

THE PRE-MODERN HUMAN FOSSIL RECORD IN ITALY FROM THE MIDDLE TO THE LATE PLEISTOCENE: AN UPDATED REAPPRAISAL.

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ABSTRACT: The fossil record from the Italian peninsula is of special interest for assessing the variability of pre-modern human populations (i.e., extinct humans non-belonging to the proper species *Homo sapiens*) and their evolutionary history. In 2005, a detailed "Catalogue of Italian Fossil Human Remains from the Palaeolithic to the Mesolithic" was published and still represents a milestone on the topic, which however requires a reappraisal. Here we provide a commented overview of the pre-modern human fossil record from the Italian peninsula, where we have included updated information on specimens that were already in the Catalogue of 2005 as well as new discoveries of the recent years, thus providing a comprehensive report of this important regional samples. We hope that this work may represent a useful state-of-the-art on the topic. It also embodies notes concerning the more sophisticated technologies that have been applied in the last years to document and study such a paleoanthropological archive, allowing the acquisition of new data even from old specimens.

Keywords: Palaeoanthropology, human evolution, Neanderthal lineage, *Homo heidelbergensis*, *Homo neanderthalensis*.

1. INTRODUCTION

The Italian peninsula represents an interesting paleo-ecological scenario for the late Early and early Middle Pleistocene faunal dispersals (*Homo* included) in Europe. Human presence in Italy has been reported as dating back to 1.6-1.3 Ma, as inferred from the lithic assemblage found at Pirro Nord in Southern Italy (Arzarello et al., 2007; Arzarello & Peretto, 2017). Therefore, Italy appears as the node for subsequent dispersals in the continent, which can be described as complex, both in space as well as time, and strongly influenced by ecological factors (Manzi et al., 2011).

This picture is paired with indirect and direct evidence attesting the earliest human presence in South-Eastern and Western Europe between 1.8 Ma (Parés et al., 2006; Garcia et al., 2010) and 1.2/1.1 Ma (Carbonell et al., 2008). The scanty fossil record pertaining to these first Europeans highlights the occurrence of archaic and rather variable skeletal features (Bermúdez de Castro et al., 2011; Bermúdez de Castro et al., 2017) in association with Mode 1 (i.e., Oldowan) lithic technologies (Carbonell et al., 1995).

It appears that subsequent human dispersals in Europe were associated with a turnover of mammalian species that benefited of periods of climatic instability, being more adapted to the new habitats and resources, particularly in Italy (Manzi et al., 2011; Magri & Palombo, 2013). Humans, by possessing characteristics of

opportunistic scavengers, were probably favoured by the fragmentation of the landscape (Blain et al., 2019). The Italian paleontological and archaeological record associated to the earliest phases is limited to a few sites dated earlier than 700 ka and scattered along the entire peninsula below the Po Valley. As a matter of fact, the first human presence in Italy is attested only by lithic assemblages, such as those from Pirro Nord (Puglia) and Monte Poggiolo (Romagna), dated back to a chronological range comprised between 1.6 and 0.85 Ma (Arzarello & Peretto, 2010, 2017), but probably there are also important sites in Southern Latium (Biddittu, 1972; Biddittu, 1974; Segre & Biddittu, 2009), which could have been penecontemporaneous to those in Apulia and Romagna.

For what concerns the fossil record, so far the earliest occurrence in Italy starts after the Marine Isotope Stage (MIS) 16 and is represented by the partial shaft of a femur from the level supra- α of Venosa Notarchirico (Belli et al., 1991; Moncel et al., 2020), dated to 661-614 ka (Pereira et al., 2015), and the isolated human deciduous incisor from the level 3 (overlying layer 3a) of Isernia La Pineta, dated to 583-561 ka (Peretto et al., 2015; Fig.1). It is noteworthy that these two sites, both located in Southern Italy at a distance of approximately 300 km, as well as rather close in chronology, apparently show differences in the archaeological assemblages. Venosa Notarchirico has yielded the earliest evidence of Acheulean settlement in Italy (Moncel et al., 2020) and the femur shaft recovered in the upper part of the archaeo-

logical sequence is at present the oldest fossil human in Europe clearly associated with bifaces of Mode 2 (i.e., Acheulean) technology (Fig. 1). On the other hand, the lithic assemblage from Isernia La Pineta is composed primarily of small and medium-sized flakes of local flint and limestone, with the absence of bifaces (Peretto et al., 2015). These differences may reflect local and ecological diversity in subsistence strategies or a more complex population scenario in correspondence of the appearance of bifaces into the European archaeological record after, or around, MIS 16 (Manzi et al., 2011; Moncel et al., 2020; Santagata et al., 2020).

The human remains from Isernia La Pineta and Venosa Notarchirico represent two of the major updates to our knowledge on the pre-modern (i.e., extinct humans non-belonging to the proper species *Homo sapiens*) fossil record in Italy since the publication of the "Catalogue of Italian Fossil Human Remains from the Palaeolithic to the Mesolithic" (hereafter referred to as "the Catalogue") edited by G. Alciati and colleagues (2005) following the same template of the "Catalogue of fossil hominids" edited by the Natural History Museum of London (Oakley et al., 1971). Nonetheless, after 2005 there have been a number of new discoveries of human remains from Lower and Middle Palaeolithic sites across the Italian peninsula, while many sites/specimens have been reconsidered; thus, nowadays, the Italian human fossil record dated to the Middle and early Late Pleistocene is increased (Fig. 2, Tab.1). It includes crucial findings attributed to both *Homo heidelbergensis* and *Homo neanderthalensis*; they are of great interest for our understanding of the so-called "Neanderthal lineage" over time in the wider European scenario (Manzi, 2004, 2016).

Therefore, in the following sections we present these findings with an approximate chronological criteri-



Fig. 1 - The human deciduous tooth from Isernia La Pineta (left, from above, respectively, labial and incisal views, modified from Peretto et al., 2016) and a digital rendering of the femur shaft from Venosa Notarchirico (right)

on and discuss their contribution to the reconstruction of the human evolutionary dynamics during the Middle to the early Late Pleistocene, as documented by the human fossil record from Italy.

2. THE LOWER PALAEOLITHIC

Alongside the mentioned novelties for this issue (i.e., Isernia La Pineta and Venosa Notarchirico), other important updates approximately referable to the middle of the Middle Pleistocene (Lower Paleolithic, Mode 2 or Acheulean) concern also other sites, including the dating and the anatomical interpretation of relevant specimens already reported in the Catalogue of 2005: the calvarium from Ceprano and the dental remains from Visogliano and Fontana Ranuccio.

2.1. Isernia La Pineta

We have already reported updates for the sites of Venosa-Notarchirico and Isernia La Pineta. However, the latter site requires a separate and more detailed treatment since it was not previously included in the Catalogue. The only human remain found so far in the site, in fact, is an isolated human deciduous incisor (labelled IS42) discovered in 2014 and described by Peretto and colleagues (2015). Isernia La Pineta (South-Central Italy, Molise) is an extensive open-air archaeological site of the Lower Palaeolithic located just outside the city of Isernia (41° 35' 27.8" N, 14° 14' 29.3" E) at 457 m above sea level, along the left side of the Cavaliere Stream, in the middle upper part of the Volturno River basin. The site has been discovered in the fluvio-lacustrine sedimentary series of "Le Piane basins" during road construction works in 1978. The abundant lithic assemblage and faunal remains are distributed across four archaeosurfaces and two sectors which are now musealized. The faunal assemblage has been attributed to the Early Toringian and the lithic assemblage is characterized by the exploitation of two local raw materials: flint and limestone (Peretto et al., 2015).

The stratigraphy of the site has been described by Coltorti and colleagues (2005). From bottom to top, five stratigraphic units can be recognised: lacustrine clays (U5), lacustrine travertines (U4), fluvial sediments with sands and fine gravels (U3) sands and gravels (U2), gravels and sands with intercalated tuffs (U1). Unit 3 contains the archaeological deposit, and it is subdivided into three sedimentary sub-Units (U3A, U3E, U3F).

The human tooth was recovered within the archaeological level 3 coll (overlying U3A) that, according to new $^{40}\text{Ar}/^{39}\text{Ar}$ measurements, is dated to about 583–561 ka, i.e. to the end of MIS 15 (Peretto et al., 2015). The deciduous tooth, which preserved the crown and some 4 mm of the largely resorbed root, is identified as a maxillary left lateral incisor (Peretto et al., 2015). The buccolingual diameter is 4.71 mm and the mesio-distal diameter is 5.66 mm. Incisal wear has exposed a large strip of dentine on the flat horizontal incisal edge corresponding to the 4th wear stage. On the lingual face the slight cervical eminence is symmetrical, corresponding to grade 1 of "tuberculum dentale" in the ASU-DAS system (Scott et al., 2016). Both the mesial and distal marginal crests are weakly developed, with the distal more marked. A



Fig. 2 - Distribution of sites in Italy with non-modern human remains. Sites dated to Middle Pleistocene are indicated in red, while those dated to Late Pleistocene are in blue; Spinadesco is reported in dashed black because not yet dated (see section 3.2); the sites that yielded new human remains after the publication of the Catalogue edited by Alciati and colleagues (2005) are highlighted.

weak mesial sulcus and distal sulcus can also be observed adjacent to the respective marginal crests. No “shovelling” is evident (grade 0 ASU-DAS; Peretto et al., 2015).

2.2. Ceprano

The calvarium from Ceprano (Fig. 3) comes from a small locality near the towns of Castro dei Volsci, Ceprano - hence the name - and Pofi, in Southern Latium, less than 100 km South-East of Rome.

The calvarium was discovered in fragments by the archaeologist Italo Bidditu in March 1994, during a survey along a trench cut by the bulldozers for the construction of a new road (Ascenzi et al., 1996). Despite the archaic morphology of Ceprano (Manzi et al., 2001; Mounier et al., 2011; Manzi, 2016), the chronology of about 800-900 ka that was originally suggested (Ascenzi et al., 1996) has been more recently reassessed and referred to a younger age, bracketed between 430 and 385 ka (Manzi et al., 2010). This new

Site	Province, region	Chronology	Sample
Fumane *	Verona, Veneto	47.6 – 43.9 ka cal BP	3 deciduous teeth
Tagliente *	Verona, Veneto	~ 60 ka BP	2 deciduous teeth
De Nadale §	Vicenza, Veneto	70.2 +1/-0.9 ka BP	Deciduous tooth
Visogliano *	Trieste, Friuli-Venezia Giulia	500 - 350 ka BP	Mandible, teeth
Spinadesco §	Cremona, Lombardy	unknown	Frontal bone
Broion §	Vicenza, Veneto	48 ka cal BP	Deciduous tooth
Fenera, Ciota Ciara §	Vercelli, Piedmont	MIS 5	Cranial fragments, teeth
Fate	Savona, Liguria	82 +36/-25 ka BP	Cranial and postcranial fragments, teeth
Grotta del Principe	Imperia, Liguria	~ 250 – 200 ka BP	Iliac bone
Buca del Tasso	Lucca, Tuscany	> 40 ka BP	Femur diaphysis
Calascio	L'Aquila, Abruzzo	Würm I	Femoral head
Castel Di Guido	Rome, Latium	~ 300 ka BP	Cranial and postcranial elements
Ponte Mammolo	Rome, Latium	~ 250 ka BP	Femur
Polledrara di Cecanibbio §	Rome, Latium	340 - 320 ka	Deciduous tooth
Saccopastore *	Rome, Latium	~ 250 - 120 ka BP	Two crania
Sedia del Diavolo	Rome, Latium	~ 250 ka BP	Postcranial elements
Casal de' Pazzi	Rome, Latium	~ 300 – 250 ka BP	Fragment of parietal
Fontana Ranuccio *	Frosinone, Latium	~ 400 ka BP	3 teeth
Pofi	Frosinone, Latium	~ 400 - 368 ka BP	Cranial and postcranial elements
Ceprano*	Frosinone, Latium	~ 430 - 350 ka BP	Calvarium
Isernia La Pineta §	Isernia, Molise	~ 583–561 ka BP	Deciduous tooth
Campoverde §	Latina, Latium	129 ± 1 ka BP	Deciduous tooth
Il Fossellone	Latina, Latium	Late Würm I – early II	Mandibular fragment
Grotta Breuil	Latina, Latium	36 ka BP	Cranial fragment, teeth
Grotta Guattari	Latina, Latium	57 - 51 ka BP	Cranium, 2 mandibles
Bisceglie (Santa Croce)	Bari, Apulia	Late Würm I – early II	Femoral fragment
Venosa Notarchirico	Potenza, Basilicata	661 ± 4 - 614± 4 ka BP	Femoral diaphysis
Altamura *	Bari, Apulia	172 ± 15 - 130.1 ± 1.9 ka BP	Skeleton
Maglie (Fondo Cattie)	Lecce, Apulia	Upper Pleistocene	Tooth
Melpignano (Nuzzo Quarry)	Lecce, Apulia	Late Pleistocene	Tooth
Cavallo §	Lecce, Apulia	45.6 –42.9 ka BP	2 teeth
Taddeo *	Salerno, Campania	Würm I - Würm II	4 teeth
Grotta del Poggio	Salerno, Campania	~ 200 ka BP	Talus bone, tooth
Scario (Molare)	Salerno, Campania	Würm I	Mandibular fragment
Leuca	Lecce, Apulia	Early Würm	Tooth
Nicotera	Catanzaro, Calabria	Upper Pleistocene	Juvenile parietal
Archi (San Francesco)	Reggio Calabria, Calabria	> 40 ka BP	Mandibular fragment

Tab. 1 - Inventory of the Italian sites with non-modern human remains and their chronology (based on the most recent data available in the literature); sites are ordered according to their latitude and longitude (see Fig. 2). A (*) indicates sites that have been re-considered after being reported in the Catalogue of 2005, while (§) indicates either a new site or a site where new remains have been found.

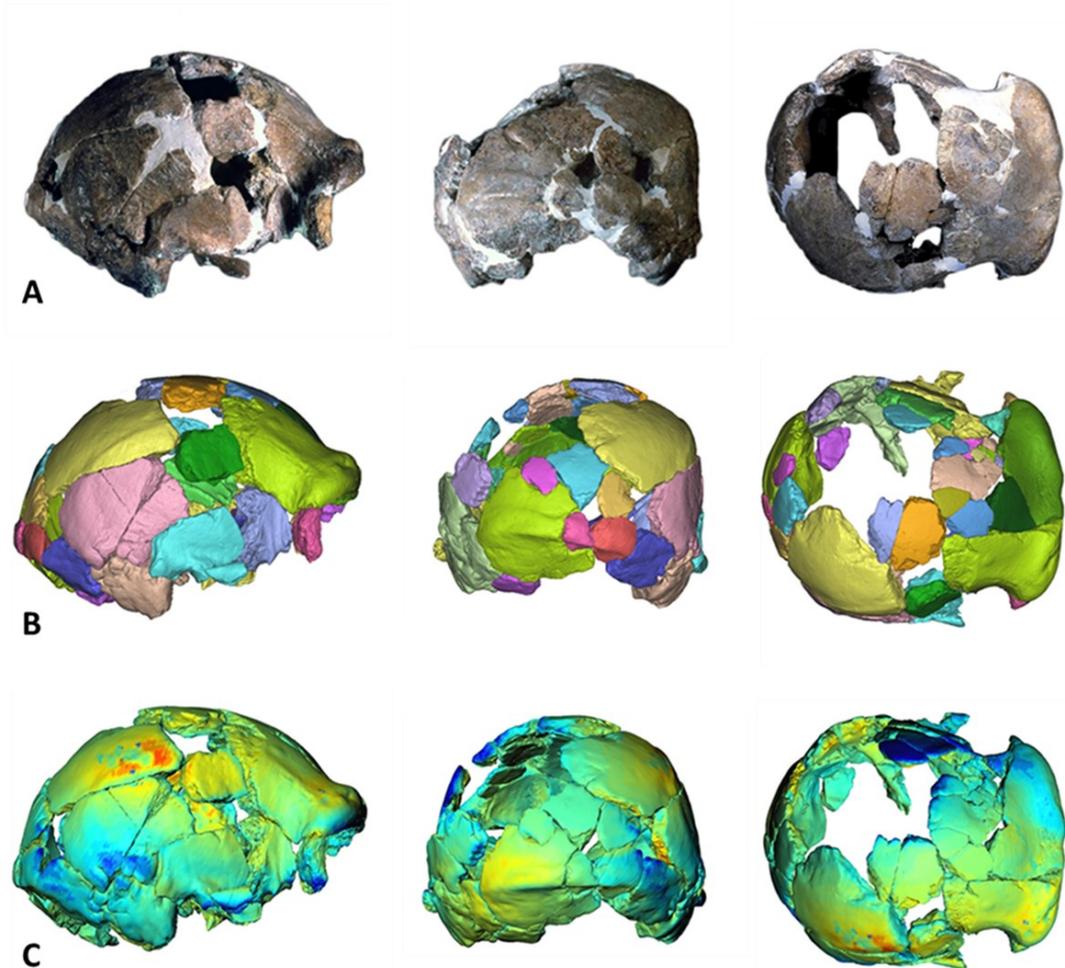


Fig. 3 - The Ceprano calvarium: A) the final physical reconstruction based on the original fragments (Ascenzi et al., 2000) is compared to (B) the digital segmentation of the fragments and digital reconstruction, with virtual removal of the plaster, and to (C) the retro-deformation of the calvarium (i.e., removal of the taphonomic deformation), which restores its probable original shape (modified from Di Vincenzo et al., 2017).

and accurate estimate derives from a composite ensemble of data, including geo-stratigraphic and paleoecological data, but also palaeomagnetism (Muttoni et al., 2009), K/Ar and Ar/Ar datings (Manzi et al., 2010; Nomade et al., 2011).

Portions of the calvarium were found in situ, within stratified fluvio-lacustrine deposits (Ascenzi et al., 1996; Di Vincenzo et al., 2017), while the remaining fragments were recovered in the shaly sediments or in the sieve. No evidence was found of fragments belonging to the facial skeleton. Recently, a new digital reconstruction has been performed, correcting the taphonomic distortion of the braincase (Di Vincenzo et al., 2017). On the digital reconstruction, it was possible to make new observations dealing with both taphonomy and morphology.

The interpretation of the intervened taphonomic process revealed that Ceprano was found in primary deposition (Di Vincenzo et al., 2017), thus supporting its date back to about 400 ka (MIS 11). At the same time,

from a morphological point of view, Ceprano shows absence of any apomorphic Neanderthal trait, while it exhibits affinities with specimens attributed to *Homo heidelbergensis* found in Ethiopia and Zambia (i.e., Bodo and Kabwe), as already demonstrated by previous studies (Manzi et al., 2001; Mounier et al., 2011). These results shed further light on the phylogenetic significance of Ceprano as the best candidate to represent the ancestral morphology of the putative polymorphic species *Homo heidelbergensis* (Manzi, 2016), diversely from previous attributions to a peculiar variant of *Homo erectus* (Ascenzi et al., 1996; Clarke, 2000) or to a distinct new species (Mallegni et al., 2003).

2.3. Fontana Ranuccio and Visogliano

About 40 km North-West from Ceprano, within the Anagni basin, it is located the site of Fontana Ranuccio. Here, in addition to abundant stone and bone bifacials and other artefacts of Mode 2, four human fossil teeth were recovered in the 80s of the last century. These

human remains were reported in the literature (Segre & Ascenzi, 1984; Ascenzi & Segre, 1996), as well as in the Catalogue, as the two lower second molars, probably belonging to a single individual, and other two incisors (lower left central and undetermined).

A new revision by Rubini and colleagues (2014) reclassified the molars as the two lower first molars, while the two incisors were reconsidered as a lower left lateral incisor and a possible upper left canine, respectively. In addition, Muttoni and colleagues (2009) provided a new K/Ar date of about 0.46 Ma for the site of Fontana Ranuccio. In addition, a recent digital approach has been used to analyse both the enamel thickness and the pulp cavity morphology of the teeth from Fontana Ranuccio (Zanolli et al., 2018). The analysis was also extended by including in the sample the teeth from the site of Visogliano (North-Eastern Italy) recently dated by ESR/U-series at an interval between MIS 13 and MIS 10 (Falguères et al., 2008). Both samples showed morphological traits shared by Neanderthals, indicating a pattern of evolutionary continuity in Europe already established during the Middle Pleistocene in Italy (Zanolli et al., 2018) as well as elsewhere (Arsuaga et al., 1997, 2014).

This, alongside with the apparent contrast with Ceperano, traces an interesting and complex evolutionary scenario. It can be suggested that some populations of about 400 ka ca retained in Italy more archaic morphologies, while other populations in Europe – such as Atapuerca Sima de Los Huesos in Spain (Arsuaga et al., 1997, 2014), Petralona in Greece (Stringer, 1983), or Steinheim in Germany (Wolpoff, 1980) – already presented varying grades of a morphological progression towards the typical Neanderthal assemblage of traits, suggesting the penecontemporaneous occurrence of different sub-species of *Homo heidelbergensis* (Manzi, 2016).

2.4. Polledrara di Cecanibbio

The site of La Polledrara di Cecanibbio is located in the Western sector of the Rome basin (41° 56' 05.4" N, 12° 18' 07.8" E), in Latium (Central Italy). It is one of the most interesting Mid-Pleistocene sites in Europe, discovered in 1985 and studied with regular excavations since then. It was not reported in the Catalogue, since no human remains had been found there at the time of its publication. The fluvial and fluvio-palustrine fossiliferous deposits of the site are part of the Ponte Galeria Sequence (PGS), and within this, it is included in the PG6 sub-sequence (Middle Pleistocene, Aurelia Formation, MIS 10 and 9; Santucci et al., 2016).

The PG6 deposits derive from the contemporaneous resedimentation of a volcanic unit known as "Tufi Stratificati Varicolori di La Storta (TFVLS)" dated between 379±40 ka and 450±7 ka (Marra et al., 2014). The quantity and state of preservation of the faunal remains is significant. They are distributed with varying density on the paleosurface, and are mostly referable to large mammals, as *Palaeoloxodon antiquus* and *Bos primigenius*. Faunal assemblages are associated with lithic and bone artifacts (Anzidei et al., 2012). No bifaces were recovered in palimpsest, in contrast to other neighbouring and coeval sites (Castel di Guido, Torre in

Pietra), however, the presence of about 600 flint implements recovered around the carcass of a single elephant in anatomical connection are evidence of a butchery site, where complex human/elephant interactions occurred (Santucci et al., 2016). Part of the paleosurface (about 900 m²) is musealized.

New excavations started in 2006 and led to the recovery of a deciduous second maxillary molar, probably belonging to a juvenile human individual with an age at death comprised between 5 and 10 years (Anzidei et al., 2012). The molar lacks a portion of the crown on the distal side and almost all the roots, probably because of post-mortem fractures. The bucco-lingual and mesio-distal measurements of the crown are 10.1 mm and 8.6 mm, respectively. The tooth is in bad state of preservation and the occlusal surface is characterized by a high degree of wear, so that the dentine is totally exposed. A fair presence of tartar was observed at the level of the neck distributed on the buccal, distal and medial surfaces (Anzidei et al., 2012).

3. THE MIDDLE PALAEOLITHIC

Human fossil specimens referable to the Middle Palaeolithic - during the late Middle and the early Late Pleistocene - show a mixture of archaic features and more progressive (Neanderthal) traits. This is particularly true in the case of the skeleton from Altamura (Southern Italy), as well as in the case of other specimens which reignited the interest of researchers in recent years, thanks to new morphological and chronological data. Important updates with respect to the Catalogue of 2005 comes from the localities Saccopastore, Taddeo Cave, Broion Shelter, Tagliente Shelter, Fumane Cave, Fenera (Ciota Ciara) and Cavallo cave. In addition, new specimens were discovered in new localities: Spinadesco, Campoverde and De Nadale Cave.

3.1. Altamura

Known as "Altamura man", the skeleton from the karstic cave of Lamalunga, near the town of Altamura in Puglia, was accidentally discovered by a group of speleologists in October 1993 (Pesce Delfino & Vacca, 1993). The skeleton is the only human specimen found in the cave, apparently not associated to any lithic artifact throughout the karstic system. The skeleton is exceptionally preserved and probably complete, even though largely embedded in calcite concretions (Lari et al., 2015; Di Vincenzo et al., 2019). The bones show no signs of transportation, modification or deformation, except for some breakage of postcranial elements due to taphonomic agents; it can be thus inferred that the individual remained trapped in the karstic system and died right in the place of deposition, where it is still preserved (Fig. 4). The stable microclimatic condition of the cave may have contributed to the excellent condition of preservation of the bones (Di Vincenzo et al., 2019; Vanghi et al., 2019).

Due to the difficult context of deposition and the presence of the concretions, in addition to various administrative and management problems, the specimen is still within the cave. Systematic studies started only after 2008, leading for the first time to the removal of a small

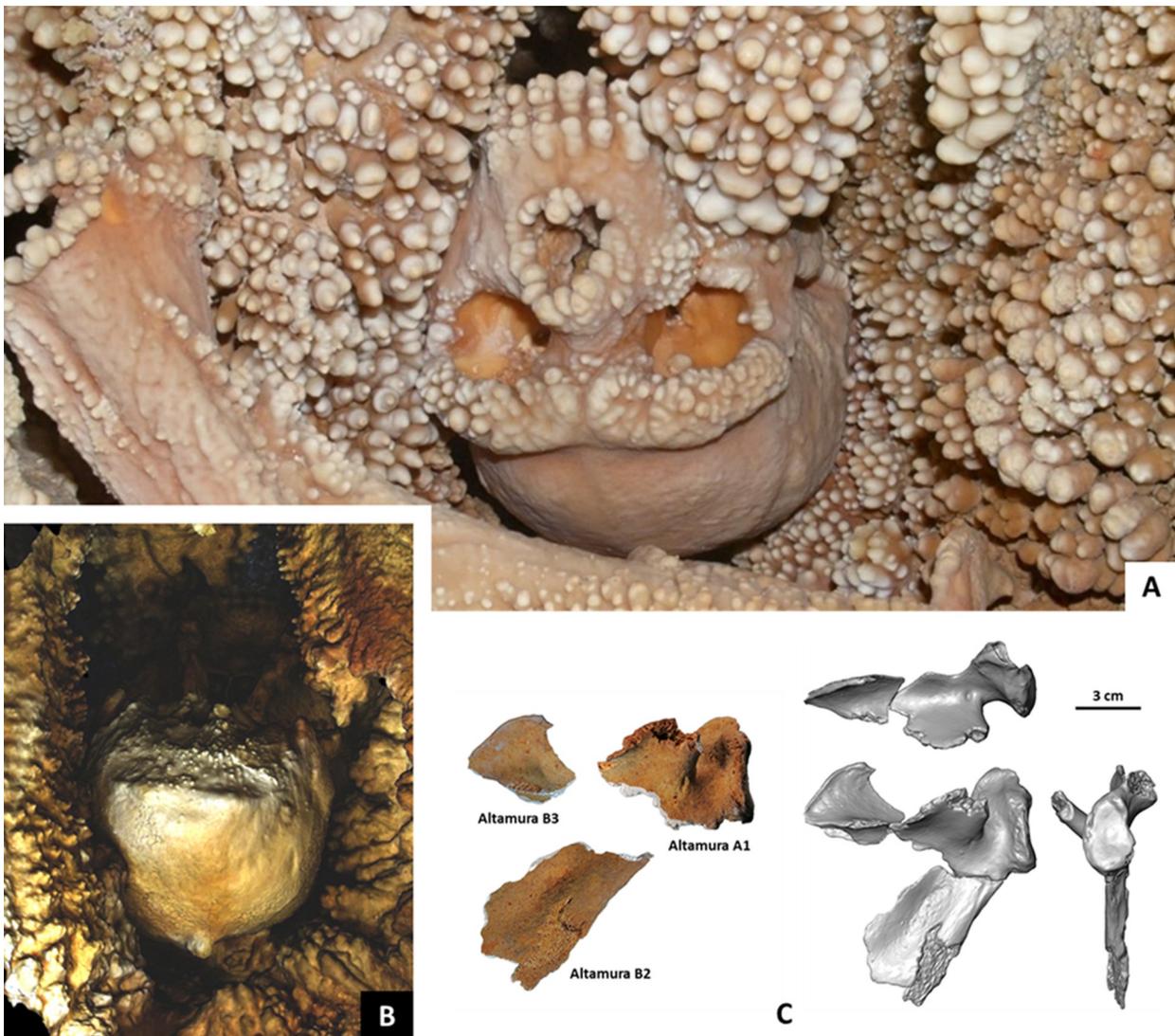


Fig. 4 - The cranium of the Altamura skeleton: A) its position inside the Lamalunga cave; B) digital acquisition of the occipital bone performed *in situ* during the new campaigns of study started in 2008; C) the extracted scapular fragments and the digital reconstruction of the right scapula (modified from Di Vincenzo et al., 2019).

skeletal element, its GM morphometric analysis, a genetic mtDNA characterisation, and an accurate U/Th dating that suggested an age bracketed between 172 ± 15 and 130.1 ± 1.9 ka (Lari et al., 2015); this point out the Altamura skeleton as one of the oldest Neanderthals.

Another research led to the virtual reconstruction of the right scapula (Fig. 4, C), starting from three fragments that were sampled for the main purpose of paleogenomic analyses. The reconstruction showed that Altamura exhibits a bisulcate/ventral pattern of the axillary border of the scapula. This is a feature that is uncommon for the Neanderthals and, more in general, among the archaic humans of the Middle and Late Pleistocene in Europe, but for a low frequency of this feature in the sample from Krapina in Croatia. This observation suggests a phenetic connection between the

Italian specimen and the early Neanderthals of the adjoining Balkan region (Di Vincenzo et al., 2019).

Further studies have been performed *in situ* until now, in the framework of a project entitled "Rediscovering Altamura: advanced multidisciplinary investigations on the skeleton from the Lamalunga cave, Italy (the K.A.R.S.T. project; PRIN 2015WPHSCJ)" directed by one of us (GM). Waiting for the possibility to extract the bones from the depths of the karstic complex, the researchers have been collecting data directly into the cave, with the aid of telemanipulated cameras, high-resolution videoscopes, laser scanners and X-ray portable machines. This new generation of studies will give rise soon to a series of papers, dealing with both the skeleton and the micro-environment of the cave, starting from the so far unpublished dental evidence pertaining to this Neanderthal (Riga et al., 2020).

It must be added that the completeness of the skeleton from Altamura include also some skeletal elements that are absent from the previous human fossil record, such as for instance the very delicate bones of the nasal cavity. The possibility to virtually study the inner nasal region, as well as other skeletal districts, by using the most innovative technologies and methods promises to greatly contribute to shed light on the Neanderthal evolution.

3.2. Spinadesco

The adult frontal bone nicknamed "Pàus" (Manzi et al., 2014; Tuniz et al., 2014) was found in 2009 near the small town of Spinadesco, Cremona, at the current left bank of the Po river (hence the nickname). The fossil was discovered in alluvial deposits with the following approximate geographic coordinates: 45° 08' 09.4" N, 9° 53' 42.7" E.

The specimen (Fig. 4) shows signs of transportation and the place where it was found clearly is not its primary deposition. Therefore, at present, it has not been possible to estimate a reliable dating for it. Nevertheless, the morphology of the frontal squama and the supraorbital torus shows interesting traits that are similar to archaic Neanderthal frontal bones like those from Lazaret (de Lumley et al., 2018) and Biache Saint-Vaast (Guipert et al., 2011), both dated to the final part of the Middle Pleistocene: about 190-170 ka (Valensi et al., 2013) and 200-150 ka (Sommé et al., 1988), respectively. A detailed comparative study of the specimen will allow further observations and conclusions.

3.3. Fenera - Ciota Ciara

The cave of Ciota Ciara opens on the Western slope of Monte Fenera (Piedmont, North-Western Italy) at 670m above sea level. Three human specimens are listed in the Catalogue, represented by the squamous portion of a right temporal bone (Ciota Ciara 1; Mottura, 1980) and two permanent teeth (Ciota Ciara 2 and 3). The temporal fragment was recovered among the material deriving from sediments reworked by uncontrolled excavations carried out in 1955-'56, while the right mandibular molar (Ciota Ciara 2) and the right maxillary premolar (Ciota Ciara 3) were found in 1989 in the eroded surface of the Mousterian deposit near the entrance to the site (Villa & Giacobini, 1996). Since 2009, research on the site has been resumed under the direction of the University of Ferrara and regular excavation campaigns have been conducted since then. The new research activity has led to the complete revision of the geoarchaeology and sedimentology of the cave (Arzarello et al., 2012; Angelucci et al., 2019; Daffara et al., 2019). In addition, new fragmentary human remains have been discovered: a portion of occipital bone and a permanent lower incisor in 2019; a canine and a maxillary molar in 2020 (J. Arnaud and M. Arzarello, personal communication). The human remains were recovered from the same Mousterian level and they are currently under study.

3.4. Saccopastore

The scenario of human evolution viewed from Italy, as attested in most part of the peninsula, becomes more

relevant when *Homo neanderthalensis* is considered. Latium, corresponding to the Tyrrhenian side of Central Italy, West of the Apennines, has yielded notable examples of the morphological progression from the so-called "Ante-Neanderthals" and "Pre-Neanderthals" (*Homo heidelbergensis*) to the so-called "classic" morphotype of the species *Homo neanderthalensis*, well represented by the renowned Neanderthal cranium from Monte Circeo, referred to as Guattari 1 (e.g., various papers in Piperno & Scichilone, 1991; Marra et al., 2020).

A locality in the North-East countryside of the city of Rome was known in the past as Saccopastore. In 1929 a Neanderthal cranium was accidentally found at Saccopastore, within a gravel quarry by the workers (Sergi, 1929). In the same site, six years later, a second and less complete cranium was discovered by Alberto Carlo Blanc and Henri Breuil (Breuil & Blanc, 1936) and led to an excavation campaign in 1936, which brought to light faunal remains and Mousterian tools (Blanc, 1942). After World War II, the development of the city has totally cancelled the site; the locality of Saccopastore is now lost among the suburbs of Rome.

Both the Neanderthal specimens from Rome, Saccopastore 1 (Scp1) and 2 (Scp2), were studied for decades by the anthropologist Sergio Sergi, together with other specimens, most notably the typical Neanderthal Guattari 1 (Sergi, 1929, 1944, 1948, 1962). He reached the conclusion that the Neanderthals from Saccopastore represent a good example of the combination between archaic and derived features preceding the advent of the "classic" Neanderthal, to the point that he proposed a name for a distinct subspecies: *Homo neanderthalensis aniensis* (Sergi, 1936). More recently, similar conclusions have been reached by other authors, with the application of new methods and technologies (Condemni, 1992; Bruner & Manzi, 2006, 2008; Bruner et al., 2006; Manzi & Giacobini, 2018), consistently with the accretion model theory (Dean et al., 1998; Hublin, 2000, 2002) stating the gradual accumulation of Neanderthal traits in Europe during the Middle and early Late Pleistocene.

The archaic morphology of the two crania from Saccopastore is consistent with the proposed dating of about 120 ka (MIS 5e) made by several authors (Blanc, 1948; Segre, 1948; Caloi et al., 1998). A recent reassessment of the aggradational succession in the area of Rome, including the Aniense Valley in the Northern part of the city, stratigraphically suggests for the site a dating to MIS 7, that is to about 250 ka (Marra et al., 2015); this is also consistent with the morphology of the two crania from Saccopastore, viewed in the light of the accretion model hypothesis.

3.5. Campo Verde

A large number of Lower Paleolithic stone artifacts and fossil vertebrates were exposed in a trench excavated for the modification of a canal in locality Campoverde (formerly Campo Verde, 41° 32' 16.8" N, 12° 45' 22.6" E), about 45 km South of Rome. Faunal remains include many large mammals (*Palaeoloxodon antiquus*, *Mammuthus* ex gr. *chosaricus-primigenius*, *Ursus spelaeus*, *Canis lupus*, *Equus ferus*, *Equus hydruntinus*, *Stephanorhinus* cf. *S. hemitoechus*, *Hippopotamus* cf. *H. amphibius*, *Megaloceros* cf. *M. giganteus*,

Cervus elaphus, *Dama dama* cf. *D. d. tiberina*, *Capreolus capreolus*, *Bos primigenius*). The lithic assemblage shows similarities with that from Casal De' Pazzi and it is characterized by the absence of Levallois technique (Marra et al., 2018). The age for the terrace of the Campoverde complex is constrained by the $^{40}\text{Ar}/^{39}\text{Ar}$ age to 129 ± 1 ka (Marra et al., 2018). Mazza and colleagues (1992) described a human deciduous right upper second molar, which was not included in the Catalogue. Only the crown is present, as the tooth is broken below the cemento-enamel junction and a flake of enamel is missing on the buccal face of the paracone. The occlusal surface is square in outline. The mesio-distal diameter is 9.4 mm, the bucco-lingual diameter is estimated in 10.2 mm. A Carabelli pit is recognizable. The tooth shows a high degree of wear on all the four cusps. On the base of the presence of an interproximal wear facet, the individual was estimated to be of 8-9 years of age (Mazza et al., 1992). The repository of the tooth, as well of the faunal and lithic remains, is the museum "Antiquarium Comunale" of Nettuno.

3.6. Taddeo

Four fossil human teeth were discovered in 1967 at Taddeo Cave, near Marina di Camerota (Salerno, South-Western Italy). The layer the teeth come from has been attributed either to MIS 5c or 5d or to MIS 5a (Benazzi et al., 2011). Benazzi and colleagues (2011) provided a revised morphological description and morphometric comparisons of these Middle Paleolithic remains, by using quantitative assessment of the internal morphology with the aid of micro-CT imaging. The tooth Taddeo 1 was previously considered either an upper right canine or a lower right canine, while the new analysis identified it as a lower left canine. Similarly, the tooth Taddeo 2 has been reclassified as a right P4 instead of a right P3. Based on the occlusal and interproximal wear, the new analysis also shown that Taddeo 2 and Taddeo 3 (right M1) belonged to the same individual. All teeth show characteristic Neanderthal features of the crown (Benazzi et al., 2011).

3.7. Tagliente

The two deciduous teeth recovered in the Mousterian deposits (levels 36 and 37) of Tagliente Shelter (Stallavena di Grezzana, Verona, North-Eastern Italy) were re-examined by Arnaud and colleagues (2016a). The upper right second deciduous molar labelled Tagliente 3 shows typical Neanderthal derived features (e.g. large hypocone and complex topography of the enamel-dentine junction). The lower left deciduous canine labelled Tagliente 4 falls in the range of the Neanderthal variability for its bucco-lingual diameter. In terms of tissue proportions both teeth fall within the Neanderthal range of variation: Tagliente 3 for the enamel thickness distribution and Tagliente 4 for the volume of the crown dentine (Arnaud et al., 2016a).

3.8. Broion

The Cave of Broion (Vicenza, North-Eastern Italy) is figured in the Italian Catalogue of 2005 as well as in the "Catalogue of fossil hominids" (Oakley et al., 1971), because of the presence of fragmentary cranio-dental

and postcranial fossilized human remains, found in 1951 within Epigravettian levels. Recently in a shelter close to the cave and named "Riparo Broion" a human tooth was retrieved from a late Mousterian level and investigated by morphometric and paleogenetic analyses (Romandini et al., 2020). The tooth is an exfoliated right upper deciduous canine, and its general morphology and enamel thickness distribution support the attribution to a Neanderthal child, confirmed by the mitochondrial DNA sequence. The site of Riparo Broion preserves a stratigraphic sequence also documenting the Middle-to-Upper Paleolithic transition, in particular the final Mousterian and the Uluzzian cultures. The radiocarbon dating of the tooth points to approximately 48 ka cal., as the most likely minimum age (Romandini et al., 2020). Romandini and colleagues (2020) labelled the Mousterian tooth as "Riparo Broion 1" causing some confusion with the Epigravettian material known as "Broion 1". Here, we propose to continue the numeration introduced in the Catalogue of 2005 for the archaeological area of Broion and therefore to name the Mousterian tooth as Broion 2.

3.9. De Nadale

The De Nadale cave ($45^{\circ}25'16.3''\text{N}$ $11^{\circ}29'23.1''\text{E}$) is a new Middle Palaeolithic site located in the Berici Hills (North-Eastern Italy). A single anthropic layer (Unit 7) was recovered between sterile levels. Unit 7 has yielded a faunal assemblage mostly composed of cervids, bovids with some carnivores. Both macro-mammal and micro-mammal assemblages reflect a landscape dominated by open forests and grasslands in a generally cold-temperate climatic context (Arnaud et al., 2016b). The lithic assemblage made on flint has been attributed to the Quina Mousterian. Recent chronometric data based on Uranium-series (U-Th) on a sample of herbivore teeth from Unit 7 has provided a minimum age of 70.2 $11/20.9$ ka (Jequier et al., 2015). From Unit 7 comes a lower first deciduous molar which has features frequently observed in Neanderthal (i.e., incipient tuberculum molare, marked mesial marginal ridge and well-developed mid-trigonid crest connecting the protoconid and the metaconid, deep anterior fovea). The observed presence of small pit on the enamel surface could be correlated to incipient caries (Arnaud et al., 2016b).

3.10. Fumane

The site of Fumane Cave also known as "Stazione della Neve" or "Riparo Solinas", near the village of Fumane (Western Lessini Mountains, Northern Italy) contains a stratigraphic sequence spanning the Middle to early Upper Paleolithic. The uppermost Mousterian deposits of Fumane Cave are grouped into nine stratigraphic units, labelled from bottom to top as A13 to A5 (Peresani et al., 2008). The human fossil sample reported in the Catalogue of 2005 consists of two Middle Palaeolithic (Fumane 1 and 2) and one Upper Paleolithic Proto-Aurignacian (Fumane 2) teeth. Additional teeth were recovered during excavations from 1989 to 2011 from the Mousterian (Fumane 4, 5) and Uluzzian (Fumane 6) levels of the cave. All human remains except for Fumane 6 are deciduous teeth. The Fumane sample was analysed by Benazzi and colleagues (2014). Based on metric data (crown and cervical outline

analysis, and lateral enamel thickness) and non-metric dental traits (e.g., mid-trigonid crest), Fumane 1 (re-described as a lower left second deciduous molar) falls within the Neanderthal variability. Fumane 4 is described as upper right central deciduous incisor and Fumane 5 as lower right lateral deciduous incisor. Fumane 6, a fragment of a permanent molar, does not show any morphological features useful for taxonomic discrimination. Peresani and colleagues (2013) described the presence of an ochered fossil marine shell (*Aspa marginata*) from the Mousterian unit 9 of Fumane cave dated to at least 47.6-45.0 ka Cal.

3.11. Cavallo

The Cavallo Cave (Grotta del Cavallo) is located near Nardò (Lecce, South-Eastern Italy) on the rocky coast of the Uluzzo Bay. The Cave is a Paleolithic site where three human teeth have been discovered. These are reported in the Catalogue of 2005 (Giacobini & Manzi, 2005) and are respectively a Neanderthal deciduous molar (lower left second, Cavallo A) and two early modern deciduous molars (an upper left first, Cavallo B, and an upper left second, Cavallo C). Cavallo A comes from the Mousterian stratum, while Cavallo B and C come from the Uluzzian layer (Benazzi et al., 2011, 2012; Palma di Cesnola & Messeri, 1967).

In 2013, another new human deciduous incisor (Cavallo D) has been recovered in a Mousterian sublayer of the site and dated by ^{14}C to a time range of 45.6-42.9 Ka cal. A morphological assessment of Cavallo D identified Neanderthal features, among which the size and the relative thickness of the enamel. In addition, Cavallo D represents the most recent Neanderthal hu-

man remain in southern Italy related to a radiocarbon dated stratigraphy (Fabbri et al., 2016).

3.12. San Bernardino and Mezzena

The Mid-Palaeolithic site of San Bernardino Cave (Berici Hills, Veneto, North-Eastern Italy) appears in the Catalogue of 2005 because of three human remains (both cranio-dental and postcranial) unearthed in 1986-1987 from the macro-unit II, which represents Mousterian layers dated at > 40 ka (Alciati & Vacca, 2005).

Recently, a taxonomic reassessment by Benazzi and colleagues (2014) has been carried out on a lower right third molar from the site (San Bernardino 4) by crossing various methodologies (e.g. morphometrics, aDNA, mtDNA, isotopic analyses, AMS), and it has been ultimately identified as belonging to a modern human, while a ^{14}C dating attributed it to the Middle Ages. The same conclusions have been obtained for the other human remains. These were modern human remains post-deposited in the Mousterian levels (Benazzi et al., 2014) and thus must be removed from the Italian human fossil record and the relative Catalogue.

A similar case is that of Mezzena Shelter (Lessini Mountains) from the same region. The site is cited in a very short note at the end of the Catalogue because of human cranial fragments associated to Mousterian lithic assemblages. In the Catalogue is highlighted the problematic context of the site and no specific characterisation is reported for the remains. Nevertheless, the materials have been recently revised and resulted to belong to a Neolithic burial (Talamo et al., 2016). The site must be thus removed from the Catalogue.



Fig. 5 - Views of the so-called "Devil's Trail" of Roccamonfina. Two different trackways from the ichnosite near Foresta (Campania): left, the trackway B and on the right the pathway P1 (modified from Avanzini et al., 2020).

4. AN ICHNOSITE: FORESTA (ROCCAMONFINA)

The Foresta ichnosite in the municipality of Tora and Piccoli (Caserta, South-Western Italy), also known as 'Devil's Trails' (Fig. 5), was briefly described in the notes at the end of the Catalogue of 2005. Further research added new information to that reported there, which was mainly based on first report of this spectacular site (Mietto et al., 2003).

Panarello and colleagues (2020) described new footprints larger than those already studied, which form a new trackway that moves in the opposite direction with respect to the others. All mammal and human footprints (trackways A-E and isolated elements) have been found on top of the LS7 pyroclastic unit, which is dated around 345-350 Ka, that is to the cold stage MIS 10 (Scaillet et al., 2008; Santello 2010). Panarello and colleagues (2020) also reported the discovery in the thin layer at the base of LS8 and in the surroundings of the Foresta of basalt artefacts of Mode 2.

At least another Palaeolithic ichnosite is present in Italy inside the "Hall of Mysteries" (Sala dei Misteri), in the Cave of Bósura near Toirano in Liguria (Avanzini et al., 2020). The about thirty footprints were dated to about 14 ka Cal. (Citton et al., 2017; Avanzini et al., 2018) and are thus referred to modern humans of the very Late Pleistocene.

5. A FINAL SYNOPSIS

As reported in the present overview, since the publication of the Catalogue of 2005, much new information has been collected with respect to Lower and Middle Palaeolithic populations thanks to new site discoveries that took place across the Italian peninsula, new datings of known sites and specimens and/or the application of innovative methods of investigation. Therefore Italy, South of the Alps, confirms to be a territory of primary importance for the study of the European populations in some of the most crucial phases, in particular with respect to the appearance of the Mode 2 technology and the diffusion of *Homo heidelbergensis*, the subsequent evolution of *Homo neanderthalensis* and the transition between the Middle and Upper Palaeolithic.

Particularly, we would underline that some finds of exceptional importance have been studied for the first time or reanalysed thanks to the use of innovative technologies, new methods (especially the geometric morphometrics approach) and the development of new tools offered by the digital imaging. All this new information has significantly modified our knowledge of human evolution in Italy and in Europe during the Pleistocene.

Further data are coming from new findings, or from old specimens studied through the application of new methodologies. Much is also expected from several specimens we cited in this review, that are currently under study. Actually, the present reappraisal is intended to be the starting point for a "new catalogue" including the knowledge acquired to date as well as the forthcoming: we expect that in the following years more evidence will be achieved for the reconstruction of the complex patterns of human evolution in Europe during

the Pleistocene, particularly through the study of the Italian fossil record and prehistoric sites.

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