

TNT: The Neanderthal Tools and NESPOS

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ABSTRACT

TNT is a combined research and demonstration project within the EU "Digicult" program, which facilitates research and preservation work on Europe's artistic and cultural treasures using latest technology. Eight scientific and technical partners from five European countries are involved in the project. Artefacts, human fossils and related data from Neanderthal sites are not only being uniformly catalogued for a web based databank, but also visualized through CT and 3-D surface scans. Moreover tools are developed for a collaborative internet platform called NESPOS which, through visual simulation methods, enables graphic reproduction, measurement and examination of fossils and archaeological objects. Further on the public ArchChannel will be installed, a popular science portal which reflects the current state of the European research on Neanderthals.

1. INTRODUCTION

TNT is a combined research and demonstration project within the EU "Digicult" program, which facilitates research and preservation work on Europe's artistic and cultural treasures using latest technology (Semal *et al.*, 2004). It started in March 2004 and will end after 24 months. The project was initiated by the Neanderthal Museum and ART+COM, a company for interactive media-technology in Berlin which is the project leader. Three further scientific institutions (University of Poitiers, France; Croatian Museum of Natural History, Zagreb, Croatia and Royal Belgian Institute of Natural Sciences, Brussels, Belgium) and three additional technical partners (Hasso Plattner Institute, Potsdam, Germany; PXP Austria, Vienna, Austria; National Geographic Germany, Hamburg) are involved in the project. Artefacts, human fossils and related data about Neanderthal sites are not only being uniformly catalogued for the database, but also visualized through CT and 3-D surface scans, 2-D digital images and other documents. Moreover, tools are developed for a collaborative internet platform called NESPOS which, through visual simulation methods, enables graphic visualisation, measurements and examination of fossils and archaeological objects. The visual simulation engine developed within the project is called VISICORE. With VISICORE researchers will have the chance to easily exchange content in 3D format via the Internet, to compare results and artefacts with each other, to test theories, to combine results world wide and to reduce direct handling of the fragile fossils.

Within the TNT-framework the public ArchChannel will be installed by National Geographic Germany. The ArchChannel is planned as a popular science portal, which reflects the current state of the European research: Every user is invited to discover the world of the Neanderthals through the internet. From the end of 2005 onwards, the website will not only supply extensive information, but also provide numerous interactive modules enabling the user to make an entertaining journey through time to the world of the Neanderthals. The creation of a scientific cross-border data pool and the integration of new imaging processes, in combination with a website for the general public, make TNT unique.

2. STATUS QUO IN NEANDERTHAL RESEARCH

Today several thousand archaeological sites of Neanderthals are known in Europe. About 300 Neanderthal fossils from some 130 sites are known and at least 50 sites delivered exceptional archaeological objects and features crucial for the understanding of Neanderthal adaptation and subsistence. In the last decade Neanderthal research has become an interdisciplinary task crossing national and international borders being embedded into palaeoanthropology, archaeology, geology, palaeoclimatology, palaeobiology and social sciences. The amount of data has exploded. State of the art research requires therefore innovative tools to handle the large body of data. At the same time the fragility of human fossils demands special requirements for an appropriate conservation policy and a responsible cultural heritage management.

During the last years the application of CT and computer-assisted 3D-reconstruction have become more and more important in palaeoanthropology, as these techniques have proven to be highly useful for the study of fossil hominids. Often hominid fossils are embedded in stony matrix that cannot be removed manually without risking damage of the precious fossil. By the means of computer-assisted reconstruction a virtual removal of sediment is possible as a completely non-invasive approach (Gröning, 2003). In addition, it allows the refitting of fragmentary fossils, the correction of taphonomic deformation or the study of internal features like the bony canals of the inner ear (Spoor *et al.*, 2003). For these purposes various software packages, mainly adopted from medical applications, have been used by palaeoanthropologists (Zollikofer and Ponce de Léon, 2001).

However, the necessary software is rather expensive and requires a lot of technical knowledge so that only very few anthropological institutes are able to work on high-quality 3D-reconstructions, especially as insufficient funding of universities is a common problem in several European countries. Furthermore, there is only little collaboration between the teams of different institutes at this stage.

At present, most of the anthropological and archaeological research is still based on the study of the original artefacts or fossils. By now, relatively few fossils have been scanned with computed tomography. Hardly any 3D-scans exist of archaeological finds associated with Neanderthals. If CT-scans of fossils already exist, they are often of insufficient quality or only suitable for the study of certain anatomical features. In addition, most often only the reconstructed image stacks are saved, but not the raw data of the scans so that additional image reconstructions are not possible. Then it is necessary to scan the fossil again.

In order to study the original fossils the permission of the curators is required. In some cases this is rather difficult to obtain for reason of conservation policy. As hominid fossils as well as archaeological finds can often only be studied within the museum, where they are kept, travel costs of archaeologists and anthropologists are in general very high. This is especially the case if studies comprise the comparison of finds from several sites. In addition, finds of the same site can be distributed among museums in different countries.

The originals themselves suffer from repeated examinations. Even if they are handled with care, minor damages cannot be avoided e.g. that edges are worn off or scratches on the surface occur. This is for example a severe problem for the famous Krapina collection, which has already been noticeably damaged by the repeated examinations of anthropologists from all over the world. In order to preserve the fossils for future generations, it is necessary to reduce the treatment of the originals to a minimum.

Next to the accessibility of the original fossils and artefacts, the accessibility of literature is a problem. Many Neanderthal sites have been dug before the 1950ies. Therefore, the first detailed descriptions of the sites might have been published in journals that do not exist any longer and the early volumes have been preserved only in very few places. However, especially for the understanding of the archaeological context of the finds, these original descriptions are essential.

On the other hand, Neanderthal sites and finds that have been studied very recently are often not yet published, so that it is not possible to get detailed information. Sometimes it takes several years until the first detailed descriptions are published. Unfortunately, some sites are then only described in journals with very limited regional distribution. In addition, fossils and artefacts are often published as so called grey literature only (Master thesis, PhD thesis etc.), which is also not easily available and only known to a small group of scientists.

Besides this, the data input from disciplines others than anthropology and archaeology has increased dramatically. Therefore, a structured overview on the various research results is hardly to achieve by means of conventional data management.

Although Neanderthal research has, therefore, benefit during the last decades from new computerised techniques and interdisciplinary approaches, the scientific progress is slowed down by an inefficient dissemination of new results and the low degree of international collaboration.

3. THE NESPOS SOLUTION

The scientific heart of TNT is NESPOS (Neanderthal Studies Professional Online Service), an innovative scientific tool for anthropology and archaeology that stores all accessible data on fossils, artefacts, site related data and literature.

One major advantage of such a large database for digitised Neanderthal fossils and artefacts is that research becomes more independent from the originals. For many issues in palaeoanthropology it is sufficient to work on the CT-data of the fossils. If high-quality scans are available through NESPOS, many studies will not require to including the examination of the original fossils any more. As the raw data is saved, it will be possible to create new image reconstructions on already existing scans. By this, the fossils are prevented from unnecessary damage by repeated analyses. NESPOS will, therefore, contribute to a large extent to the conservation of this world heritage for future generations.

In addition, the travel costs of scientists can be reduced if they do not have to study the original fossil or artefact any more. As a consequence, good scientific results will depend less on funding opportunities than today. This will especially benefit young scientists, for whom raising funds is more difficult than for the established researchers.

By the development of VISICORE, new visualisation software for real-time exploration of 3D-models, the number of researchers working with computer-based reconstruction will be highly increased. Furthermore, using the same software

and the same data formats will facilitate the exchange of data and consequently the collaboration between scientists. The NESPOS user interface will promote "Research Networking" by the use of synchronic displays of 3D datasets and allowing discussion on special topics and/or comments on any data in the database. The database workflow will allow the users to specify the status of any data (private, private but shared with some colleagues, public). By this way the use of the NESPOS system is possible from the beginning to the end of any scientific process without additional work.

Prehistoric data can be regarded as highly imprecise or soft data that can be interpreted in various ways. Discussions and comments on the different interpretations are, therefore, important means of the data analysis. As the NESPOS database will comprise not only archaeological and anthropological data, but also data from neighbouring disciplines like palaeobotany, zoology, geology, physics and human genetics, it will provide best opportunities for interdisciplinary research on Neanderthals.

Next to the digitised fossils and artefacts, 3D-scans of modern humans as well as extant non-human primates will be available. For comparative studies, large modern samples, preferably representing different regions of the world, are essential for the correct interpretation of results, but not all anthropological institutes possess such a large modern reference sample. By providing this data, not only Neanderthal research but anthropological studies in general will benefit from NESPOS.

Finally, the collection of all the additional data on fossils, sites and artefacts like digitised literature, isolated images and tables will be of great advantage for Neanderthal research. Articles in old journal volumes or exhausted books will be available online. Time-consuming search in different libraries can be avoided and costs for travel or interlendings can be reduced. As NESPOS provides the opportunity to upload very diverse data including personal comments on e.g. sites, fossils or single files, also unpublished information is integrated. Therefore, researchers will be able to provide preliminary data on sites which have not been published yet. Through the continuous updating of the NESPOS database by the scientists themselves, it will significantly speed up the distribution of new results among the scientific community and thus the progress of Neanderthal research in general.

NESPOS will be curated from 2006 on by the NESPOS society. This society is planned to associate about 150 scientific institutions world wide being involved in Neanderthal research, making NESPOS to the "reference warehouse" on Neanderthals.

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