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Three-Dimensional Topographic Survey of the Human Remains in Lamalunga Cave (Altamura, Bari, Southern Italy)

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A B S T R A C T

The aim of the Research Unit, in the framework of the »Programma Nazionale di Ricerca – MURST (Ministero dell'Università e della Ricerca Scientifica e Tecnologica) 1998–2000«, was to study human fossil remains and sites of paleoanthropological interest; the observations regard sites and remains found principally in Apulia, amongst which, the Lamalunga Cave – Altamura. The results of the survey phases of the cave and the three-dimensional topographic distribution of the human remains are reported. Three-dimensional spatial coordinates describing the collocation of the skeleton were sampled. These points were used as reference points for the spatial positioning of numerical models reproducing elements of an adult male skeleton. The survey allows the interactive observation of the remains and their relationship with the site, so that the remains can be observed from points of view actually impossible. On the basis of such views, it was possible to better deduce the relationship between the skeletal elements, confirming the hypothesis that the skeletonization phenomenon occurred in the actual site where the remains are now found.

Key words: *Altamura remains, 3D survey, Neanderthal*

Introduction

The »Lamalunga Cave« is located in the countryside near Altamura (Bari, Apulia, Southern Italy). The cave was discovered by cavers belonging to the local caving association – C.A.R.S. (Centro Altamurano Ricerche Speleologiche). They reached the karstic complex enlarging a small fissure in the rock through which a strong draught came out. During the first phases of the exploration, cavers

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Fig. 1. The Altamura remains in situ, top view.

belonging to the speleo group of Bari, C.A.I – (Club Alpino Italiano), joined the CARS; exploring one branch of the cave, they sighted a skull and some human bones. Some slides shot in that occasion were shown to anthropologists from Bari University, so that on 8th October 1993, they inspected the cave and could observe the remains in situ.

The access to the cave consisted of a well about 8 meters deep, followed by a narrow passage (which was later artificially enlarged), a few meters long and just wide enough for a person to pass through. This passage widens into a large cavern with several tunnels starting all around; one of these branches is the one which leads, after some 60 meters, to the recess containing the human bones.

The human remains were found in the corner of a small cavity between the floor and the far wall, this latter having the form of a strong stalactitic curtain. They are lying on an oblong area delimited by columnar formations (Figure 1); they appear to be partly incorporated within the calcareous concretions, and partly evident; however they are covered by a calcareous shell of varying thickness which often takes on the aspect of coralliform formations.

The skull lies on its vault, and is partially turned towards the left; above, in correspondence with the upper maxillary, it lies against a stalactitic formation. On the left side this formation covers the zygomatic process up to the frontal area and the whole of the area behind it; on the right side the stalactitic formation covers part of the maxillary, leaving the upper edge of the zygomatic arch visible. The maxillary, which is lacking the canine fossa, clearly recalls the Neanderthal morphology. The majority of the vault, the orbits and, on the right, part of the lateral region of the skull, up to more than half the length of the face, are clearly visible. It was also possible to evaluate the completeness of the area of the occipital foramen, the palate and the base.

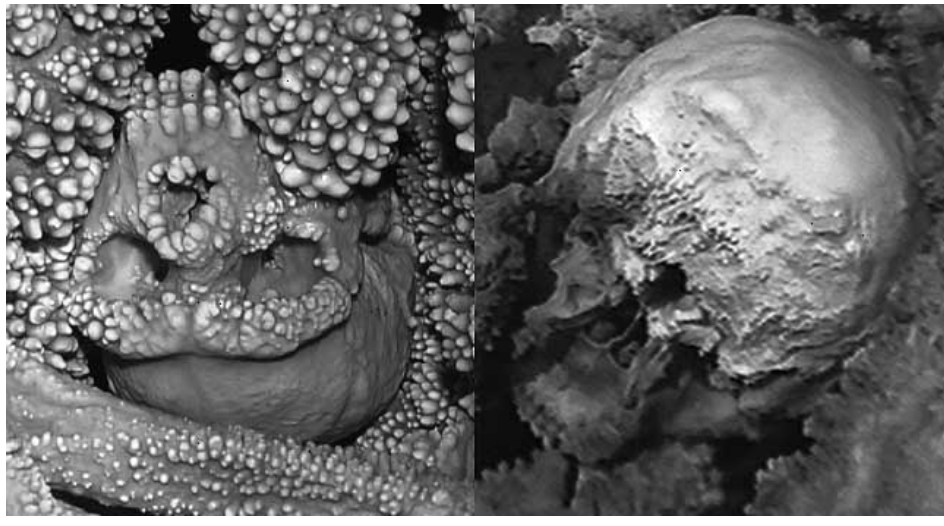

Fig. 2. Altamura cranium, (the occipital view, not directly visible, was obtained by micro video-cameras).

At first sight the supraorbital tori stand out, although this impression should be considered with caution since this is one of the zones where the thickness of the concretions is at its greatest. The same caution has to be applied to the evaluation of the existence and size of a sulcus at the supraorbital level. The torus seems to be subdivided into two slightly arched tracts above each orbit, which are separated by a clear triangular depression; the thickness varies in a medium-lateral direction, giving the torus a spindle shaped aspect thinning towards the outside.

The squama of the frontal appears to be moderately but regularly convex and, in the sagittal area, there is a slight bone thickening.

Judging from the views obtained by micro video-cameras, the occipital plane, almost rounded, is covered with a layer of fairly uniform concretions, while the concretioned surface of the nucal planum is rather uneven and irregular as are the edges of the occipital foramen; the transversal torus seems to be bipartite and in relief, the mastoid apophisis is clearly visible.

In front of the skull there are many elements of the postcranial skeleton that are not all immediately identifiable as a result of the concretions. The part which lies furthest away from the skull is the left innominate bone of which only the iliac portion is visible and which, together with the controlateral bone, is covered by a calcitic crust which impedes observations of the synphysial region and the rest of which is incorporated in a thick stalagmitic formation.

The elements that can be evaluated, such as the general robusticity of the skeleton and the form of the iliac fossa (quite high and narrow), the orientation of the iliac crest and the degree of tooth wear, all indicate that the individual was an adult male.

An estimation of the stature was obtained by using the length of the femur taken in situ, and resulted in a middle-low height.

In many aspect the morphology of the Altamura skull (the maxillary and the occipital for example) quite clearly resembles those of the Neanderthal line (Figure 2). It is possible that without the calcareous concretions some features of the vault and of the base could appear less advanced, according to a scheme of differentiated progression between morphological traits which has already been noted in findings of the same evolutionary line.

The discovery of the »Altamura man«, has revealed, from the moment of the discovery, various elements that make the find singularly spectacular, both for the characteristics of the position of the remains in the cave and for the evolutionary significance of the anatomical and anthropological characteristics of the remains[1,2] themselves.

Two main problems have arisen: the possibility to observe the remains in situ, allowing specialists from different disciplines to plan successive work stages, and the need to comply with strict criteria of access and monitoring controls to protect the site and the remains while still allowing general cultural-touristical access.

Material and Methods

From 1998 to 2000 the SARASTRO project (integrated tele-operated system with living tele-video observation and telemetrics), developed for scientific and cultural access to the archaic remains of the Altamura man, designed by the University of Bari, was developed and realized by Digamma Research Consortium[3]. The project aimed at the installation of a system of technologically assisted access, using a complex and innovative telematic solution, which can be defined as a »from-the-field museum«. The project was designed to create wide access to a cultural asset that would not normally allow direct fruition, both for the sake of its conservation and for the safety of the visitors themselves, in this way confronting the difficult compromise inherent in any discussion of 'conservation versus access' to unique cultural assets.

As a part of the project, observations and surveys were conducted to define certain aspects regarding the collocation and distribution of the human remains and their morphology.

The three-dimensional general survey of the cave, carried out by specialists from the speleological group CARS (Centro Altamurano Ricerche Speleologiche)[4] stands as an indispensable tool for a deeper understanding of Lamalunga cave. In order to perform this survey, specific procedural and technical solutions were developed to increase the precision and accuracy of the survey, much better than in the classic speleological surveys. The »Apse«, the area containing the human remains, was measured with a detail of 2 cm. The resultant survey was the starting point for the mapping of the paleoanthropological, speleological and faunal elements present in the cave.

In this phase a three-dimensional topographic distribution of the visible human bone segments was obtained by the authors; this survey, together with the general survey of the cave, guaranteed the possibility of creating a spatial map of the remains, with respect to the cave and to the corresponding surface area.

Results and Discussion

The survey was performed sampling three-dimensional spatial coordinates (130 points approx.) The points describe the collocation of the skeleton, or of its parts directly visible, where concretion is slight. Certain elements, indeed, are only partially visible; only the iliac portion of the right part of the pelvis, for example, is visible, the rest being covered by calcite. In the same way, only the proximal portion of the right femur is visible, the

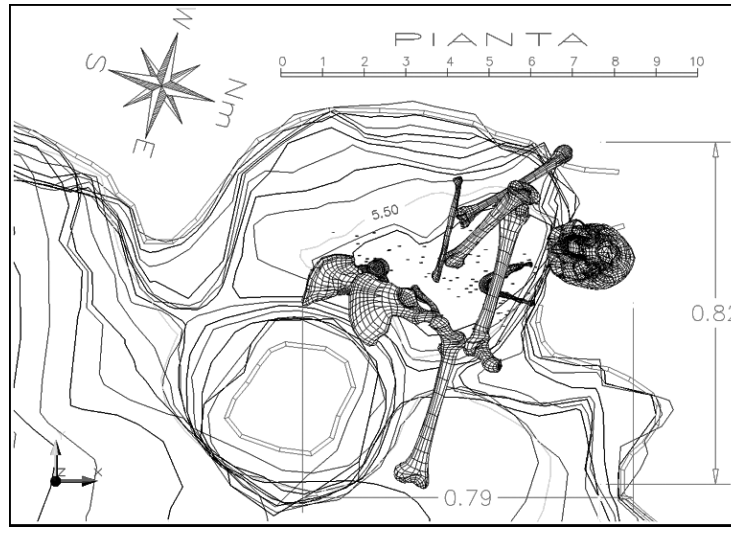

Fig. 3. Survey of the Lamalunga cave, detail of the Apse: the recess containing the human remains. The map shows the points sampled on the remains and some models of the bone elements positioned according to three-dimensional coordinates.

distal portion being covered by concretion.

This situation suggested, first of all, to develop a topographic model of the remains, to permit successive surveys for fine morphological modelization with specifically designed dedicated technology.

In this phase, the sampled points were used as connection points for the spatial positioning of numerical models reproducing skeletal elements in relation to the general survey of the cave and the Apse. A model reproducing an adult male skeleton, approx. 165 cm tall was used for post-cranial bones; for the skull, a general model reproducing a Neanderthal morphology was used. The single bone elements were re-composed in a virtual space using the real points sampled (Figure 3); the relationship between the skeletal elements was then verified in the laboratory using a video-photographic data base illustrating the position and state of the remains.

The survey allows the interactive exploration and observation of the remains and their relationship with the site, which can be observed from points of view actually impossible as, for example, an underneath view. Based on such views (Figure 4), the relationship between the skeletal elements confirms the original hypothesis that the skeletonization phenomenon occurred in the actual site where it is now found and that, at a later date, it underwent only very limited movements with respect to its original position.

Conclusions

The Altamura bone remains are obviously not in anatomical connection; the topographic distribution of some of the bones such as the femura, the right tibia and fibula, the left tibia and fibula, the radii and humeri, the position of the mandible with respect to the skull and the pelvic bones, all suggest a unified position of the body immediately after death,

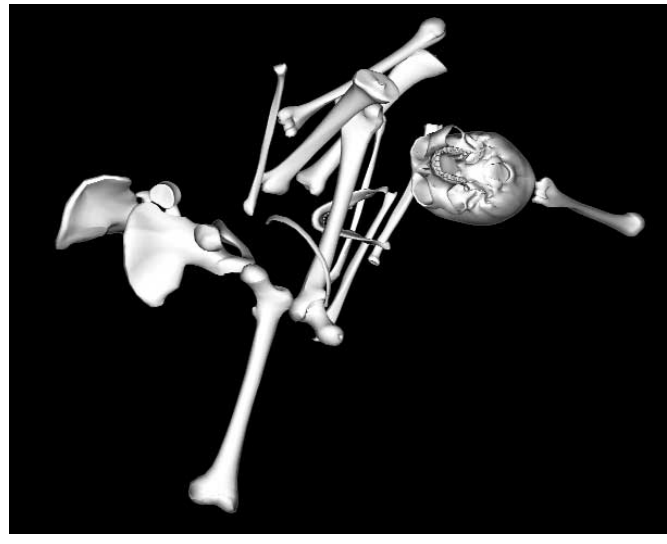

Fig. 4. Three-dimensional topographic distribution of the Altamura remains, top view.

so that fossilisation took place where the bones have been found. The earliest events should have been the detachment and fall of the skull and mandible, and of the bones of the upper limbs; it was only later that the disarticulation and collapse of the axile skeleton and the detachment of the femurs from the pelvis led to the final layout of the bones. After the fossilisation process and before the concretion phenomena, which finally settled the bones, slight movements of the individual bones or the action of water might have resulted in the current arrangement of the bones.

The model so obtained*, moreover, allows a reasonably accurate calculation of the true volume of the human remains, which, in some places, is very different from the volume that can be directly observed or calculated, thus virtually completing the bone elements that are actually embedded in concretions. This information is an indispensable instrument for the future planning of the sampling or removal of the remains.

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* Interested institutions can request to the authors the CD-ROM containing the interactive 3D-model.

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TRODIMENZIONALNA TOPOGRAFSKA ANALIZA LJUDSKIH OSTATAKA IZ PEĆINE LAMALUNGA (ALTAMURA, BARI, JUŽNA ITALIJA)

SAŽETAK

Cilj istraživalačke ekipe, unutar »Programma Nazionale di Ricerca – MURST (Ministero dell'Università e della Ricerca Scientifica e Tecnologica) 1998–2000«, bio je proučavanje fosilnih ostataka paleoantropoloških nalazišta čovjeka, prije svega na prostoru Apulije, posebice pećine Lamalunga, Altamura. Ovdje su iznosimo rezultate preliminarnih istraživanja pećine kao i trodimenzionalnog prostornog razmještaja ljudskih skeletnih ostataka, koji je određen korištenjem trodimenzionalnih prostornih koordinata koje opisuju međusobni razmještaj prikupljenih kostiju. Ove su točke korištene kao odrednice u razmještaju brojčanih modela koji predstavljaju dijelove skeletnih ostataka odraslog muškarca. Ovo omogućava interaktivnu analizu ostataka i njihovog odnosa unutar nalazišta te vizure kao nisu realno moguće na samom nalazištu. Ovim postupkom omogućen je bolji uvid u međuodnos raznih skeletnih elemenata, kojim je potvrđena teza da se fosilizacija dogodila na mjestu pronalaska skeleta u okviru nalazišta.