structure and rearrange it according to a new set of premises, unlike the hierarchical concepts. In Figure 1 is presented a simplified chart depicting the logic of the conceptual scheme called "3/TRIAN I", and the relation of the data model set to a very simple archaeological three-dimensional model.

[1] Schlader (2002) has reconstructed the semantic and structural of database systems usage in archaeologhical research and presentation noting some of the difficulties regarding the concept of metadata and its qualities.

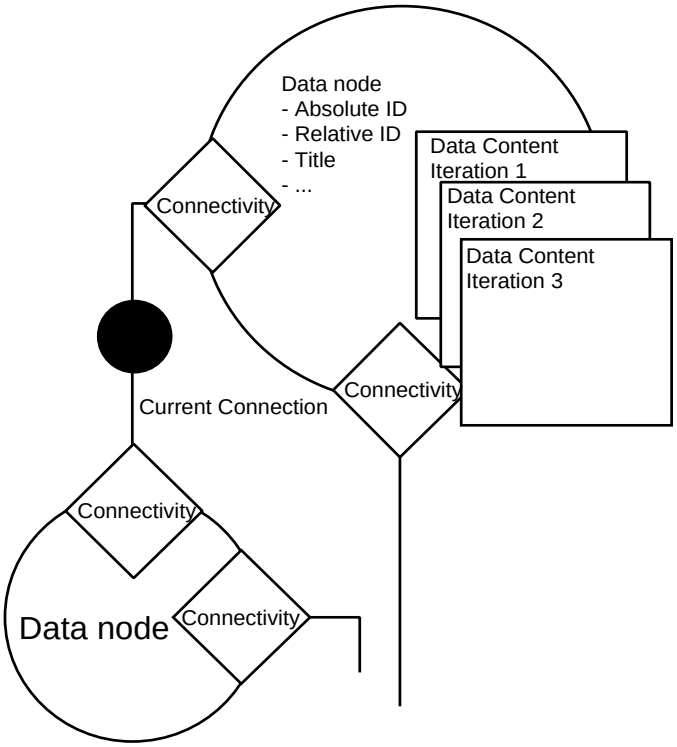

Fig. 1. *A conceptual model for a 3/TRIAN 1 scheme of dynamic annotation and description of archaeological virtual realities from implementing a cognitive non-textual approach.*

The node data in scheme evolution version 1 includes the following data containers:

- Absolute ID
- Relative ID (in interpretative chains)
- Probability factor (a fuzzy value with references to related nodes)
- Nodes with relation to the present node (strength, direction and type or relation)
- Characteristic features of the node (both user defined and computed)
- Node name (a textual identifier)
- Reference to source (a link, reference to media, reproduction of the media i.e. photo)
- Comment, explanation
- Dynamic references to similar external entities

Unlike the "3/TRIAN I" scheme may suggest, the essential feature in trying to define a more usable system for annotation and documentation of virtual realities is not however in defining a new data set for a node, but defining a framework according to what it should be functioning. From the cognitive point of view the physical structure of annotation apparatus does not have to be directly inserted in the virtual reality document, nor in a fixed metadata scheme. The information itself and the according scheme should be rather linked by dynamic connections allowing restructuring and reorganisation depending on the approach the readers of the model take. The second notion is that the inner logic of the annotation scheme should not necessarily have to follow the conventions of textual annotation schemes, but rather concentrate on annotating virtual reality according to the logic the human beings are conceptualising three dimensional spaces as suggested in the critique of the traditional conceptions on the metadata.

5 Conclusions

As the virtual reality applications become more and more widely used in archaeology, demand for a common scheme to document and annotate the models, in a universally accepted way is growing.. As the applications grow more and more complex, and they become more and more the only direct source for many research results, it becomes imperative to be able to handle them as scientifically valid documents. For archival purposes, the need for a comprehensible way to communicate through using models for critical evaluation and further studies by fellow scholars and scientists, becomes even more actual. Without such a standards the scientific community risks losing both information and a sound base for the whole methodology if considered in a longer time span. As a document ceases to be communicative, it loses its reason to exist.

What then should be done and what should not be done? The purpose of this article is by no means to neglect the work done in developing the traditional methods of annotation in virtual archaeology. I agree that the same goals of promoting virtual reality models as scientifically valid documents can be pursued by using common static and expandable textual metadata schemes as it has been done for decades (e.g. Ryan 2001). What I disagree or at least like to question is whether it is the best possible approach. While the perception and the process of constructing meanings for a multi-dimensional space is inherently different from the process of working with textual documents and linear narrative or non-narrative information, it seems plausible to expect that also the annotation scheme should be constructed according to the inner cognitive structure of the new media form and not according to traditional classification and key-wording.

The general principles presented here are by no means a comprehensive answer to the question. A usable logic for managing the annotation framework, comprehensive list of descriptors, essentiality of different kind of information, and the final evaluation and comparison to the traditional annotation has yet to be done. To get answers to these questions is one of the primary aims for the 3/TRIAN (3-dimensional annotation) project, but also a subject of discussion for the whole community of researchers using and developing virtual reality in archaeology.

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