A COLLECTION OF FOSSIL VERTEBRATES FROM THE UPPER VALDARNO (CENTRAL ITALY) CALIBRATED IN THE END PLIOcene TO SPAN 220,000 YEARS ACROSS THE OLDUVAI MAGNETOCHRON

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Riassunto. La collezione di fossili a vertebrati con la dicitura Faella, proveniente dal Valdarno Superiore (VS), ebbe inizio nel Museo di Storia Naturale di Firenze più di due secoli addietro, ma rimase sempre ridotta e non venne mai formalizzata dal punto di vista paleontologico in un'associazione faunistica. Negli ultimi due anni la sua consistenza è passata da 17 a 29 esemplari, in rappresentanza di 12 specie, a partire dai primi 3 esemplari della fine del sottocento, che raggiunsero il numero di 13 fino al 1883 per poi iniziare ad accrescere soltanto nel 1967 con il 14° esemplare. Nell'area del borgo di Faella affiora solo la successione di Montevarchi, quella intermedia delle tre del bacino intermontano del VS ed è esposta per quasi tutta la sua estensione nella Cava Pratiglioli che contiene la sezione di Faella. Recentì tagli hanno messo a giorno argille, limi e sabbie ed hanno consentito di ricostruire l'estensione dei tre membri di questa successione, nella quale è stata rinvenuta la gran parte dei fossili del VS.

La magnetostratigrafia della sezione di Faella fu inizialmente ricostruita per la parte bassa, contenente la base del crono Olduvai (C2n, 1.95-1.77 Ma), e completata poi con la sezione aperta dal taglio per la nuova galleria ferroviaria Tasso dove è stata individuata la fine del magnetocrono. Nella sezione composita è rappresentato quindi l'intero Olduvai, al quale si aggiunge uno spessore sovrastante di ca. 15 m per una durata di ca. 50 mila anni, calcolata dalla velocità di accumulo espressa dalla durata delle magnetostrati, calibrata con lo standard magnetostratigrafico. Un livello ancora più basso e non in continuità, nel giro dell'Arno, non è calibrato. Pertanto sono disponibili i valori di età di ogni livello al quale è associabile la posizione che i singoli reperti della raccolta di Faella assumono nella serie magnetostratigrafica, utilizzando la revisione delle notizie ottenute dai controlli incrociati del sistema di catalogazione automatizzata delle collezioni. Le informazioni del catalogo diventano, anzi, oggetto delle prime e più importanti ricerche del nuovo assetto geocronologico della serie del VS, poiché alle altre notizie sui reperti ora si aggiunge il valore numerico della loro età. Nella collezione di Faella i fossili di più antica acquisizione, i 13 esemplari che fino al 1883 contenevano 7 specie sono stati ritrovati sempre di valore della loro posizione stratigrafica. Viene ora ritenuto che questi provengano dalla colla superiore della successione di Montevarchi e nella sezione di Faella assumono una posizione media intorno a 1.775 ± 0.052 Ma. I restanti reperti furono tutti rinvenuti nella sezione di Cava Pratiglioli a partire dal 1967 e quasi tutti in successione stratigrafica secondo un ordine così definito: uno, nel latino appena sovrastante quello contenente all'inizio dell'Olduvai, è datato 1.945 ± 0.002 Ma; un secondo, raccolto nel 1992 a circa metà della sezione della cava e quindi ubicabile con l'incertezza di ± 5 m di spessore, ha un'età di 1.872 ± 0.015 Ma, ed il terzo (del 1999) alla base dell'affioramento a 1.985 ± 0.002 Ma. Di un quarto esemplare, del 1977, non è data la posizione e la sua età è stata equiparata a quella degli esemplari anteriori e con la stessa loro incertezza. Gli ulteriori 12 esemplari, acquisiti nel gennaio 2000, furono rinvenuti tutti nei ca. 15 metri basali dell'affioramento, con gli esempi 1.95 ± 0.002 Ma e 1.945 ± 0.002 Ma, tranne uno proveniente dall'altocumulo di sabbie della serie e perciò datato 1.885 ± 0.002 Ma, i due restanti rinvenuti nei livelli più bassi, a 1.985 e 1.995 ± 0.002 Ma, hanno un'età di ca. 1. milione di anni successiva a quella degli ultimi esemplari della precedente fauna di Castelnuovo dei Sabbioni raccolti nel deposito di lignite (3.1-3.0 Ma) della successione di base dei sedimenti del VS.

Abstract. The small Faella collection of fossil vertebrates, from the Upper Valdarno (UV) continental sediments, was first assembled in the Natural History Museum of Firenze over two centuries ago, reaching 13 specimens for 7 represented species, until in 1967 new finds were retrieved from the Cava Pratiglioli clay pit. The latter were mainly collected in the lower stratigraphic levels, reaching 29 specimens for 10 species, while the position of the ancient specimens, which are among the most representative ones of the late Villafranchian mammal age, was tentatively determined from catalogue informations. The magnetic stratigraphy of the clay pit sequence at Faella, and additional controls on their database led to assign them an age of 1.775 ± 0.050 Ma. Each recent specimen was assigned a numerical age comprised in the time span measured in the composite Faella section, extending from 45 by prior to the onset of the Olduvai magnetochron at 1.95 Ma to shortly before the end of it at 1.77 Ma.

The Faella faunal assemblage will therefore play a key role in the geochronology of the UV faunal events, which occurred during the deposition of the Montevarchi intermediate fluvial-deltaic sequence, because the specimens occupy a wide range of ages and the lowermost ones represent the earliest fauna of the late Villafranchian, close to the beginning of the Mammal zone MN 17 of the Neogene classification. Its magnetostratigraphic date, ranging from 1.993 Ma to 1.775 Ma, represents the first example in the UV fossil collections of a measured time span within one assemblage collected in stratigraphic order. The biochronological position of the Faella fauna fits well the distribution of the late Villafranchian reconstructed in the UV, and the present example will represent a criterion for dating most old collections, especially the classical ones, whenever a magnetostratigraphy of the units containing them will be available for correlation.
Introduction

In the Upper Valdarno (UV), south of Firenze, the magnetostratigraphic record was recently established, and dates of the faunal events there recorded (Albianelli et al. 1997, 2001; Napoleone et al. 2001b) may summarize most of the Apennine history through the middle and late Pliocene and earliest Pleistocene. The UV fossil record of vertebrates, from either recent findings and old collections, was the base to establish the Villafranchian Stage for the Mammal Age classification (Azzaroli 1977) and the reference for some major events in the European biochronological history (Azzaroli 1983). Its role was critical in pointing out the Pliocene-Pleistocene turnovers for the Italian faunas (Azzaroli 1995; Azzaroli et al. 1997; Rook & Torre 1996; Torre et al. 1999), while the paleomagnetic dates of the main dispersal events were reviewed by Opdyke (1995) and discussed by Lindsay (2001). The greatest part of the UV fossil record was concentrated in the time span considered in this study, as it was calibrated to the new magnetostratigraphic framework (Cioppo & Napoleone 2001), for an age close to the Pliocene-Pleistocene boundary mostly reconstructed from the area shown in Fig. 1 around the Faella village.

The collection of fossils with the reference label of Faella consists of one of the oldest assemblages in the Natural History Museum of Firenze University (NHMFU). Three specimens were collected "since the time of the Grand Duke" (the second half of 17 hundred). The old assemblage included however only 13 specimens (the last one acquired in 1883), with 7 species (Tab. 1), and two of them are exposed in the permanent exhibition of the Museum (Azzaroli et al. 1992). After nearly one century a new specimen enriched the collection, bringing to 8 the number of species represented until 1999. As a matter of fact, the Faella assemblage was never the object of a palaeontological study aimed to give an account of its biochronological character.

The present interest takes origin from two occasions: the reappraisal of the automated catalogue information (Cioppo et al. 1996) due to new acquisitions made in the last two years, which nearly doubled its record and brought to 10 the number of species, and the new numerical dating provided by magnetostratigraphy of the Faella section, at the Cava Pratigliolini clay pit. Such circumstances are here stressed for the Faella collection because its specimens were assembled from different stratigraphical levels while they were dated to the base of the late Villafranchian. Consequently, a range of ages could be calculated for them from the Faella magnetostratigraphic section to which they are related, and distributed in the revised geochronology of Berggren et al. (1995) based on the geomagnetic polarity time scale (GPTS).
The UV magnetostratigraphy to study the Museum collections

Magnetostratigraphy, first introduced for pelagic sequences in the Umbrian Series, was applied to continental deposits in various regions (Butler et al. 1977, 1985; Azzaroli & Napoleone 1981; Biquand et al. 1990; Heller et al. 1991; Tamrat et al. 1995). When in the UV the Matassino Locality was dated as the earliest fauna of the late Villafranchian, shortly after the onset of the Olduvai magnetic chron (Torre et al. 1993; Albianelli et al. 1995), the established biochronological classification for that interval had to be reconsidered. The late Villafranchian was in fact originally fixed to begin in the Pleistocene, with the Olivola Faunal Unit from northern Tuscany immediately followed by the Matassino one, and these dates were changed by calibration to the Olduvai chron, to which the Plio-Pleistocene boundary was formally related in the stratotype at Vrica (Van Couvering 1997). It was recently shown that most UV faunal assemblages may be dated in an interval around it (Napoleone et al. 2001b), which implies that the Museum collections reported with precise stratigraphical location could be directly dated in the new magnetostratigraphical framework (Napoleone et al. 2001a). In contrast, only inferences could be made for the uncalibrated ones, although also their dates improved into narrower time intervals, as in the case of the Olivola F.U.

Among the UV finds from the late Villafranchian units of the Montevarchi Succession (MS) with detailed stratigraphical positions, either new localities (Mazzini M. et al. 2000) and old Museum collections (Cioppi & Napoleone 2001) were given an accurate paleomagnetic dating. Two cases of dated collections were the rhinoceros recovered by Nesti in 1811 at Monte al Pero (Fig. 1), of \(1.830 \pm 0.015\) Ma (Napoleone et al. 2001a), and the elephant skeleton recovered by one of us (Azzaroli in 1953), not far from the town of Montevarchi, to approximately the same age (Azzaroli & Napoleone in ms.).

After such magnetostratigraphic datings, the ages of specimens reported in the catalogue appeared inadequate, although they represented one of their major characters (Cioppi & Napoleone 1999). Even more difficult were the conditions of the nearly 75% of the collections which lack a dating because the location of old findings was not reported. In the Faella area most remarkable sections of the MS are exposed and the richest fossil sites are located (Fig. 1), but the reconstruction of their faunal associations was made with reference to the classical collections, which often contained the most significant specimens, not dated or dated with too vague ages (e.g., only with a "Pliocene", or "Pleistocene"). The same conditions were also found elsewhere for well located sites, from California to Macedonia, beyond Italy (Dundas et al. 1996; Kostopoulos 1997; Mazzini L. et al. 2000), mostly because they occurred in too short sections whose magnetostratigraphy would not reach a polarity sequence to be correlated with a reference paleomagnetic series.

Lithostratigraphy of the Faella area

The argillaceous and sandy silt of the MS was deposited during the calibrated ages shortly before 2.0 Ma and after 1.8 Ma, measured in this area for the portion bounded at its top by the clays of the Oreno sand (Fig. 2), and at the bottom by the silt and sand of the Terranuova unit, which enclosed in the middle the Ascione clay. All such deposits contained also the largest part of faunas collected in the UV (Azzaroli 1967; Azzaroli et al. 1992). The longest magnetostratigraphic measured sequence in the Oreno unit was that of the Tasso tunnel section. In the Terranuova one only short intervals were exposed in separate sections, the lower-

Fig. 2 - View of the escarpments "le balze" near the Faella small town, where the upper Oreno sand closing the Montevarchi Succession is exposed, but of difficult access and not sampled in the present study. Remnants of fresh cuts in the Poggio Rosso and Tasso tunnel sections showed good magnetic properties and were easily measured.
The Faella Section

Fig. 3 - Section of the Cava Pratigliolmi clay pit near Faella, where the magnetostratigraphic series was measured. A - The excavation front in the lower Terranuova silt is mostly exposed in the extreme right (out of view) while the front view is the most recent cut (summer 1999) at an elevation from ca. 150 m to ca. 158 m. It may be correlated to the top of the small white wall (high, to the right) above which a cuspidal section is visible as the end of the outcrop. B - The upper section, seen from the high extreme right of A, reaches 202 m level after the quarry operations have removed the overlying sand; a short wall behind it attains 207 m level but its magnetic record was too poor.

most of which reached the Arno river bed, and the Ascione is overlapping it in several outcrops (Monte al Pero and Poggio Rosso, on the right bank of the river, and Cava Gori at Campitello and Cava Frascalanci at Borrassole, on the left bank). The wall of the Cava Pratigliolmi pit, south of Faella, provided the best exposure of the continuous MS, in the fresh section showing all the mentioned units and most of their extent (Fig. 3).

A new sedimentological analysis of the sequence there exposed was carried out with the highest detail (Magi, unpubl. data) after the antler of a cervid was acquired in April 1999. A new recognition was carried out of the key elements within the MS, the intermediate phase of three which characterized the sedimentary sequence of the basin (Merla & Abbate 1967; Magi et al. 1992), for an indicative thickness of over 500 m (Sagri et al. 1994). The MS phase developed with lacustrine and palustrine sediments in the central part of the basin, and with deposits of alluvial fan in the marginal areas. The first were characterized by sandy and clayey silts with frequent sandy lenses which in their median-upper part contained intercalations of peat and lignite, while the deltaic deposits were characterized by coarse pebbles which change downstream to channelled sands and gravels. Therefore, the averaged thickness of the three MS lithostratigraphic units represent 80-90 m of the mentioned Terranuova silt, Ascione clay, and Oreno sand, as shown by Albaneli et al. (2001).

While detailed information of sedimentological and magnetostratigraphical analyses were reported elsewhere, here some data on the acquisition phases and distribution of the fossil specimens in the catalogue are examined.

The fossil findings in the Faella area

The section of the quarry lies 2 km south-east of that of Cava Matassino (Fig. 3). Denominations of both sites were reported in the old documents, respectively as "Il Matassino" and "La Faella", to indicate the whole surrounding area. The finds recovered from these areas were often reported in old catalogues only with the addition "near Figline Valdarno", the main town in that region, as occurred also for the specimens of the collection labelled as Faella. Those collected until 1883 and those from the Faella section acquired before 2000 are reported in Tab. 1, ordered according to the dates determined in the present study. The remaining specimens collected in the Faella section in 2000 are listed in Tab. 2 according to their stratigraphical positions.

A significant finding for the present discussion was the fauna recovered by Cocchi (1867) with the excavation carried out just at the south-eastern base of the sequence at Monte al Pero (Fig. 1). Although the collection of fossils was lost, the finding deserves to be illustrated for the details of its information. Cocchi reported that "along the Faella creek, in the locality called Casanuova, where in 1862 I ordered to execute an excavation which produced a rich recovery of fossil bones, the hill offers the following section", 80 m high and with 6 described lithotypes (Fig. 4). "In the lower sandy layer, of which the lower limit was not attained, were collected Drepanodon, Ursus, Felis, Cervus, Bos, Rhinoceros, etc."

After about one century from the acquisition of 1883, the Faella assemblage in 1967 was increased, but most specimens were acquired in January 2002. All these new remains were recovered in the Cava Faella section, which has been exposed since over 50 years by the quarry exploitation, but did not release any large fossil deposit. Concerning the stratigraphic log, the entire section was extended more than 80 m, now reduced by the
removal of the sandy top not used for the brick production. Part of it is shown in Fig. 3, and exactly corresponds to that described by Cocchi for the facing site of Casanuova, if the escarpments of the upper sandy deposits shown in Fig. 2 are included. Concerning the distribution of the fossil finds, they were scanty along

![Diagram](image)

**Fig. 4** - Reproduction of the 82 meter section reported by Cocchi (1867) as "The cut of the Faella excavation executed in 1862. 1, Clay-sandy layer with sandy pebble and gravel; 2, Grey clay with thin interbedded sandy levels; 3, Yellow coarse sand; 4, Compacted clay; 5, Pebble and sand, seldom with iron oxides; 6, Sandy layer with bones (Drepanodon, Ursus, Felis, Cervus, Bos, Rhinoceros, etc.). Its lower boundary was not reached; 7, Lower bluish clays outcropping to some distance and at lower level towards the Arno."

**Analysis of the catalogue record**

The exact positions of the recent specimens of the Faella collection allowed to directly calibrate them in the magnetostratigraphic type series, but for the remaining old findings, still nearly 45% of the collection, only a vague indication on their position can be desummed from catalogue information. A little more may be inferred from the traces of sand deposits referable to the upper unit shown by all of them. This led one of us (Azzaroli) to suggest that the specimens of the old collection might have been retrieved in the shallow cover of the upper sandy layers, due to their characteristic fossilization features in the sand. In contrast, the fossils recovered by Cocchi at the base of the section in front of the Faella one, and at the level of the Faella creek bordering on the left the Fossa from Faella to Figline (Fig. 1), were not further described for definition of their species nor adequately preserved, as they were lost.

The ancient finds were catalogued with the only indication "Faella", while for the recent ones the provenance was indicated as either "Cava Faella" and "Cava Solava" of Del Bufa Brothers, or "Cava Pratigliolmi" of the present owners, all indicated as Locality 62. Also the old collection may be grouped in this Locality number, in analogy with the nearby Localities, which were collected either as precisely sited (Matassino, Poggio Rosso) or from several scattered findings (Casa Frata, C. Inferno), and even indicated with approximate localities (Tasso). These all produced musueal assemblages, formalized into local faunas (De Giuli et al. 1986; Azzaroli et al. 1988) representing the bulk of the late Villafranchian in the UV. The latter case of the Tasso fauna is significant because its almost 300 specimens were recovered in scattered sites below the Tasso village, and assembled as the Tasso Faunal Unit, although labelled only with reference to a generic area of provenance and broadly positioned in its upper unit, whose remains are the crags shown in Fig. 2 (Azzaroli 1977, 1992).

As already said, the 13 ancient specimens of the Faella assemblage made up the bulk of the collection and their systematic aspects were defined in the catalogue with the exact indication of the species (Tab. 1). In the present occasion their position was inferred in the shallowest levels and therefore they may be grouped with the remaining specimens in the order here reconstructed, with reference to the MS outcrop exposed in the Cava Pratigliolmi clay pit. The quarried sequence begins at 143 m a.s.l., and after the old specimens the four finds recovered in it until 1999 were positioned in Tab. 1. The first site was that of the elephant tusk fragments collected by A. Berzi in 1967. These Archidiskodon fragments represented also the first finds that could be exactly located; from the catalogue controls they were referred as embedded in the "slid down clay" and "some
Tab. 1 - List of the 13 fossils from the old collection which formed the nucleus of the Faella fauna and of the 4 recent ones. Their age is attributed after calibration by the magnetostratigraphic type section of the Cava Pratiglioni clay pit at Faella: the error interval is given by the degree of accuracy of the catalogue informations for their position in the series. Specimen 14, unpositioned, was recovered in 1977 (see Appendix 1), and therefore its assigned age is that inferred for the previous ones as collected on the ground and possibly from the same upper sandy levels.

<table>
<thead>
<tr>
<th>Catalogue No.</th>
<th>Taxa</th>
<th>Age (Ma)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>IGF 1209V premolar, Pachyrhincus brevirostris</td>
<td>1.775 ± 0.030</td>
</tr>
<tr>
<td>2.</td>
<td>IGF 2377 metacarpal dx, Leptobos vallissani</td>
<td>*</td>
</tr>
<tr>
<td>3.</td>
<td>IGF 416 mandible, Sus strozzii</td>
<td>*</td>
</tr>
<tr>
<td>4.</td>
<td>IGF 11785 lower molars, dx M1 M2, Canis arnensis</td>
<td>*</td>
</tr>
<tr>
<td>5.</td>
<td>IGF 3282V calcaneum, Eucladoceros dicranios</td>
<td>*</td>
</tr>
<tr>
<td>6.</td>
<td>IGF 31V tibia, Eucladoceros dicranios</td>
<td>*</td>
</tr>
<tr>
<td>7.</td>
<td>IGF 906 skull, Ursus etruscus</td>
<td>*</td>
</tr>
<tr>
<td>8.</td>
<td>IGF 2352V calcaneum dx, Leptobos etruscus</td>
<td>*</td>
</tr>
<tr>
<td>9.</td>
<td>IGF 2361 metacarpal sx, Leptobos etruscus</td>
<td>*</td>
</tr>
<tr>
<td>10.</td>
<td>IGF 500 humerus sx, Leptobos etruscus</td>
<td>*</td>
</tr>
<tr>
<td>11.</td>
<td>IGF 2365 metacarpal ss, Leptobos etruscus</td>
<td>*</td>
</tr>
<tr>
<td>12.</td>
<td>IGF 624 mandible ss, Leptobos etruscus</td>
<td>*</td>
</tr>
<tr>
<td>13.</td>
<td>IGF 611 mandible dx, Leptobos etruscus</td>
<td>*</td>
</tr>
<tr>
<td>14.</td>
<td>IGF 3325V mandible ss, Leptobos etruscus</td>
<td>*</td>
</tr>
<tr>
<td>15.</td>
<td>IGF 6281V mandible, Sus strozzii</td>
<td>1.880 ± 0.015</td>
</tr>
<tr>
<td>16.</td>
<td>IGF 14439 tusk, Archidactylodon meridionalis</td>
<td>1.945 ± 0.002</td>
</tr>
<tr>
<td>17.</td>
<td>IGF 7543 antler sx, Pseudodama nestii</td>
<td>1.985 ± 0.002</td>
</tr>
</tbody>
</table>

Tab. 2 - List of the 13 specimens collected by M. Malpassi since 1985 in the lower part of the series, which is exposed in the abandoned section on the eastern side of the Cava Pratiglioni clay pit, and acquired by the Museum in January 2000. The bottom specimen at 134 m level is positioned in the wall of the Faella creek, 1.2 m below the walking surface, while the others partly overlap the dated specimens listed in Tab. 1. The ages attributed to the specimens according to their stratigraphic positions range from 1.995 Ma to 1.945 Ma with a resolution better than 2 ky, those in the interval between 134 m - 146 m are dated with less accuracy at 1.975 ± 0.010 Ma and the overlying ones again with a resolution better than 2 ky; at 1.963 Ma, 1.960 Ma, 1.950 Ma and 1.945 Ma. The highest specimen is from the "Ascione level", dated 1.890 ± 0.030 Ma.

<table>
<thead>
<tr>
<th>Catalogue No.</th>
<th>Taxa</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>IGF 8199V maxillary dx, Equus stenonis</td>
<td>Ascione level</td>
</tr>
<tr>
<td>2.</td>
<td>IGF 8198V metacarpal dx, Leptobos etruscus</td>
<td>152 m</td>
</tr>
<tr>
<td>3.</td>
<td>IGF 8208V phalanx, I, Leptobos etruscus</td>
<td>150 m</td>
</tr>
<tr>
<td>4.</td>
<td>IGF 8205V tarsal, astrag., nav. dx, Equus stenonis</td>
<td>147 m</td>
</tr>
<tr>
<td>5.</td>
<td>IGF 8215V tarsal, navicular dx, Equus stenonis</td>
<td>147 m</td>
</tr>
<tr>
<td>6.</td>
<td>IGF 8235V mandible D2-D3, Eucladoceros dicranios</td>
<td>146 m</td>
</tr>
<tr>
<td>7.</td>
<td>IGF 8204V antler dx, Pseudodama nestii</td>
<td>146 m</td>
</tr>
<tr>
<td>8.</td>
<td>IGF 8205V antler sx, fragm., Pseudodama nestii</td>
<td>146 m</td>
</tr>
<tr>
<td>9.</td>
<td>IGF 8206V antler, fragment, Pseudodama nestii</td>
<td>146 m</td>
</tr>
<tr>
<td>10.</td>
<td>IGF 8209V upper molar, sx Leptobos etruscus</td>
<td>146 m</td>
</tr>
<tr>
<td>11.</td>
<td>IGF 8210V tarsal, cubo-navicular, dx Leptobos sp.</td>
<td>146 m</td>
</tr>
<tr>
<td>12.</td>
<td>IGF 8202V mandible sx M3-M2, Leptobos etruscus</td>
<td>134 m</td>
</tr>
</tbody>
</table>

Fig. 5 - The Cervid antler collected by O. Pasquini and acquired in 1999. The site lies 1 - 2 m above the Fig. 3. The Cervid antler, acquired in 1999. The site lies 1-2 m above the ground level at the entrance of the brick factory (136 m in elevation), and therefore 5 - 6 m underneath the base of the magnetostratigraphic section (143 m). A - View during the recovery in February 1987; B - After the detached pieces were restored in April 1999.
3 meters above the base level of the pit" (see Appendix). The lowest bank in the pit is nearly 8 m thick, in the Terranuova silt, and is followed by one of ca. 2 m sand. The elevation of the escarpment can be reconstructed as being not higher than 10 m above the base and immediately overlain by a silty clay bank which is presently exploited. The fossil position may have reached at most meter 153, with a lower limit at 146 m (the reported 3 meters above the base level). Furthermore, considering that also the fossilization is typical of sand instead of silt and clay, it may be presumed that the fragments were contained in the sand on top of the escarpment, which slid down. The original altitude therefore should have been close to 150 m.

The next two specimens were collected, one in 1977 with the only reference Faella, and the second one in 1992, in the mid section. The fourth specimen (IGF 7543V) is the left antler of a cervid acquired in April 1999 and retrieved from the base of the abandoned north-eastern wall of the quarry. In Fig. 5a it is shown in its natural position, 1-2 m above the ground level at the entrance of the brick factory (136 m in elevation), and in Fig. 5b after its restoration. The importance of this finding was to trigger new interest in re-examining the catalogue for timing it and the remaining collection into the UV magnetostratigraphy, and it increased for the specimens of Tab. 2 acquired in January 2000. The stratigraphically most significant one of the latter was part of a mandible of Lepidotes etruscus, recovered in the wall of the Faella creek, almost 3 m below the cervid antler, i.e. 1-2 m underneath the treading plane, which represents the oldest find in the MS. In a short digression, the Casanuova Locality was recovered by Cocchi (1867) from a level very close to that, on the hillfoot of Monte al Pero, whose top (Poggio) yielded the famous rhinoceros of Nesti also calibrated to the Faella magnetostratigraphic type section.

More details on the last 4 specimens acquired before January 2000 are reported from the catalogue files in the Appendix, with additional notes to show the criteria adopted to assign their ages.

**Discussion of the catalogue data**

The dating of the Faella sequence was the main aim to summarize the time span of most faunal records of the MS, including that of the largest collections stored in the NHMFS. The acquisition in 1883 of the
last specimen of the Faella collection, and then an interruption of recoveries for almost a century was significant because it coincided with the occurrence of two major events which marked an epoch in the activities of the NHMFU. One was the recovery of rich deposits at Olivola and Montopoli, respectively in northern and western Tuscany (Forsyth Major 1877, 1889), with several samples diffused in European museums, mostly in London and Basel, while there were no findings at Faella until 1967. The second event was the recovery made by Azzaroli in 1949 and 1953 near Montevarchi, south of Figline Valdarno, of two almost complete skeletons of elephant which were since exposed in the Museums of Montevarchi and of Firenze, respectively. The attention paid to the exhibition aspects moved to reconsider the old collections and the key finds of Olivola and Montopoli outside the UV, together with those of Matassino and Tasso in the UV, became the base for assembling the biochronological history of the Villafranchian mammal age. After the revision on those faunas had already begun (Azzaroli 1947, 1950), a new asset was made (Azzaroli 1977) which is still in use (Gliozzi et al. 1997; Torre et al. 2001).

A similar condition presently occurs in the UV, after the new findings in large deposits contributed a spectacular enrichment of the Museum patrimony, and a new asset for redrawing the sedimentary history of the basin was provided by magnetostratigraphy. Also the
faunal events in its three basic sequences underwent a drastical revision of their ages, involving the mentioned Matassino and Poggio Rosso Localities (Napoleone et al. 2001b), to which the specific dates of the 1811 rhinoceros and of the 1953 elephant were added. Therefore, the catalogue indications on the Faella collection suggest the following two proposals, to assign to all findings the site number of Cava Faella (n. 62), comprehensive of all labelled synonymous references (Cava Pratiglomni, C. Solava, C. Del Buffa), and to assemble all the catalogued specimens under a single denomination as the Faella local fauna. It would group a fairly wide variety of forms, considering that it is made by the 10 species in the catalogue and 2 more genera (Megantereon and Rhinoceros, now Stephanorhinus) included by Cocchi's finds of 1862 at Casanuova.

Therefore, all specimens of the Faella collection, reported in Tab. 1 and Tab. 2 may be dated with the accuracies determined for each one by their position in the magnetostratigraphic type section.

**Magnetostratigraphy of the Faella section and age of its fauna**

The elements for the magnetostratigraphy of the Faella section were based on rock-magnetic properties of good quality, summarized from those reported in
Albianelli et al. (2001) and shown in Fig. 6. The measured section begins at ground level of the quarry, 143 m a.s.l., with a reversed polarity registered over more than 6 m thickness, and dated as the end of chron C2r 1r, Matuyama, preceding the onset of the Olduvai C2n normal chron (Torre et al. 1993). This was measured up to 171 m, where sampling was interrupted, and then the magnetostratigraphic record was integrated with that of the Tasso section (Fig. 7). In it, the terminal Olduvai chron showed a 10 m long reversed interval above 190 m, containing the Plio-Pleistocene boundary, as defined in the Vrica stratotype "just before the end of the magnetic chron" (Van Couvering 1997). The date of the Ascione-Oreno sedimentary transition is in a time interval of the order of 80 ky before the end of the Olduvai at 1.77 Ma in the GPTS magnetochronology (Berggren et al. 1995). This magnetostratigraphic framework completed the detailed sedimentological and stratigraphical reconstructions of the sequence, and the fossil specimens from the Faella collection were stratigraphically ordered so that they may now be calibrated on the Faella magnetostratigraphic type section for the UV.

The elephant tusk fragments assumed a key position in the stratigraphic record, lying closely above the onset of the Olduvai (dated 1.950 Ma in the GPTS), which was identified at 149.5 m level. Their position between 150 m and 153 m would date them nearly 5 ky after the polarity change, at 1.945 ± 0.002 Ma, according to the accumulation rate measured from the magnetostratigraphic polarity sequence. The second positioned specimen of the list in Tab. 1 was reported from the middle of the section and may be dated with larger incertitude, at the best within a stratum level ca. 10 m thick, corresponding to a time span of approximately ± 15 ky, around the age of 1.880 Ma. The last one is the deer antler at the base of the outcrop, in the abandoned quarry and 1-2 m above the ground level; again, it can be dated with better accuracy, at an age of 1.985 ± 0.002 Ma. Finally, the specimen from the Faella creek, acquired in January 2000 and laying just underneath the previous one is dated 1.995 ± 0.002 Ma. Both specimens assume a great relevance, as they become the oldest fossil remains in the UV mammal faunas of late Villafranchian age and the ones dated with the highest resolution. Their dates are 45 ky and 35 ky before the onset of the Olduvai chron, while the re-calibrated age of the Mataasso Locality is ca. 30 ky younger than it (Napoleone et al. 2001b). It may be remarked that this result extends the duration of the UV late Villafranchian, significantly enlarging the interval for dating the faunal diversification in the basin.

The last acquired specimens are listed in Tab. 2, with their stratigraphical position. The whole range of ages is calculated from the magnetozone durations of Fig. 7, with minor adjustments made after the first results of the cyclostratigraphical analysis of the continuous magnetic record changes.

The lowermost find at meter 134 was dated at 1.995 ± 0.002 Ma, while those recovered between the latter and the ones at 146 m were confined at 140 ± 3 m, and therefore dated 1.975 ± 0.010 Ma. The remaining specimens were dated again with 2 ky accuracy, those at 146 m at an age slightly older than 1.960 Ma, i.e. 1.963 Ma, that at 147 m 1.960 Ma, that at 150 m was almost coincident with the magnetozone boundary at 1.950 Ma, while the last one at 152 m was dated slightly younger than the polarity change, say 1.945 Ma, corresponding to that of the Archidiskodon of Tab. 1. The uppermost specimen is less accurately positioned, being only reported as recovered in the Ascione unit which extends almost 20 m around 170 m level; if placed in the mid Ascione unit, within ± 10 m incertitude, it would date 1.890 ± 0.030 Ma (Fig. 8).

Conclusions

Two criteria were tested on the Faella collection: the rapid controls of the NHMFU automated catalogue to review the indications on the palaeontological collections and the magnetostratigraphic numerical dating of the series in which the fossil remains were recovered. The results from the former allowed to reconstruct the positions of the specimens which spanned the whole stratigraphic unit, and led to consider it a Locality with a special character, due to its stratigraphical significance. Those from the latter provided the Faella collection a chronological position with the highest accuracy, and an age in years for its whole extent covering most of the late Villafranchian faunal record to which the richest collections in the NHMFU do belong. In spite of that, the Faella assemblage remained for over two centuries a minor collection, which was never reported for its palaeontological relevance, and only lately increased by doubling its total amount up to 29 specimens.

The catalogue indications on the Faella collection suggested the following two proposals, to assign the whole collection the site number of Cava Faella n. 62, comprehensive of all labelled references (Cava Pratiglioni, C. Solava, C. Del Buffa), and to assemble all catalogued specimens under a single denomination of Faella local fauna. It would group a fairly wide variety of forms, considering that it is made by 10 species. The whole range of ages extends over 220 ky, from 1.995 ± 0.002 Ma for the lowermost specimen to 1.775 ± 0.050 Ma for those of the old collection, near the end of the Olduvai chron. Successive steps were marked by the cervid antler of Tab. 1 at 1.985 ± 0.002 Ma, and the three specimens of Tab. 2 undetermined between the bottom one and that of 146 m, at 1.975 ± 0.010 Ma, followed by those positioned with 1 m accuracy, at 1.963 Ma, 1.960 Ma, 1.950 Ma, and 1.945 Ma. Also the Archidiskodon tusk of Tab. 1 was dated to the same age, at 1.945 ±
0.002 Ma, while last sample of Tab. 2 is located in the Ascione unit and dated 1.890 ± 0.030 Ma, followed by that in the mid section at 1.882 ± 0.015 Ma. All the specimens with undetermined location were inferred to come from the Oreno unit, whose full extent in the Faella area reached an average height of 225-230 m, with a middle level close to the end of the Olduvai, where they were positioned.

The numerical sequence of the GPTS, by which the Faella magnetostratigraphic type section was calibrated to the Pliocene/Pleistocene boundary stratotype, has become a relevant character of the automated catalogue. Revision of old collections can now drive to update the UV fossil catalogue and enable for a new biochronological asset of their stages, tightly constrained in the frame of paleomagnetic calibration. Numerically dated faunal events enable to fix bench marks on the evolution of life in the basin, during 220,000 years just preceding the chronostratigraphic renewal of the geologic system into the Quaternary age. It should be also remarked that during such time span the late Villafranchian fauna, although represented by several Localities through the MS and by its richest assemblages, did not evidence any significant diversification, because it was fully summarized within the Faella small collection.

REFERENCES


Ciofpi E. & Napoleone G. (2001) - The fossil vertebrate database of the Natural History Museum of Florence and


Appendix

The first four finds after almost one century from the last one of 1883, as they are reported in the catalogue cards. The original parts and some immediate annotations are included for comment.

1967: Archidiskodon meridionalis - tusks (various fragments)
IGF 14439 (Solava Brick Factory, Faella) (Plate 1 A-7).
It has to be noted that in the list it is also reported:
Foss. Loc. 62 FAELLA, followed then by further annotations:
Furnace of Del Buffa Bro. - Parts of Elephas tusks in the clays.
Coll. A. Berzi (Nov. 19, 1967). The specimen has been reported by the workers, almost 3 meters above the excavation ground level in the slid clay.

1977: Leptobos etruscus - Mandible sin., fragment of
IGF 3323V (without location, but only with an indetermined FAELLA label). To be noted that any position datum is missing. Although the finding is so recent, annotations are so scarce that its precise dating within the interval 1.95-1.77 Ma of the Olduvai chron (or even before?) becomes questionable.

1992: Sus strozzi - Mandible, fragment of a left jaw (with P4-M3)
IGF 6281V (Pratigliolmi Quarry, foss. loc. 62)
Retrieved at ca. half the height of the section in the quarry.

Coll. M. Martinelli.
To be noted that it is a relevant sample because the elevation of the site is quoted as intermediate in the outcrop. It therefore represents the specimen at the highest level in the Faella quarry together with the sample of Tab. 2 found in the "Ascione layer", and below the inferred elevation of the unlocalised ones in the old collection averaged at 192-195 m.

IGF 7543V (Pratigliolmi Quarry, foss. loc. 62) (Fig. 5)
From the basal levels of the Pratigliolmi Quarry.
Coll. O. Pasquini.
It should be remarked that this is a juvenile specimen. At the note "From the basal levels" the estimate of their elevation may be seen in the photographs taken in February 25, 1987 during the recovery, with an allowance of about 1 m, being the site 1.5-2 m above the base level of the entrance to the Pratigliolmi Factory located at an altitude of 136 m, in the dismissed banks of the left wall.
The date of acquisition is April 1999, and for the moment it may be left as a reference date for the catalogue. The age calculated by magnetostratigraphy is $1.985 \pm 0.002$ Ma, i.e. of approximately $35 \pm 2$ ky before the onset of the Olduvai. Two new data may therefore be added in the notes:
'Descr. Magnetostratigraphical age: $1.985 \pm 0.002$ Ma, $35 \pm 2$ ky before Olduvai';
'Geological map of the area (M. Maggi), photo of the find in situ (O. Pasquini)'.

Fossil vertebrates from Upper Valdarno