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Stephanorhinus jeanvireti (Guérin) 1972 (Rhinocerotidae, Mammalia) from Roatto near Villafranca d'Asti, NW Italy. Revision of the specimen from Dusino.

ABSTRACT

The authors report on a partial rhinoceros skeleton (*Stephanorhinus jeanvireti*) found in Roatto near Villafranca d'Asti. A third upper premolar of *Stephanorhinus* was found in association with these remains. Both taxa are typical of the Lower Villafranchian (Lower Pliocene).

New data on the post-cranial morphology of this rhinoceros species, still poorly known, are presented, thanks to the good preservation of the remains. In the context the Dusino rhinoceros skeleton (Sacco, 1895) found at the end of past century in the same area, is also reviewed.

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1. INTRODUCTION

During fieldwork in the spring of 1989, one of the authors (A. Mottura) discovered a small portion of dental crown and some bone fragments. These remains had been uncovered by ploughing in a field on the left side of the Val Triversa, about 150 metres south of C. Melona and at an altitude of about 190 metres above sea level, near Roatto (Asti) (Fig. 1).

More complete skeletal remains were expected to be present underground. Once permission to excavate had been obtained from the Soprintendenza Archeologica del Piemonte, after a preliminary localisation of the buried remains by Georadar (unsuccessful because of the presence of reflective concretions levels) the excavation led to the discovery of the partial skeleton of a rhinoceros. This fact has given the opportunity for an update of geological and paleontological knowledge about the find area.

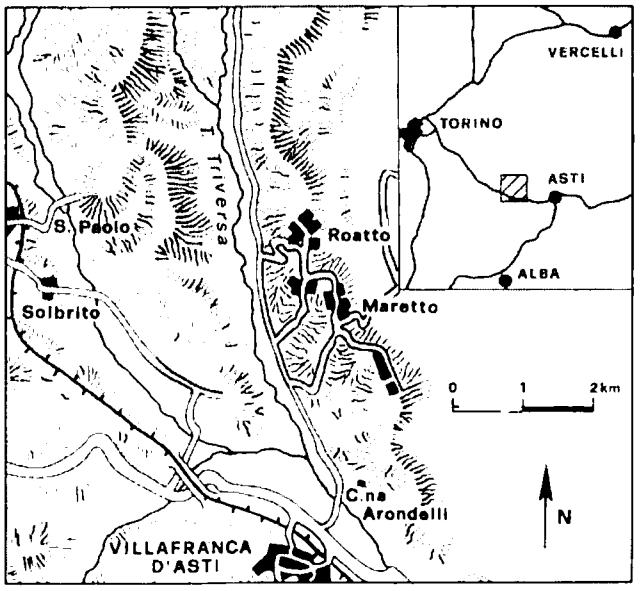


Fig. 1 - Index map - Fig. 1 Ubicazione dell'area rilevata.

2. GEOLOGICAL SETTING (M.G. Forno)

The Val Triversa is developed with a roughly N-S trend at the western edge of the Asti reliefs, between 150 and 300 metres above sea level: these reliefs are the morphological evidence of the so-called "*Bacino di Asti*" which was filled by a regressive succession of marine, transitional and continental sediments. The stratigraphy of the Villafranchiano type was established on the two last terms. The sediments are slightly deformed into a synclinal structure: the axis of the structure has a E-W trend with a mild westly plunge. The Val Triversa, which is orthogonal to the northern slope of the syncline, cuts from north to south the progressively more recent terms of the succession (see geological map).

In the past century the sediments outcropping in this area and their fossil content of land vertebrates and invertebrates were the object of several studies. The most important geological and paleontological data are summarised in paragraphs 2.1 and 3 respectively.

2.1. *Previous geological studies*

The first brief description of the continental sediments outcropping in the Villafranca d'Asti area was given by Pareto (1861). De Mortillet (1864) added a list of the fossil findings and illustrated a section located between Villanova and Villafranca. Shortly afterwards, Pareto (1865) provided the first exhaustive description of the succession. Because it is particularly thick and fossiliferous, it was proposed as reference succession, named "*piano Villafranchiano*" and attributed to the Quaternary.

The general, most important, geological work is that by Sacco (1889-1890) who published the first geological map of the "*Bacino Terziario e Quaternario del Piemonte*" in which the Villafranchian sediments, referred to Upper Pliocene, were distinguished from the underlying marine sediments. The same survey was republished in the first edition of the Sheet 69 "Asti" of the *Carta Geologica d'Italia* at 1:100.000 scale (Sacco, 1922).

After a break in studies, the previous data were revised by Martinis (1949) and Gabert (1962).

Only partial studies on the Villafranchian succession were carried out by later authors. Petrucci & Taghavini (1968) examined the morphology of the western sector of the fluvio-lacustrine basin and pointed out the presence of an extensive erosional surface which cuts upward the succession. These sediments were mapped in the second edition of Sheet 69 "Asti" of the *Carta Geologica d'Italia* (Boni *et al.*, 1970) and briefly described in the illustrative notes (Boni & Casnedi, 1970). Some observations about the Villafranchian sediments in the Piemonte reliefs were done more recently during the studies for the *Carta Neotettonica d'Italia* (Carraro *et al.*, 1980). The original discontinuity in the distribution of the sediments was pointed

out: they did not fill extensive lacustrine basins but a series of reduced local basins at different times. Furthermore, the deformation of these deposits was confirmed. In a subsequent note (Carraro *et al.*, 1982) two superimposed complexes were recognised: they are constituted respectively by transitional and fluvial deposits and by prevalently lacustrine deposits.

The Villafranchian succession was referred, according to the different authors, either entirely to the Pliocene or entirely to the Pleistocene or partly to the Upper Pliocene and partly to the Lower Pleistocene.

2.2. *Geology*

After the Roatto rhinoceros discovery, the geological survey of the north-eastern sector of the Villafranchian type-area allowed a detailed description of the succession outcropping in the Val Triversa, which appears to dip gently towards south-west (see geological map). The outcropping thickness is some tens of metres: the maximum thickness, recorded north of the Roatto village, is about 90 metres (1). In the succession four overlying units are recognizable; these are present in the whole Villafranchian type-area (Boano & Forno, 1995). These are named, from the bottom upward, "Unità di Ferrere", "Unità di San Martino", "Unità di C. Gherba" and "Unità di Marello". Where the contacts are visible, it is evident that only the Unità di C. Gherba is separated from the underlying unit by a clear erosional surface with angular discordance (2).

Given the poor exposure and the necessity to keep the data, separate from their interpretation, it was decided to map the individual outcrops, distinguishing them from the interpolated areas. The geological map includes the field work data up to 1993. The more representative outcrop is near C. Melona, just north of the rhinoceros site, where the upper part of the Unità di San Martino is recognisable.

The *Unità di Ferrere* outcrops very locally and only for a visible thickness of a few metres at the northern edge of the study area. It is constituted by sandy sediments with trough cross bedding. In some outcrops the remains or moulds of tree trunks and branches occur, alongside infrequent fragments of marine molluscs.

The *Unità di San Martino* outcrops in the lowest part of the valley slopes, where it is visible for a maximum thickness of 40 metres (1). This unit is formed by alternating silty and sandy sediments, from ten centimetres to a

(1). Immediately to the west of C. Melona, at an altitude of circa 190 m, a well was dug in which the lower part of the same unit was found, not outcropping, and about 15 metres thick.

(2). The Unità di Ferrere and the Unità di C. Gherba, outcropping essentially in the southern type-area, are attributed with the name of two localities outside of the mapped area.

metre thick. The silty levels show a parallel lamination and often contain leaf moulds, tree trunks and branches, concentrations of vegetal fragments and of land molluscs. The sandy levels generally show a cross lamination. The variability of the facies results in different features of the various outcrops, even contiguous.

The *Unità di C. Gherba* is visible only in a few outcrops: the thickness less than ten metres prevents to verify its lateral continuity. It is constituted by sandy sediments showing a trough cross bedding.

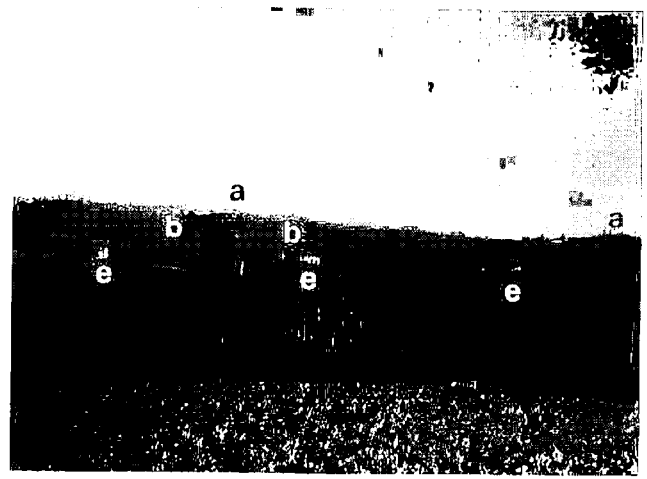


Fig. 2 - The right slope of the Val Triversa, seen from C. Melona. Several episodes of fluvial modelling are marked by a series of terraced surfaces. Particularly evident are the surfaces at about 260 m (a) where is located C. Valmarrone, at about 240 m (b), at about 180 m (e) where C. Gnocchi, Cascinetta and C. Brianssa are respectively located.

Fig. 2 - Aspetto del versante destro della Val Triversa, visto da C. Melona. Sono osservabili una serie di lembi di superfici terrazzate pianeggianti, corrispondenti ad altrettanti episodi di modellamento fluviale, che incidono a più livelli la successione villafranchiana. In particolare si evidenziano lembi a circa 260 m (a) su cui è posta C. Valmarrone, a circa 240 m (b), infine a circa 180 m (e) su cui si trovano rispettivamente C. Gnocchi, Cascinetta e C. Brianssa.

The *Unità di Maretto*, more than 40 metres thick, has a continuous distribution and constitutes the upper part of the valley slopes. It is formed by silty-clayey unstratified sediments, characterised by considerable areal homogeneity. Carbonatic concretions, some centimetres to about ten centimetres in size, frequently occur (locally known as "*murs*"). The presence of these sediments, more eroded than the underlying units, is also morphologically recognizable from the lesser inclination of the valley slopes.

Within the different units described, lenses showing generally modest extension and thickness constituted by gravel deposits with trough cross bedding occur. The pebbles show a very high degree of rounding and a marked sphericity and are composed almost exclusively by quartzite and conglomeratic quartzite and subordinately by dolomite, gneiss, micaschist and gabbro. Such lithology suggests that the *Bacino del Tanaro* supplied the sediments.

The whole succession can be interpreted as regressive. It is opened by the marine coastal facies (Sabbie di Asti p.p.), includes starting from bottom delta front sediments containing fragments of tree trunks, of branches and of marine molluscs (*Unità di Ferrere*), prevalently deltaic plain sediments rich in leaf moulds, vegetal fragments and land molluscs (*Unità di San Martino*), and finally fluvial sediments generally sterile (*Unità di C. Gherba e Unità di Maretto*).

The frequent fossil land vertebrate remains found in the sediments of the *Unità di Ferrere* and the *Unità di San Martino* allow us to refer them to the middle Pliocene. On the contrary, at present, the lack of finds from the *Unità di C. Gherba* and the *Unità di Maretto* sediments, prevents any documented chronological inference.

The geological survey also enabled us to observe how the whole Villafranchian succession was cut by a series of terraced erosional surfaces: the scarps which separate them have variable heights, averaging around 20 metres. The small preserved parts of erosional surfaces are locally covered by silty fluvial deposits, or subordinately gravelly deposits with a heterogeneous lithology, some tens of centimetres to some metres thick. Between 260 m (C. Valmarrone) and about 180 m (C. Gnocchi), five terraced surfaces are recognizable (three of these are visible in Fig. 2). The *Rhinoceros* remains were located on the scarp between the two lower surfaces. The terraced series is characterised, from the top to the bottom, by a gradual improvement in the preservation of the fluvial deposits and by the presence of progressively less evolved soils, which indicate a more and more recent age.

These terraced surfaces are related to the fluvial modelling of the area which occurred in the Middle-Upper Pleistocene, considerably later than the deposition of the Villafranchian succession. This modelling involves the setting up of a new hydrographic network, with an indipendent trend as regard to the previous one.

2.3. *The sediments in excavation site*

In the context of the stratigraphic succession previously described, the rhinoceros remains are coming from the *Unità di San Martino*, about 25 metres below its top (see geological map). The *in situ* skeletal materials randomly lied near the discontinuity surface between a sandy bed and an overlying silty one. The gray, medium grained, sandy sediments, the bottom of which is unexposed, are recorded for a thickness of about 50 centimetres and display a trough cross lamination, with local levels of clay-chips. Both carbonatic and iron manganese oxide concretions, few centimetres wide, were also observed. The silty sediments, 30 to 50 centimetres thick, show a hint of planar lamination evidenced by iron coatings which also underlined some of the fossil remains. Finally, this bed is overlain by heterogeneous colluvial sediments, some tens of centimetres thick, formed by a chaotic mixture of sandy, silty and clayey sediments. This is poorly compacted, containing reddish-brown soil fragments and thus characterised by a variate colour (Fig. 3). The cross laminated sandy sediments, suggesting a tractive flow, are interpreted here as stream channel fillings, while the silty sediments may suggest some low energy episodes. The overlying cover is then formed by far more recent colluvial deposits.

3. THE LAND FOSSILS OF THE VILLAFRANCA D'ASTI AREA: A REVIEW OF PREVIOUS STUDIES (F. Campanino)

The continental sediments overlying the Pliocene marine sands in the Asti area contain numerous fossils, known from the end of eighteen century and included in the old collections of Turin University and of the Academy of Sciences. The first remains from Piemonte, which are attributable to *Anancus*, were described by Cuvier (1806). Later Borson illustrated other remains (1818, 1823, 1825) and first described (1823) a tooth of a new species later named *Zygolophodon borsoni*. All came from the Villafranca d'Asti area or from its edges, such as Villanova and Valle Andona. The sporadic discoveries of other remains of vertebrates continued with time: some of them are documented in the Museum Catalogue published by Borson in 1830.

Only around 1850 during the excavation of the Turin-Asti railway-cut, from Villanova to Villafranca, a significant number of remains of different animals were collected, thus promoting an increase in the research on the surrounding area. The most complete fossil, a skeleton of *Anancus arvernensis*, was found near Solbrito, and was described by F. Sismonda in 1851. This author described the sediments, containing the fossil together with some land molluscs, and defined them as fluvio-lacustrine deposits. He distinguished them clearly from the underlying formation: "*...siffatti depositi fluvio-lacustri, che per la loro natura e modo di formazione loro vanno*

staccati dalla serie dei veri sedimenti pliocenici marini." (E. Sismonda, 1851, p. 55). He also stated their stratigraphic position: "*chiaramente risulta che i sedimenti fluvio-lacustri con ossa di pachidermi fanno bensì parte del gruppo terziario, anzi della formazione pliocenica*" (op. cit., p. 57). Furthermore the

Fig. 3 - View of the excavation. At the centre the group of fossil remains is visible. On the wall of the section in the background the following can be observed, starting from the bottom: deltaic plain sediments represented by sands and by overlying planar laminated silt, underlain by oxidized levels; heterometric conglomerate and unstratified colluvial cover; agricultural soil.

Fig. 3 - Aspetto dell'escavazione. È visibile al centro l'insieme dei resti fossili. Sulla parete di taglio sullo sfondo sono osservabili dal basso verso l'alto: sedimenti di piana deltizia rappresentati da sabbie e da soprastanti silt a laminazione pianoparallela sottolineata dalla presenza di livelli ossidati; conglomerato eterometrico e copertura colluviale non stratificata; suolo agricolo attuale.

author reported "*A poca distanza si trovarono denti di Elefante, corna di Cervo, una mandibola di Rinoceronte*" and near Ferrere by Gastaldi "*con molari ed una magnifica zanna di Mastodonte... scoprironsi denti di Ippopotamo e di Tapiro*" (op. cit., p. 59).

In the same years Gastaldi was, in fact, forming a rich collection of vertebrate remains, which contained a large number of specimens coming from the Villafranca d'Asti area (Briccarello di Cortazzone, Cantarana, Dusino, Ferrere, San Paolo). In 1858 he published a memoir on the Piemonte vertebrates with illustrations of some *Zygolophodon* and *Anancus* remains together with a list of all the species coming from the "*alluvioni plioceniche*". In the stratigraphic succession Gastaldi recognised two different superimposed sedimentary complexes with different faunas: "*Gli strati marini passano insensibilmente alle alluvioni plioceniche. Queste sono composte generalmente di ghiaia grossa e minuta, e di sabbia sovente purissima, e contengono molti resti di Mastodonte, di Elefante ed alcuni anche di Rinoceronte e Ippopotamo. Sono sovrapposte senza interruzione agli strati marini e si immedesimano per così dire con essi e io non le avrei separate da quelli se esse non passassero a grado a grado a strati di argilla, di marna e di calcare grossolano costituenti un vero fondo di palude e racchiudente molti resti di ruminanti, di solipedi, di roditori, una fauna cioè che ha maggiore analogia con la nostra.*" (Gastaldi 1858, pp.45-46). The paleontological discoveries and the stratigraphic inferences of Sismonda and Gastaldi formed the basis on which the following research of Pareto and of other authors were founded.

In 1860 a collection of bones found in the study area during the railway trenching was donated to the Museum. Unfortunately the fossils of this collection, including some important specimens, were recovered by the railway workmen, and it is not possible to know the exact position of these finds within the sedimentary succession. The fact is relevant if one takes into account that in a tract of a few kilometres the railway cut - which descends from 260 m above sea level, at the edge of the Altopiano di Porrino near San Paolo, to 180 m, at the confluence of the Rio Traversola-Rio Stanavasso - cuts the sedimentary succession for about 80 metres of its thickness. Among these fossils some cranial remains of a singular bovid drew the attention of Sismonda who began a study and, proposing the name of *Bos stenometopon*, sent a drawing to Rutimeyer. The latter published it in two works (1868 and 1878) attributing, however, to *Bos etruscus*. With the death of Sismonda, who did not complete his study of *Bos stenometopon*, and the death of Gastaldi, the studies on the Piemonte Villafranchian fauna were temporarily interrupted.

In 1880 the discovery of a nearly complete skeleton of rhinoceros near Dusino in the "*alluvioni plioceniche*" (Baretti 1880a, 1880b) renewed interest in the fossils of this region. The important fossil of Dusino will be described by Sacco many years later, in 1895, after the geological survey and

the publication of his memoir on the "Tertiary and Quaternary Basin of Piemonte" (1889-1890) where the Pliocene age of the Villafranchian in Piemonte was confirmed. In previous years (1884, 1885) in some works on the land molluscs found in the Villafranchian sediments, Sacco had already stressed the differences between these molluscs and the Quaternary ones, confirming his opinion of the Pliocene age of the Piemontese Villafranchian. The same author, during the French Geological Society Congress in Turin (1905), provided a list of the fossil vertebrate and invertebrate species found in the Piemontese Villafranchian sediments. In 1906, Sacco documented other fossil rhinoceros remains, from the Museum of Turin collections, including those coming from the railway cut.

Shortly before, in 1903, De Alessandri had described the remains of Pliocene cervids from Piemonte, including some specimens from San Paolo Dusino ("San Paolo-Dusino" in Museum labels indicates the fossils recovered during the railway cutting).

In 1904, another unpublished nearly complete skeleton of *Anancus* was found near Villafranca.

In his 1913 memoir on the elephant remains of the Museum of Turin Zuffardi pointed out the problem of the chronostratigraphic attribution of the different species of *Elephas* found at San Paolo.

Some plant fossil remains from the Villafranchian sediments were described by Peola at the end of last century (1896) and some new species of fossil wood were described few years later by Pampaloni (1903).

In 1949 Martinis, in an exhaustive review of the geological and paleontological knowledge of the Villafranchian outcrops of the Po Valley, published a list of the species of the vertebrates and invertebrates (land molluscs, with a systematic update of the species cited) known at that time from Piemonte.

A renewed interest for the Villafranchian in the type area followed the discovery, in the 1960's, of new local fauna and the better definition of the sedimentary succession. In 1967 Hurzeler published a list of large fossil vertebrates found in the Villafranca area, belonging to a private collection and now housed at the Museum of Basel. New species were added to those already known from the last century. The author made some critical inferences on the fauna of Villafranca d'Asti and compared it with the Villafranchian faunas from other localities.

In 1965-1966 remains of small vertebrates and land molluscs were discovered in a quarry near C. Arondelli. Many new species were thus added to the Hürzeler's list (Berzi *et al.*, 1970; Berzi, 1970, on the Lagomorphs; Michaux, 1970, on the Rodents; Vernaud-Grazzini, 1970, on the Amphibians). Savage & Curtis (1970) provided a full list of the species found in the Villafranca area, including the Basel collection and the finds from C. Arondelli. In this work the authors proposed for the Villafranchian type section an age of about 3.4 m.y. In 1971 True dated the land molluscs of C. Arondelli to Pliocene.

A detailed sedimentological (Francavilla & Tomadin, 1970) and paleoecological study on the basis of the palynology (Francavilla, Bertolani & Tomadin, 1970) was carried out on some sections of the Villafranca area (C. Crottine, Cava RDB, Cascina Cantarana, C. Arondelli). In 1970 Pavia described the succession of Cava Arboschio near Cantarana, where fossil remains of *Anancus* and *Rhinoceros* and a rich flora had been found. In 1971, Azzaroli & Valli described the Villafranchian type stratum.

From this period many authors devoted themselves to the systematic revision of the fauna, to the assessment of the succession of the vertebrate faunas during the Plio-Pleistocene, and to the stratigraphic correlation of the continental faunas and of continental and marine faunas on an European and world scale. As a result of theese investigations the fauna of the type-area of Villafranca was attributed to the lower Villafranchian. Azzaroli (1977), in a work dedicated to the Early Villafranchian in Italy and to the Plio-Pleistocene boundary, included the whole fauna from the Villafranca area in the "faunal unit of the Val Tiversa". He also described the sedimentary succession and considered it "the lateral equivalent of the richly fossiliferous Astian sands farther east", accepting the dating proposed by Savage & Curtis (1970). In Azzaroli *et al.* (1987) the Early Villafranchian fauna of Tiversa include 21 mammalian species.

Esu & Girotti (1991) defined a biostratigraphic and palaeoclimatic set up of Italian Villafranchian (including the type area) based on the continental molluscs assemblages.

4. THE EXCAVATION AT ROATTO AND THE TAPHONOMIC INFERENCES (A. Mottura)

Thanks to the kind of the embedding sediments and the localized bone scattering, the excavation was carried out in only ten days, thus uncovering an extent over than 15 square metres. This allowed to record about a hundred bony remains from a single rhinoceros carcass, including a part of the axial skeleton and the most of the limb bones. Only few fragments of the skull and pelvis were gathered on the surface of the site. Some bony remains indeed, reworked by farming, outcropped along the intersection of the topographic hill slope with the fossiliferous layer. The anatomical parts which are missing, therefore, probably lay nearly to the excavation area and they not broken.

As the excavation progresses, a surface upon which the bones lay was exposed. This intersected the embedding layers with irregular trend and showed a some sudden lowering toward south east (Fig. 4).

None of the bones were found in anatomical connection, but rather these were locally and randomly scattered, and sometimes overlapped, over an extent of about 9 square metres. A numerical prevalence of the right side of the body is weakly recorded and so any early remarkable removal of the

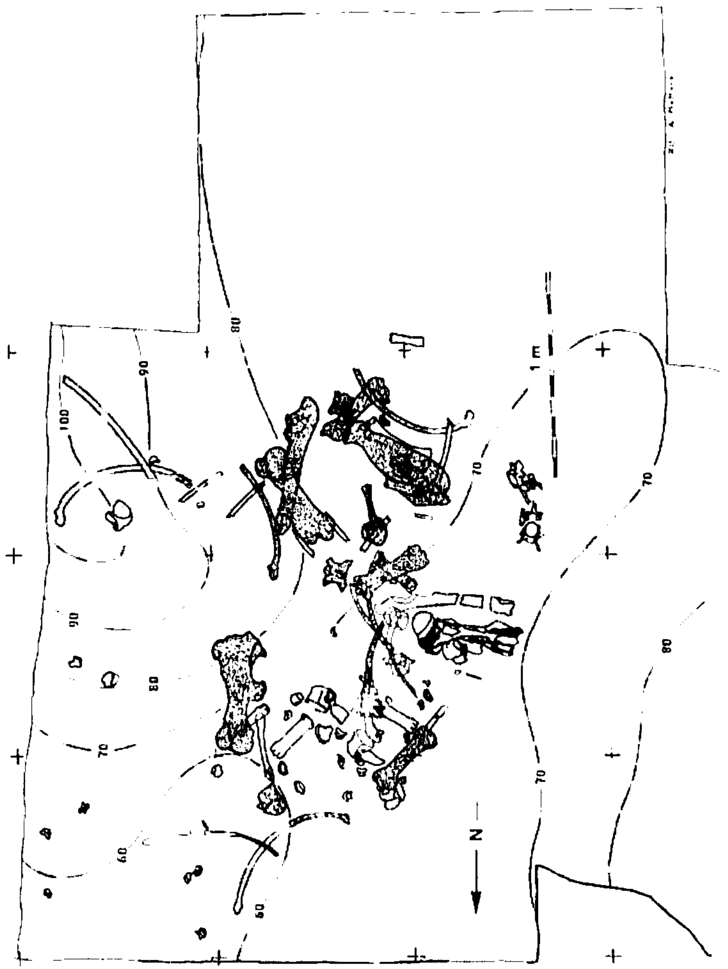


Fig. 4 Map [illegible] the ex[illegible] The bon[illegible]

Fig. 4 Ri[illegible] In puntinate le ossa contenute nei sedimenti [illegible] In b[illegible]

carcass, due to a partial erosive re-exposition, could not be inferred. The bony surfaces show no traces either of scavenger action, subaerial weathering or flood rolling. Most of the lesser dense bones with high surface/volume ratio, are also present such as ribs, vertebrae and sacrum, which are more easily dispersed even in the low energy environments (Voorhies, 1969; Behrensmeyer, 1975). Such hydrodynamic behavior and, in particular, the overall bone dip and orientation (as analysed by circular diagrams) fail to reveal for the single disjointed part any evidence of flood transport. Where observable, the lamination of the sands which lay immediately in contact with the bones show no trace of postdepositional trouble or displacement. It does not seem therefore recognizable a sinking down due to the overlying sediment load. On the other hand, from the previous observations it should be also postulated a rapid burial of the carcass parts in a "dead end" (Hanson, 1980) and not a sorting in a channel lag deposit. On the contrary, the two isolated teeth of *Sus minor* and of an indeterminable cervid (see this volume pr. 60), of by far smaller size than the previous remains, may undergo similar conditions by tractive currents.

From this overall context of the remains, therefore, one can infer that the ungulate corpse was carried off by the stream flood (or perhaps directly died) into a lower energy bar point environment, where it sank *after* the beginning of the decomposition of the soft tissues. So it was rather locally and partially dismembered, and then quickly buried by sand.

Following erosional episodes gnawed here and there the deposition surface, thus partly reexposing some of the uppermost remains, up to the very low energy passive filling and to the final obsolescence of the water body.

The fining-upward sequence of the embedding sediments, which close with a "clay plug" facies, may well support these inferences.

5 THE STATE OF PRESERVATION OF THE BONES (D. Ormezzano).

Generally the bones lying in contact with the sandy sediment have a light pinkish colour with patches reddened by the iron oxides, while those in contact with the silty sediments have a white colour tending to grey with patches of blackish patina formed by manganese oxides. In some cases a clear variation in colour on the surface of the bone documents the position with respect to the sand-silt contact. Sometimes, and especially on the articular surfaces, one observes thin coatings of cemented sand, with concentrations of limonite. The fact that the bones were found in both sandy and silty sediments has produced different situations of preservation. The bones in contact with the silty sediments are more altered. Plastic deformations are verifiable on some bones and are more evident on the

laminar portions. Also fracture deformations are numerous and important and produced by the pressure exerted on the fossiliferous horizon, close to the surface, by the repeated passage of the farming machines. Despite this the general state of preservation can be said good. An accurate preliminary consolidation by impregnation with reversable adhesive was necessary. On the bones affected by extensive areas of microfracture, a coating with gauze soaked in adhesive was necessary, in order to avoid the dispersion of very small fragments. The bones were removed after they had been wrapped with aluminium foil and cased in a two components polyurethane foam.

5.1 *Restoration*

After the removal of the adhesive used for the consolidation in the field and the cleaning with small instruments or a sand blaster, some bones were consolidated and repaired. In some cases, when present fractures with slight dislocation of the fragments by crush, the bones were taken to their simple fragment and then repaired. In other cases, when fracture and crushing deformations were accompanied by deformations of a plastic type, the operation of the restitution of the bone to its correct original morphology was compromised (the most evident cases are represented by the spine of the scapula and by the proximal part of the right femur). For some bones, which had been partially damaged by the ploughing, a complete reconstruction of the fragments found variously dislocated over the area was possible (left femur and some cervical vertebra). For the heaviest and largest bones internal reinforcing structures were made.

6. DESCRIPTION OF THE POST CRANIAL SKELETON OF *STEPHANORHINUS JEANVIRETI* FROM ROATTO AND DUSINO (B. Sala)

The rhinoceros from Roatto, even if it does lack the cranium, the mandible and part of the axial skeleton, can be considered one of the best preserved specimens of *Stephanorhinus jeanvireti*. Its attribution to this species is based on morphological characteristics of a large part of the bones, which are comparable with those described by Guérin (1972). The specimen represents a large animal, of maximum or greater dimensions than those known from the literature.

A nearly complete skeleton of another rhinoceros, which is preserved at the Museum of the Department of Earth Sciences of Turin University, was found in the last century at Dusino, only a few kilometers away from Roatto. The skeleton was partially described and figured by Sacco in 1895, and later attributed to *S. jeanvireti* by Guerin (1972, 1980). This latter specimen was unfortunately damaged during the last world war and only

now it is being restored. Since this rhinoceros is of medium or medium small size, it was decided to describe it alongside that from Roatto, in order to be able to evaluate better the characteristics of the species, the individual differences and those which are attributable to the size.

In addition, reference was particularly made to Guérin's publication of 1972 wherein the species was formally established. Comparisons on both morphological and quantitative grounds led to slight updatings of the descriptions of *Stephanorhinus jeanvireti*.

The illustrations were chosen not only to show the material studied, but also to stress the characteristics which are retained to be peculiar to the species, so that this publication might be used as a reference work.

The state of preservation of the bones and their restoration are described in this volume by D. Ormezzano.

The surface material unearthed by agricultural works at Roatto includes small fragments of cranium, minute remains of one or two teeth, and a small portion of palate with an alveolus which still preserves fragments of dental roots. This material is very fragmentary and is not described here.

The cranium and the mandible from Dusino were already broken when they were found, and were described in detail by Sacco (1895). Bombing during the last war further damaged these finds. Other dental material of *S. jeanvireti* is preserved in Museum of Turin; it will be described at a later date.

Description of the material

The material which forms the object of this study is the post cranial skeleton from Roatto, found in 1991, and that from Dusino, found in 1880. The description of the discovery of the specimen from Roatto and details of the site are given by Motture and Torino in this volume; information on the specimen from Dusino can be found in Sacco (1895).

All the measurements are given in millimeters, in the description, and in the tables of the measurements, the following abbreviations have been used:

art = articular
diaf = diaphysis
dist = distal
epif = epiphysis
left = left
max = maximum (greatest)
min = minimum
phys = physeal
prox = proximal
right = right
surf = surface

Vertebrae and ribs

The vertebral column of the specimen from Dusino is nearly complete, lacking only few caudal vertebrae. The majority of the ribs are also present, though some are incomplete. Fortunately, most of the damage produced during the last war can be repaired.

At Roatto the axis and other three cervical vertebrae were found, alongside nine thoracic vertebrae, the last lumbar vertebra, the sacrum, one caudal vertebra and fragments of another ten. Unfortunately, part of this material was displaced by ploughing.

Nine ribs are complete, while many others are fragmentary.

Scapula - Fig. 5

The material available for study consists of the right scapula from Roatto and both scapulae from Dusino.

The scapula from Roatto is nearly complete, even if it has been fragmented into many small pieces. The spine is markedly deformed, while the rest of the bone is fairly well preserved. The cranial border is badly preserved, and incomplete.

The scapulae from Dusino were well preserved before the damage caused by the last war; now they are being restored and a partial reconstruction work will also be necessary. Therefore, for the moment, their height could not be measured.

The scapula from Roatto is larger than the six of *S. megarhinus* measured by Guérin (1972).

This bone is not usually described in the literature. Comparing the lateral profile of the scapula from Roatto with those of *S. etruscus* and *S. hundsheimensis* (Fortelius et al., 1993), the former is proportionately longer and narrower.

The glenoid cavity does not seem to be characteristic; it is elliptical in the specimen from Roatto and kidney-shaped in those from Dusino.

Scapula	Dusino rg.	Roatto rg.
height		590
length of the glenoid process	133	136
length of the glenoid cavity	80	94
breadth of the glenoid cavity	68	78
length of the neck	109	116

Fig. 5 - *Stephanorhinus jeanvireti* from Roatto, right scapula: a lateral view, b distal view.

Fig. 5 - *Stephanorhinus jeanvireti* di Roatto, scapola destra: a vista laterale, b distale.

Humerus Fig. 6

The left humerus from Roatto, which is complete, and both humeri from Dusino are present. The proximal epiphysis of the right humerus from Dusino is broken and the epicondyle of the left one has been reconstructed.

The head is variable in the Roatto specimen it is more caudally protruding than in those from Dusino, so that in the latter the head is rectangular. The other characteristics observed by Guerin in the proximal part of the bone (intertuberal groove and *tuberculum majus*) are not significant in these specimens, probably because of the difference in size.

According to the description and the illustrations reported by Guerin, the lateral epicondyle in *S. megarhinus* is more elongated caudally than laterally, so that in cranial view the radial fossa is wider than the epicondyle compared to that of *S. jeanvireti*. The specimens considered here show a notable lateral development of the epicondyle which confirms the difference from *S. megarhinus*.

Humerus	Dusino II	Roatto II
length	420	398
phys. length	425	433
prox. breadth (DT of Guerin)	[illegible]	86
prox. depth (DAP of Guerin)	87	(118)
breadth caput	95	104
depth caput	103	105
breadth dia	56.5	[illegible]
depth dia	[illegible]	[illegible]
dist. breadth	163	163
dist. depth	117	119
art. dist. breadth	101	107.5
art. dist. depth trochlea (internal)	85	103
art. dist. depth trochlea (external)	62.5	93

Radius Fig. 7

All four radii are present.

The proximal surface is variable in the two individuals: the lateral glenoid cavity is more concave in the specimens from Roatto and flatter in those from Dusino.

The other characteristics, both of the proximal and distal epiphyses, are variable. For example, viewed distally the lateral border of the distal surface is slightly concave in the specimens from Dusino and nearly flat in those from Roatto.

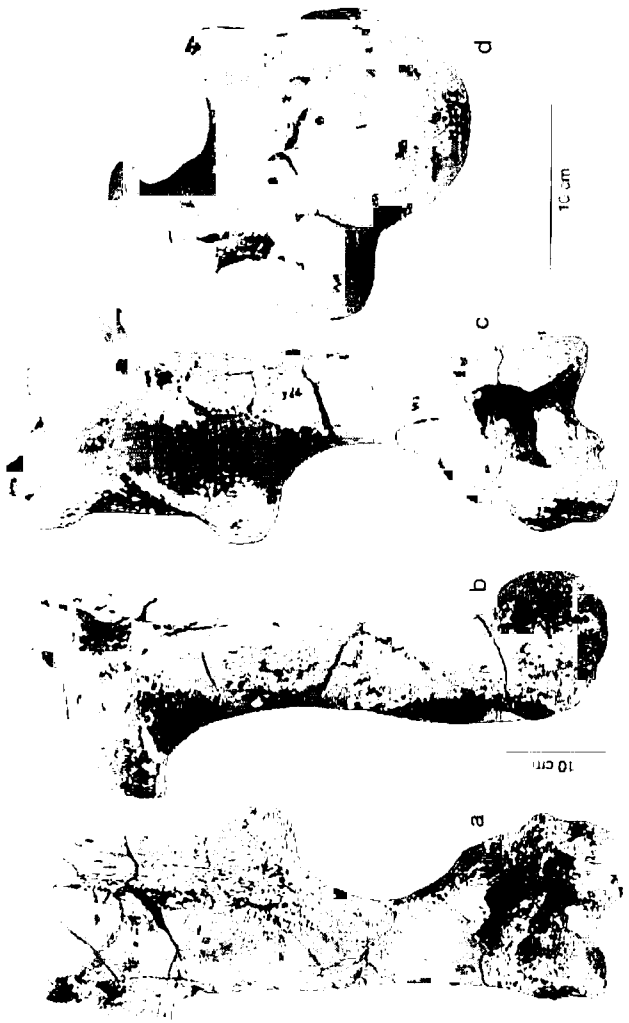


Fig. 6. *Stephanorhinus* cf. *hundsheimensis* (Toula, 1902). Roatto: left humerus in cranial (a), lateral (b), caudal (c) and proximal (d) views.

Fig. 7. *Stephanorhinus* cf. *hundsheimensis* (Toula, 1902). Roatto: left radius in cranial (a), lateral (b), caudal (c) and proximal

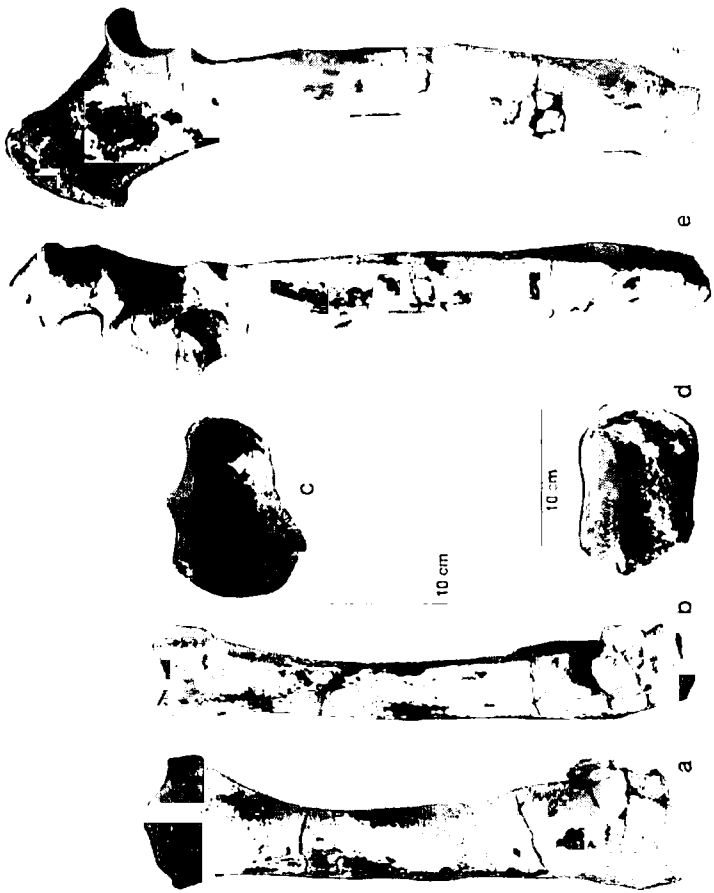


Fig. 7. *Stylocynus depereti* (Gervais) from Roatto: **a**, **b**, **c**, **d**, left radius and ulna; **a**, **e**, dorsal view; **b**, lateral view; **c**, proximal view; **d**, distal view; **e**, medial view.

Fig. 8. *Stylocynus depereti* (Gervais) from Roatto: **a**, **b**, **c**, **d**, left ulna; **a**, **e**, lateral view; **b**, dorsal view; **c**, proximal view; **d**, distal view; **e**, medial view.

The only characteristic consistent with the description given by Guerin is that regarding the tuberosity for the attachment of the lateral collateral ligament of the carpal joint, which is fairly swollen in both the specimens studied here.

Radius	Dusino (fig.)	Roatto (fig.)
length	88	100
physiological	103	120
prox. breadth	16.5	21.5
prox. depth	70	80
prox. art. breadth	102	106
prox. art. depth	60.5	68.5
min. depth shaft	37	47
dist. breadth	109	111
dist. depth	68	75
art. dist. breadth	93	96
art. dist. depth	54	57

Ulna (fig. 7)

All four ulnae are complete but chipped in the olecranon tuberosity.

In the literature the ulna of *S. megarhinus* is slightly described and thus, without the possibility of making comparisons with this species, a detailed description of the specimens from Roatto and Dusino would be of little use. However, in the specimens from Roatto the medial border of the trochlear notch is transversal, as described by Guerin, and slightly concave, while in the specimens from Dusino it is still transversal but decidedly convex.

Despite the dimensional differences, the ulnae of the two individuals are very similar.

Ulna	Dusino (fig.)	Roatto (fig.)
length	530	580
length (olecranon)	67	165
breadth olecranon and process	46	56
art. prox. breadth (coronoid process)	91	91.5
breadth tuber.	8 (ill.)	—
prox. depth	106	123
min. prox. depth (olecranon)	92.6	98
depth coronoid process and olecranon	115	136
dist. breadth	40	52
dist. depth	44	52
art. dist. breadth	40	46
art. dist. depth	30	34

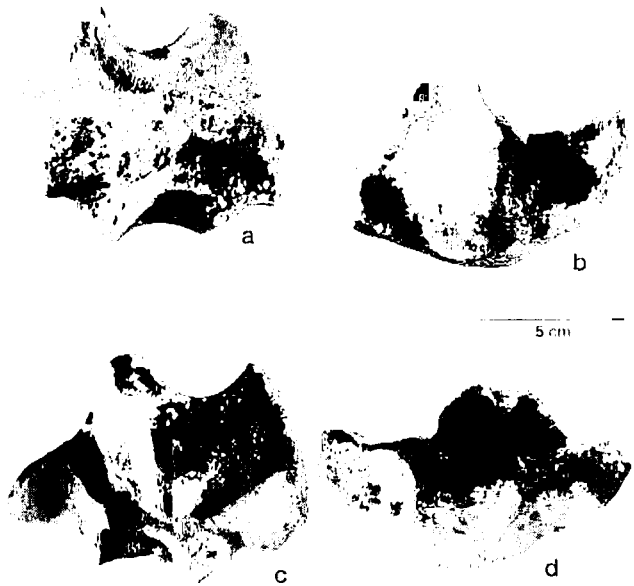


Fig. 8. *Stephanorhinus ponticus* from Roatto: left scaphoid: a dorsal view; b proximal view; c palmar view; d distal view.

Fig. 8. *Stephanorhinus ponticus* from Roatto: left scaphoid: a dorsal view; b proximal view; c palmar view; d distal view.

Scaphoid (radial carpal) - Fig. 8

All four carpal bones are present and are in perfect condition.

In medial view the profile of the scaphoid is trapezoidal with a distinctive saddle shaped proximal surface, deeper and narrower than in *Stephanorhinus etruscus* and *S. hundsheimensis*. The drawing A1 in Fig. 1 of Guerin (1972) is very clear with regard to this. The dorsal profile is pointed and forms an obtuse angle: in the specimen from Roatto this border is convex, as in *S. megarhinus*, while in the specimen from Dusino it is rectilinear. We presume that the observed differences depend on the muscle and tendon attachments which increase with both age and size.

Viewed laterally the proximal surface, which articulates with the semilunar, is divided into two parts in the specimen from Roatto and fused in those from Dusino.

Viewed proximally the articular surface is more developed medio-laterally than dorso palmarly.

The distal surface, which articulates with the pyramidal and the magnum, is narrow. The relationship between the distal articular measurements (7x100/6) is 45.3 in both the scaphoids from Roatto and those from Dusino.

Scaphoid	Dusino II.	Roatto II.
depth (length of Guerin)	92.5	100
breadth	62	67
length (height)	72.5	79
art. prox. depth	58	58
art. prox. breadth	61	64
art. dist. depth	75	79
art. dist. breadth	34	36

Semilunar - Fig. 9.1

All four semilunars are present, but badly preserved.

The dorsoproximal surface is stretched latero-medially.

Viewed distally the semilunar is elongated dorso-palmarly, with relatively narrow articular surfaces, more than in *S. kirchbergensis* and like in *S. hundsheimensis*.

Semilunar	Dusino II	Roatto II
max. breadth	76	83
depth	71	76
prox. depth	73.5	81
length (height)	58	62.5
art. dist. length	36	41.5

Pyramidal (ulnar carpal) - Fig. 9.2

All four carpal bones are present: the left pyramidal from Roatto is complete but badly preserved, while the other three are in perfect condition.

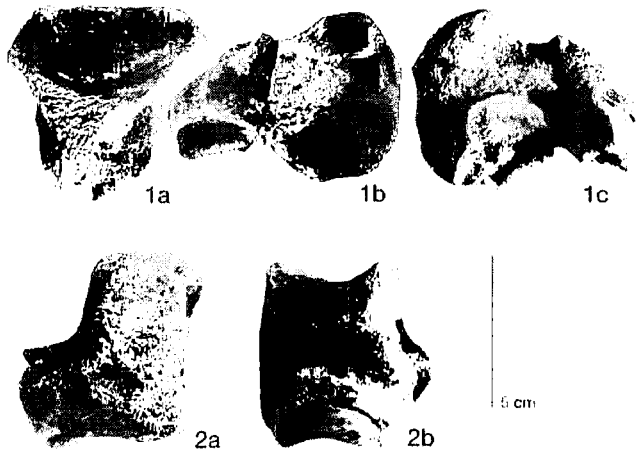


Fig. 9 - *Stephanorhinus jeanvireti* from Roatto. 1 left semilunar, 2 right pyramidal: a dorsal view, b medial view, c lateral view.

Fig. 9 - *Stephanorhinus jeanvireti* di Roatto. 1 semilunare sinistro, 2 piramidale destro: a visione dorsale, b mediale, c laterale.

The dorsal surface of the pyramidals from Roatto is more elongated proximo-distally than in the pyramidals from Dusino.

The proximal surface is very saddle shaped mesiolaterally, as was also shown in the drawings of Guérin. Viewed proximally, the specimens from Roatto are deeper dorso-palmarly than those from Dusino.

Differences can also be observed in the distal surface, which is more quadrangular in the specimen from Roatto than in those from Dusino.

In medial view, in the pyramidals from Roatto the upper surface for the articulation with the semilunar is broader than the lower, while in the specimen from Dusino the two surfaces are of more or less the same size. This is in contrast with Guérin, who believed this a peculiar characteristic of *S. jeanvireti* and that the opposite occurred in *S. megarhinus* and *S. etruscus*.

However, this bone is particularly variable and therefore the differences can be at least partially allometric.

From the measurements it is apparent that the maximum height is different between the two individuals studied, while the physiologic length is similar.

Pyramidal	Dusino rg.	Roatto rg.
length (height)	57.5	63.5
phys. length	46	47
breadth	67	68
depth	45	48
art. prox. depth	38	43
art. prox. breadth	38	45
art. dist. depth	31	40.5
art. dist. breadth	44	51

Pisiform (accessory carpal) - Fig. 10.1

Only the two pisiforms from Dusino are preserved, of which the left one is complete and the right one broken.

Pisiform	Dusino lf.
max. length (anterior-posterior)	73
height (corpus)	49.5 (rg.)
min. height (behind articulation)	30
max. breadth	29
art. length	35.5
art. breadth	28

Perhaps considered to be a variable carpal bone, the pisiform of *S. jeanvireti* was not illustrated by literature. In comparison with *S. hundsheimensis*, the find from Dusino has a more slender body and the dihedral angle formed by the two articular facets is wider, circa 90 degrees.

Trapezium (first carpal) - Fig. 10.2

There is only the right trapezium from Roatto.

This carpal bone is not described in the literature. It is similar to a sesamoid with two confluent articular surfaces forming a dihedral angle of more than 90 degrees. The proximal-dorsal surface, which is the smallest and most convex, articulates with the scaphoid while the lateral surface, which is larger and more concave, articulates with the trapezoid.

Trapezium	Roatto cast
Length (height)	32.5
art. length (art. Metacarpal)	[illegible]
art. depth (with trapezoid)	[illegible]
max. depth	35
breadth	[illegible]

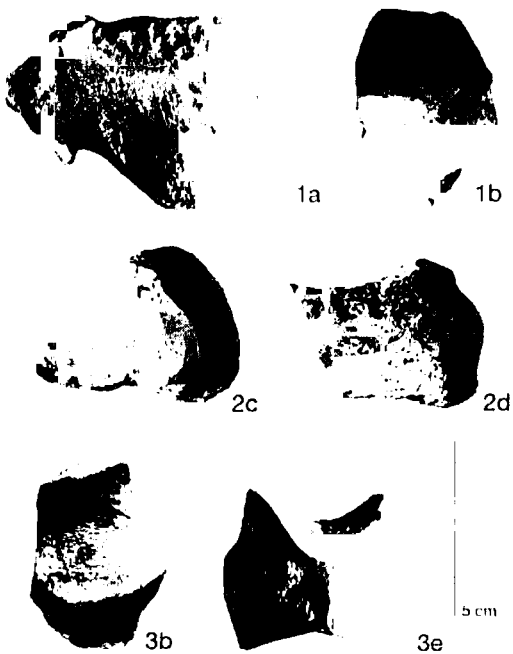


Fig. 10 - *Staphanokainis pontevicensis*. Left pisiform from Dusino; 2 right trapezium from Roatto; 3 right trapezoid from Dusino: a dorsal view; b proximal view; c lateral view; d palmar view; e medial view.

Fig. 10 - *Staphanokainis pontevicensis*. Left pisiform from Dusino; 2 right trapezium from Roatto; 3 right trapezoid from Dusino: a dorsal view; b proximal view; c lateral view; d palmar view; e medial view.

Trapezoid (second carpal) Fig. 10.3

All two right trapezoids from Dusino are present.

This carpal was also not described by Guerin. The medial surface, which articulates with the trapezium, is fused with a very saddle-shaped proximal surface which articulates with the scaphoid. The distal surface, which articulates with the second metacarpal, is also saddle-shaped. Overall the bone tends to have a cubic form.

Trapezoid	Dusino 1
max. length (height)	17.5
min. phys. length	15
depth	15
breadth	32.5

Magnum (third carpal) Fig. 11.1

Only the two third carpals from Dusino are present.

The most peculiar characteristic is represented by the shape of the distal surface which articulates with the third metacarpal. As is shown by the drawing of Guerin (1972, fig. 8, page 90), this surface is subtriangular and particularly elongated, so that, viewed medially or laterally, its profile has a radius of curvature which is greater (i.e. less concave) than in *S. hundsheimensis*.

Magnum	Dusino 1f
max. length (height)	21
min. breadth dorsal side (transversal)	11
max. breadth	17
Depth	10
art. proximal width	14

Uncinate (fourth carpal) Fig. 11.2

The two uncinates from Dusino and the left one from Roatto are present.

These bones show various differences. In the specimens from Dusino the lower-external border of the dorsal surface is rounded, while in that from Roatto it is more angular; it is also wider and deeper in the latter.

The posterior epiphysis is longer and proportionately thinner in Roatto than in Dusino.

In the uncinate from Roatto the upper articular facet forms a dihedral angle with the lateral articular facet; in that from Dusino the two facets are not in contact.

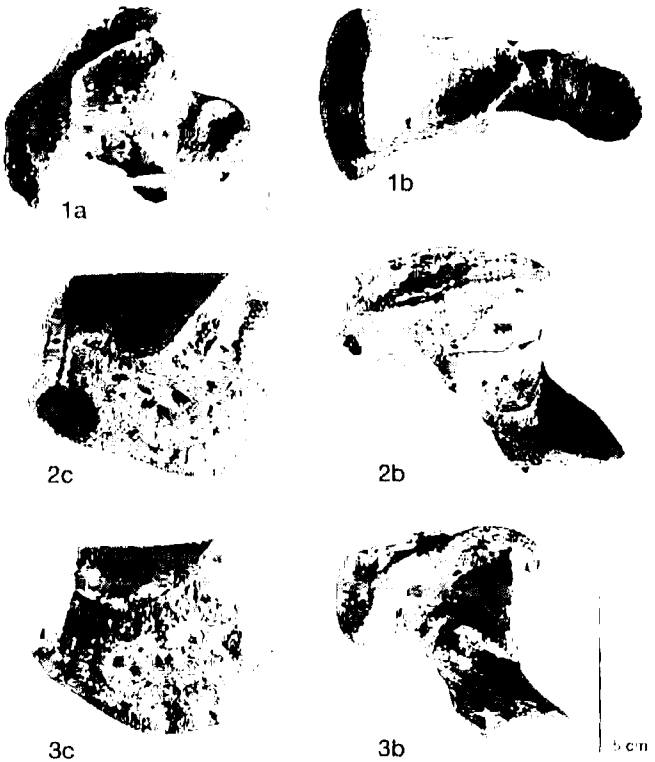


Fig. 11 - *Stephanorhinus jeanvireti*. 1 left magnum from Dusino, 2 left uncinate from Roatto, 3 left uncinate from Dusino: a lateral view, b distal view, c dorsal view.

Fig. 11 - *Stephanorhinus jeanvireti*. 1 magnum sinistro di Dusino, 2 uncinato sinistro di Roatto, 3 uncinato sinistro di Dusino: a vista laterale, b distale, c dorsale.

The observed differences may either be allometric or reflect individual variations.

Uncinate	Dusino II	Roatto II
max. depth	94.5	109
min. depth	74	94
breadth	...	...
Depth (height)	58	59.5

Second metacarpal bone - Fig. 12

The two second metacarpals from Dusino and the right one from Roatto are present; the latter is broken.

This fairly long metapodial is quite slim, and has considerably broad epiphyses.

Fig. 12 - *Stephanorhinus jeanvireti*, second right metacarpal bone: 1 from Dusino, 2 from Roatto; dorsal view.

Fig. 12 - *Stephanorhinus jeanvireti*, seconde metacarpe droite, 1 du Dusino, 2 du Roatto; vue dorsale.

The proximal surface which articulates with the trapezoid is saddle shaped, and the one which articulates with the third metacarpal is wide. In the specimen from Roatto there is a small medial surface for articulation with the trapezoid which is lacking in the specimen from Dusino.

The diaphysis is flattened and the levelling is more accentuated in the specimen from Dusino which is smaller.

In dorsal view the distal surface is more elongated in the specimen from Roatto with respect to that from Dusino.

Although similar in size to the second metacarpal bone of *S. kirchbergensis*, it differs in the more expanded proximal facet for the trapezoid.

Second metacarpal bone	Dusino	Roatto
length	90	97
prox. breadth	12.5	14
prox. depth	16	18.5
art. prox. breadth	11	13
art. prox. depth	11	12.5
breadth/len.	49	46
depth/len.	17	20
dist. breadth	14	15
art. dist. breadth	14	17
dist. depth	15.5	19.2

Third metacarpal bone - Fig. 13

The two third metacarpals from Dusino and the right one from Roatto are present. All are well preserved.

These bones show strong dimensional differences, as is apparent in the table of the measurements. The large size specimen from Roatto is much flatter than those from Dusino both in the diaphysis and in the epiphysis, thus assuming the characteristics which Guerin attributes to *Stephanorhinus megarhinus*.

The proximal facet which articulates with the second metacarpal is small in both specimens, another character in stark contrast with Guerin's description.

Viewed laterally, the proximal facets which articulate with the uncinate and with the fourth metacarpal form a dihedral angle; the former is larger than the latter.

Consequently it seems that this metapodial has no peculiar characteristics for species discrimination.

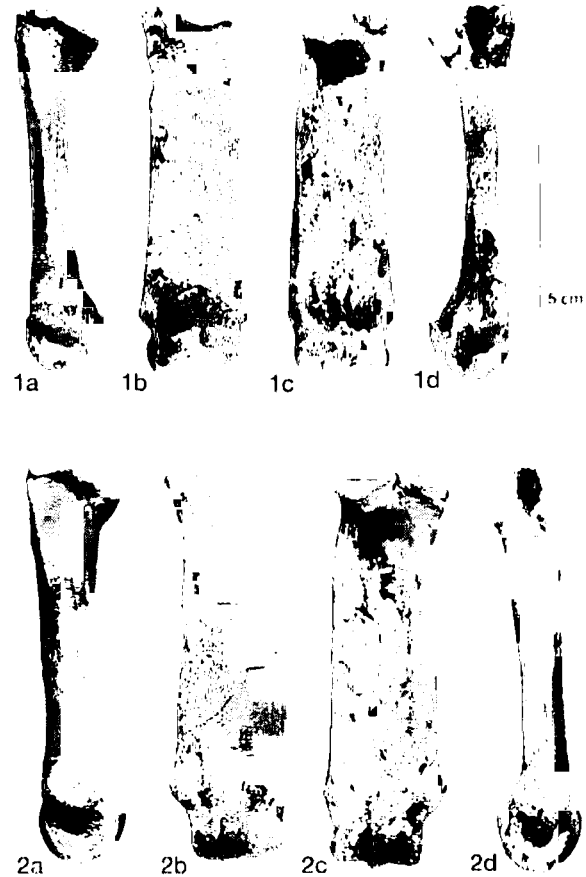


Fig. 13 - *Stephanorhinus jeanvireti*, third right metacarpal bone; 1 from Dusino, 2 from Roatto; a medial view, b dorsal view, c palmar view, d lateral view.

Fig. 14 - *Stephanorhinus jeanvireti*, fourth metacarpal sinistral; 1 di Dusino, 2 di Roatto; a medial view, b dorsal view, c palmar view, d lateral view.

Third metacarpal bone	Dusmo rg	R[illegible]rff
length	24	264
prox. br[illegible]th	6[illegible]	[illegible]
prox. depth	5[illegible]	[illegible]
breadth dia	38.5	66
depth dia	24	28
dist. breadth	70.5	80.5
art. dist. breadth	57.5	60
dist. depth	[illegible]	[illegible]

Fourth metacarpal bone - Fig. 14

There are two complete fourth metacarpals from Dusmo.

In medial view, of the two proximal facets which articulate with the third metacarpal, the dorsal one is relatively short and small, and is elliptical, while the palmar one is wider and triangular. These facets, if they were not widely separated, could resemble those of *S. megarhinus* according to the description given by Guérin.

Fig. 14 - *Stephanorhinus jeanvireti*, fourth right metacarpal bone from Dusmo: a dorsal view, b palmar view, c medial view.

Fig. 14 - *Stephanorhinus jeanvireti*, quarto metacarpal stroth Dusmo: a vrsume dorsal, b palmare, c medial.

The diaphysis has a subtriangular section up to half its length, and then becomes irregularly elliptical and shows a wide flattened medial surface, point of contact with the third metacarpal.

Fourth metacarpal bone	Dusmo I
length	195
prox. breadth	[illegible]
prox. depth	47
breadth dia	40
depth dia	[illegible]
dist. breadth	47
art. dist. breadth	4[illegible]
dist. depth	4[illegible]

Fifth metacarpal bone - Fig. 15

The left metacarpal of the fifth reduced digit from Dusmo is present.

This bone is not described in the literature because it is commonly mistaken with some sesamoid.

Its body is elongated latero-palmarly. Its larger semi-elliptical articular facet, which is located medially, articulates with the uncinate while the smaller, wedged-shaped one, located distally, articulates with the fourth metacarpal. These two facets are placed at right angles to one another.

Fifth metacarp. bone	Dusmo II
length	[illegible]
breadth	4
depth	3[illegible]

Fig. 15 - *Stephanorhinus jeanvireti*, fifth left metacarpal bone from Dusmo: a dorsal view, b medial view.

Fig. 15 - *Stephanorhinus jeanvireti*, quinto metacarpale sinistro di Dusmo: a vista dorsale, b vista laterale.

Pelvis

The pelvis from Dusino, which was whole before the war, now has both ilia broken. The restoration works now in progress should allow it to be repaired to up to 90[illegible] of its complete form.

At Roatto numerous minute fragments of pelvis were found which had been destroyed by ploughing.

We retain that the pelvis is more important for sexual than for species determination. In the absence of comparative material, it will not be described here. Full information on the pelvis can be found in Sacco (1895).

Femur - Figs. 16, 17

All four femurs are present; those from Roatto are partially fractured and deformed, but can still be measured quite precisely.

Apart from the dimensions, the femurs are very similar to one another. The proximal part shows no peculiar characteristics. The third trochanter is shifted proximally with respect to the middle of the diaphysis. This is in contrast with what was sustained by Guerin.

The characteristics which seem to be most diagnostic for discriminating between *S. jeanvireti* and *S. megarhinus* can be found in the distal epiphysis. Viewed distally the medial ridge of the trochlea is aligned with the vertical of the medial condyle while the lateral one is internal to the axis of the lateral condyle. In the drawing by Guerin (197[illegible]) (fig. 11.2) it seems that *S. megarhinus* in fact has the ridges laterally displaced with respect to the

Femur	Dusino [illegible]	Roatto [illegible]
length	[illegible]0	545
phys. length	[illegible]	53[illegible]
[illegible] breadth	[illegible]1	([illegible])
breadth caput	[illegible]	10[illegible]
depth caput	[illegible]3	[illegible]
breadth III trochanter	1[illegible]	(168)
min. breadth dia.	[illegible]3	[illegible]7
min. depth dia.	[illegible]	[illegible]
dist. breadth	[illegible]	1[illegible]
dist. medial depth	1[illegible]	193 ([illegible])
dist. lateral depth	1[illegible]	1[illegible]
min. height III trochanter	[illegible]	78
length top III troch.-dist. epi.	31[illegible]	33[illegible]
length base III troch.-prox. epi.	[illegible]	[illegible]

Fig. [illegible] a [illegible] b [illegible] c [illegible]
Fig. [illegible] *megarhinus* [illegible] femore destro di Roatto [illegible] bilatera[illegible]

condyle. This difference leads to a greater lateral enlargement of the distal epiphysis in *S. jeanvireti* and, in contrast, to a greater development of the medial part in *S. megarhinus*. Comparing the distal part of the femur of the specimens, one notes that there is a greater development in depth with respect to width in the largest specimen, that from Roatto. This different growth, probably imputable to allometry, makes it appear slimmer, in cranial view, than the femurs from Dusino.

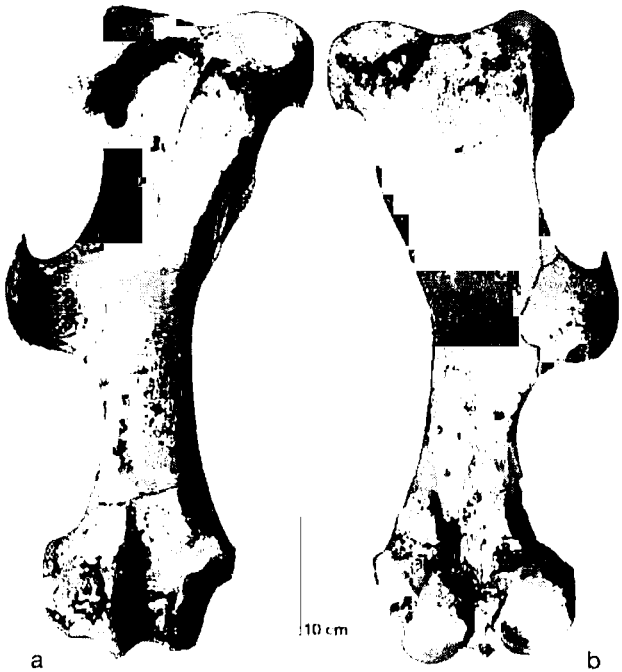


Fig. 1 - *Stephanorhinus jeanvireti* (Guérin) from Dusino: a, cranial view; b, distal view.
Fig. 1 - *Stephanorhinus jeanvireti* (Guérin) femore destro di Dusino: a, visione craniale; b, visione distale.

Patella - Fig. 18

The two patellae from Dusino and the right one from Roatto, which is incomplete, are present. The former are larger than the latter.

The specimens from Dusino exceed in size the *S. jeanvireti* patellae described by Guérin. This fact is probably due to the different age of the individuals because Guérin took the measurements on the tuberosity of the muscular insertions, on the dorsal face of the bone, which increase with age, instead of considering the dimensions of the invariant articular facet of the plantar side. Therefore the patellae from Vialette probably belong to younger individuals.

Patella	Dusino sin.	Roatto sin.
length	115	132
art. length	101	100
breadth	99	
art. breadth	87	
depth	63	73
max. depth	78	84

Tibia - Fig. 19

All four tibiae are present and complete.

As for the femurs, the large sized tibiae from Roatto are more developed in depth than in width, especially in the proximal epiphysis. This fact is less evident in the distal epiphysis.

Viewed proximally, in both specimens the axis of the tuberosity is shifted more centrally with respect to the axis of the lateral surface. This is in

Tibia	Dusino sin.	Roatto sin.
length	470	494
phys. length	381	414
prox. breadth	142	149
prox. depth	134	136
cran. breadth dia	64	63.5
min. depth dia	46	68
dist. breadth	111.5	116
dist. depth	89	91
max. art. dist. breadth	86	93
art. dist. depth	68	

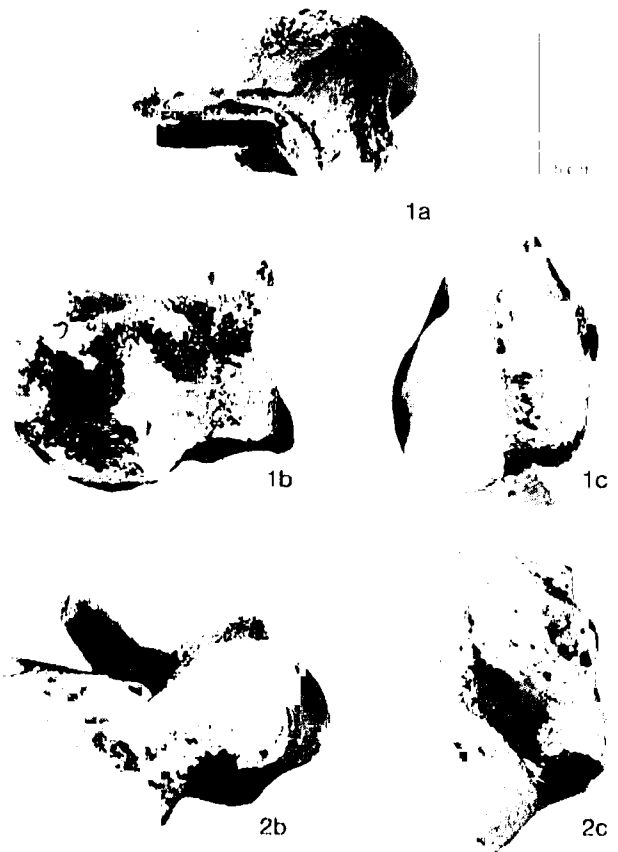
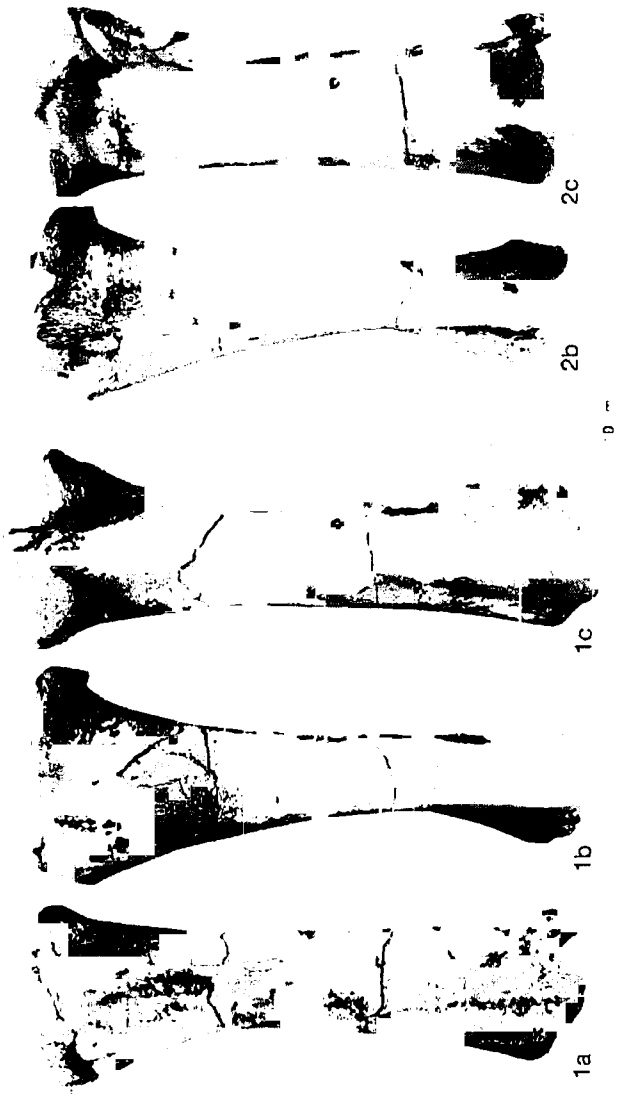


Fig. 18. *Stephanodiscus* [illegible] right valve from Duino, from Reichelt, a proximal view, b tangential view, c valvular view.

Fig. 18. *Stephanodiscus* [illegible] valve dextra da Duino, da Reichelt, a veduta prossimale, b tangenziale, c valvulare.



agreement with the drawing by Guérin of *S. jeanveti*, which differs with that of *S. megarhinus* because in the latter the tuberosity viewed proximally is in axis with the lateral surface. Other differences observed by Guérin are, at least partially, allometric and not specific.

In dorsal view, the distal epiphysis is similar to that of the specimen from Vialette illustrated by Guérin, while in the specimen from Roatto it is more developed in depth. Therefore this difference can also be imputed to allometric growth.

Fibula - Fig. 20

The two fibulae from Dusino and the right one from Roatto are present, all of them fractured but complete and undeformed.

This bone, which is little described, is quite slender and elongated, with a sub triangular section, a concave lateral surface, and a deep longitudinal groove on the plantar surface.

The facet which articulates with the astragalus is kidney shaped and contiguous with a much smaller one located proximally which articulates with the tibia.

Fibula	Dusino (fig.)	Roatto (fig.)
length	467 (fig.)	485
min. prox. breadth	22	30
max. prox. depth	46	44
min. dist. breadth	30	34
max. dist. depth	51	51
[illegible]	8 [illegible]	40 x 40

Talus (tibial tarsal) - Fig. 21

All four astragali are present.

The morphology of this tarsal bone is well illustrated in the drawings by Guérin (1972, fig. 13, page 109).

The face of the trochlea is deeply grooved and the lateral lip, viewed proximally, is very expanded sideways. This development is also visible when viewed distally since the greater articular surface, situated on the lateral proximal part, is laterally extended.

The medial lip has a similar development to that of *S. etruscus*.

Fig. 20 - *Stephanorhinus* [illegible] right fibula from Roatto: a dorsal view, b lateral view.
Fig. 20 - *Stephanorhinus* [illegible] fibula from Roatto: a) dorsal view, b) lateral view.

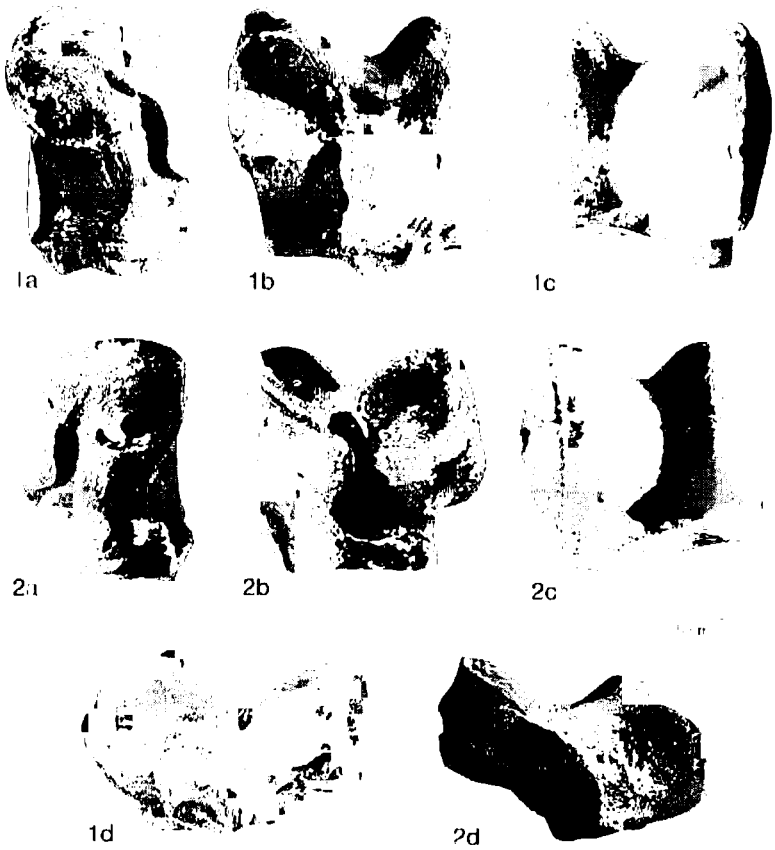


Fig. 21 *Stephanorhinus jeanvireti*, astragalus: 1 left tali from Roatto, 2 right tali from Dusino: a medial view, b plantar view, c dorsal view, d distal view

Fig. 21 *Stephanorhinus jeanvireti*, astragalo: 1 astragalo sinistro da Roatto, 2 astragalo destro da Dusino: a norma mediale, b plantare, c dorsale, d distale

Talus	Dusino rg.	Roatto rg.
breadth	107	108
depth medial side	83.5	95.5
max. breadth art. dist. surf.	86	93
greatest height	91	107
depth art. dist. surf.	49	53.5
length medial part of trochlea tali	77	84.5
length lateral part of trochlea tali	70	86
min. length cave of trochlea tali	53.5	58

Calcaneum (fibular tarsal) - Fig. 22

All four calcanea are present.

Many differences were observed among the different articular surfaces, even between two calcanea of the same individual. For example, the surface which articulates with the coracoid process is separate from that of the sustentaculum in the right calcaneum from Roatto, it is fused in the left one. In those from Dusino the two surfaces are always separate. In the specimens from Dusino two of the surfaces which articulate with the astragalus are fused in one calcaneum and separate in the other, while in Roatto they are separated in both calcanea.

Guérin indicates a medial depression in the lateral surface, unlike in *Stephanorhinus jeanvireti* from *S. megarhinus* because in the latter the depression is placed under the coracoid process. This characteristic also seems to be confirmed in the specimens studied here.

Calcaneum	Dusino rg.	Roatto rg.
greatest length	150	151.5
depth tuber	73	69
breadth tuber	58	62
depth coracoid process	72	83
breadth sustentaculum	85	91.5
min. depth corpus	63	70
min. breadth corpus	45	46
depth art. surf. for cuboid	39	49
breadth art. surf. for cuboid	44	48

Fig. 22. *Stephanorhinus jeanvireti*, left calcaneum, 1 from Rozzo, 2 from Dusino. a lateral view, b plantar view, c dorsal view.

Fig. 23. *Stephanorhinus jeanvireti*, calcaneum: 1 left Rozzo, 2 left Dusino. a proximal view, b plantar view, c lateral view.

Naviculum (central tarsal bone) Fig. 24

All four central tarsal bones are present.

It seems that the navicular of *S. jeanvireti* is more developed in depth than in width with respect to the Quaternary species of the same genus. Viewed proximally, the dorso lateral angle is very prominent and expands laterally as happens with *S. kirchbergensis*.

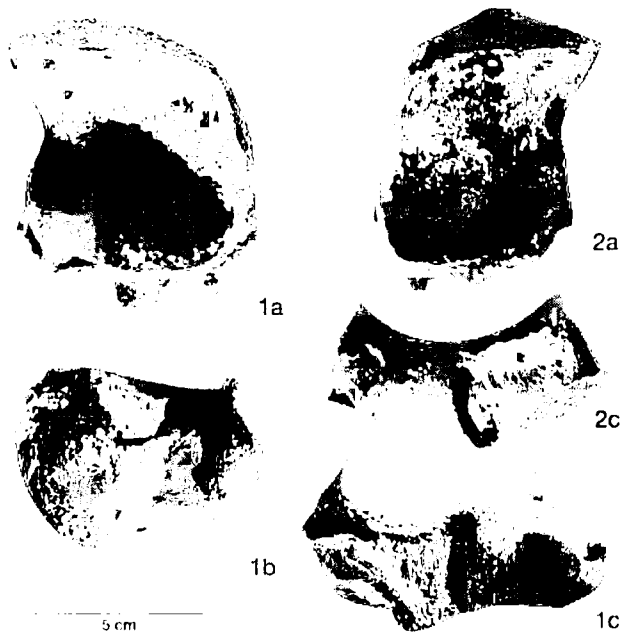


Fig. 24. *Stephanorhinus jeanvireti*, 1 left naviculum from Rozzo, 2 right naviculum from Dusino. a proximal view, b plantar view, c lateral view.

Fig. 25. *Stephanorhinus jeanvireti*, 1 navicular: 1 Rozzo, 2 navicular-cuboid: Dusino. a proximal, b plantar, c lateral.

N[illegible]	D[illegible]	R[illegible]
max. depth	[illegible]	81
depth	[illegible]	[illegible]
breadth	5[illegible]	[illegible]
length (= height)	33.5	38.5
[illegible]phys. length	[illegible]	34.5

Cuboid (fourth tarsal bone) Fig. 24

A right complete cuboid from Dusino and a large fragment of a left one from Roatto are present.

The most significant characteristics seem to be the notable width of the cuboid and the proportions of the plantar tuberosity which is large but short with respect, for example, to the corresponding tarsal of *S. hundsheimensis*.

According to Guerin (1972, fig. 15, page 115) in *S. megarhinus* the cuboid should be compressed proximo-distally.

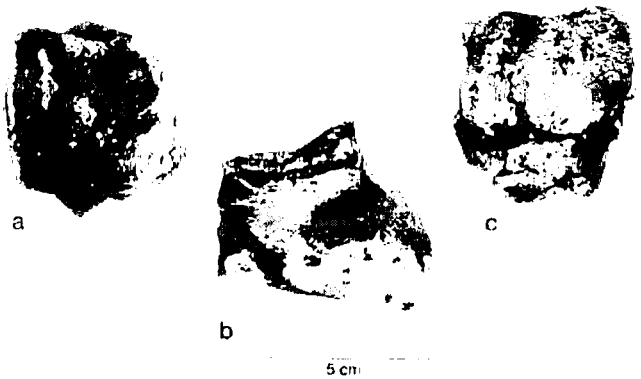


Fig. 24 - *Stephanorhinus praeme[illegible]* right cuboid from Dusino: a dorsal view, b medial view, c proximal view.

Fig. 24 - *Stephanorhinus megarhinus* cuboid of the right side from Dusino: a dorsal, b medial, c proximal views.

Cuboid	Dusino [illegible]
breadth prox. art. surf.	55
depth prox. art. surf.	4[illegible]
depth (dorsal) of [illegible]	6[illegible]
breadth	59
breadth dist. art. surf.	51.5
height dors. surf.	51
length (= height)	64
phys. length	47

First cuneiform (first tarsal bone) Figs. 25 1, 2

There are the two first tarsals from Dusino, of which the left one is fragmented, and a complete left one from Roatto.

The specimens from the two localities differ in several respects, especially in the dorsal and latero-dorsal articular facets which meet at right angles. The lateral plantar articular facet also changes in the two individuals. This tarsal bone is too highly variable and is therefore unsuitable for species discriminations.

First cuneiform	Dusino [illegible]	Roatto II
length (= height)	[illegible]5.5	89
breadth	33.5	37
depth	35	41.5

Second cuneiform (second tarsal bone) Fig. 25 3

There is only the right second cuneiform from Dusino.

The bone slightly exceeds in size the second cuneiform of *S. hundsheimensis* but has a more expanded lateral surface. The proximal surface is concave towards the plantar border and convex towards the dorsal one.

Second cuneiform	Dusino [illegible]
max. depth	[illegible]
max. breadth	25
length (= height)	21
[illegible]phys. length	[illegible]

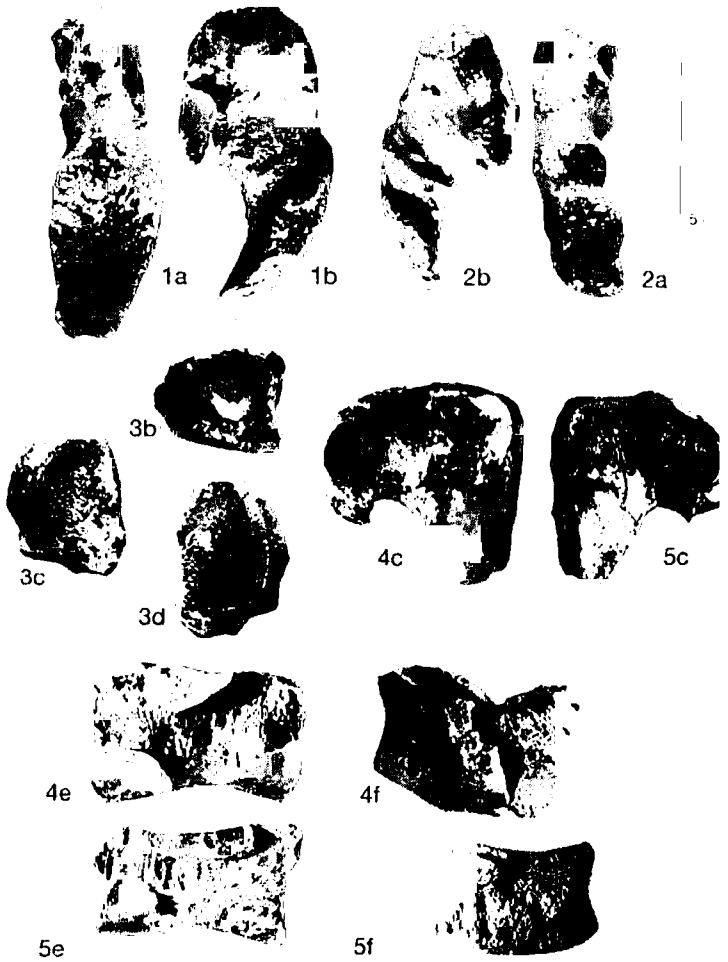


Fig. 25 - *Stephanorhinus jeanvireti*. 1 first left cuneiform from Roatto; 2 third right cuneiform from Dusmo; 3a-c second right cuneiform from Dusmo; 3d third left cuneiform from Roatto; 5 third right cuneiform from Dusmo; **a** plantar view; **b** lateral view; **c** proximal view; **d** distal view; **e** medial view; **f** dorsal view.

Fig. 26 - *Stephanorhinus cantianus*. 1 primo cuneiforme sinistro di Roatto; 2 primo cuneiforme destro di Dusmo; 3 secondo cuneiforme destro di Dusmo; 4 terzo cuneiforme sinistro di Roatto; 5 terzo cuneiforme destro di Dusmo; **a** visione plantare; **b** laterale; **c** prossimale; **d** distale; **e** mediale; **f** dorsale.

Third cuneiform (third tarsal bone) - Figs. 25.4, 25.5

All four are present.

Morphologically the third cuneiforms of the Turin Museum are very similar both to those of *S. hundsheimensis* and to the specimen of *S. megarhinus* shown by Guerin (1972, fig. 17, page 120). In Guerin's table the specimen from Vialette seems to be juvenile, not an adult.

Dimensionally the finds are closer to the third cuneiform of *S. megarhinus* than to those of *S. jeanvireti*.

In the specimens studied the proximal surface is pronouncedly concave like the distal one, but the latter is convex towards the dorsal edge.

Third cuneiform	Dusmo n.	Roatto n.
max. depth	53.0	56
max. breadth	49	55.5
length (thickness)	28	-
anteroposterior length	55	53

Second metatarsal bone - Fig. 26

All four are present.

Viewed proximally, the facet which articulates with the second cuneiform is, as described by Guerin, irregularly elliptical, with the lateral border almost rectilinear and the medial one convex, while the dorsal border is narrow and therefore different from that of *S. megarhinus* which is significantly wider.

Viewed laterally there are two facets located proximally which articulate with the third cuneiform and the third metatarsal. The dorsal facet is no larger than the plantar one, neither in the specimen from Roatto nor in that from Dusmo. The dorsal facet is vertical in Roatto and inclined towards the central part of the metatarsal in Dusmo. The differences noted by Guerin regarding the facet of *S. megarhinus* and *S. jeanvireti* do not seem to be significant at least at species rank.

The distal part of the diaphysis in the Roatto specimens is swollen and very rough in the zone of contact with the third metatarsal, while in the Dusmo second metatarsals this roughness is less pronounced. This may somehow be related with size, the specimens from Roatto being larger than the specimens from Vialette and than all those of *S. megarhinus* reported in the literature.

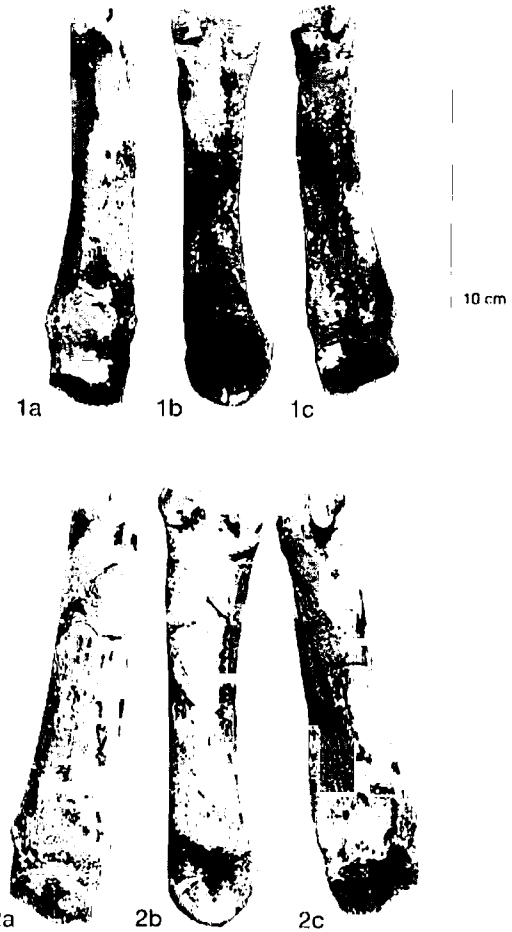


Fig. 26. *Stephanorhinus jeanvireti*, second left metatarsal bone, 1 from Dusino, 2 from Roatto: a dorsal view, b lateral view, c plantar view.

Fig. 26. *Stephanorhinus jeanvireti*, secondo metatarso sinistro, 1 di Dusino, 2 di Roatto: a vista dorsale, b laterale, c plantare.

Second metatarsal bone	Dusino (1)	Roatto (2)
length	188	208
prox. breadth	52.5	54
prox. depth	43.5	50
breadth dia.	29	34.5
depth dia.	28	33.5
dist. breadth	43.5	48.5
art. dist. breadth	39	42
dist. depth	44	47.5

Third metatarsal bone - Fig. 27

The two third metatarsals from Dusino and the right one from Roatto are present.

As with the third metacarpal, the third metatarsal from Roatto is also particularly flattened dorso-plantarly, both in the proximal epiphysis and in the diaphysis. This is very clear also from the measurements.

Dorsally or plantarly, in the Roatto specimen the medial and lateral borders of the diaphysis are parallel while in the Dusino ones they diverge distally. The Roatto third metatarsal widens slightly before the distal epiphysis which is wider and very compressed dorso-plantarly than in the Dusino specimens.

In medial view the two proximal facets which articulate with the second metatarsal are like those which Guérin described for *S. megarhinus*: semicircular and with the dorsal one much smaller than the plantar one. Therefore, as with the second metatarsal, this facet has no discriminant characteristics.

The proximal facets for articulation with the fourth metatarsal are also variable; they are similar to one another in the Dusino third metatarsals.

Third metatarsal bone	Dusino (1)	Roatto (2)
length	216	228
prox. breadth	53.6	66
prox. depth	51	53
min. breadth dia.	47	55
depth dia.	29	30
dist. breadth	65.5	67
art. dist. breadth	53	56
dist. depth	45.5	46.5

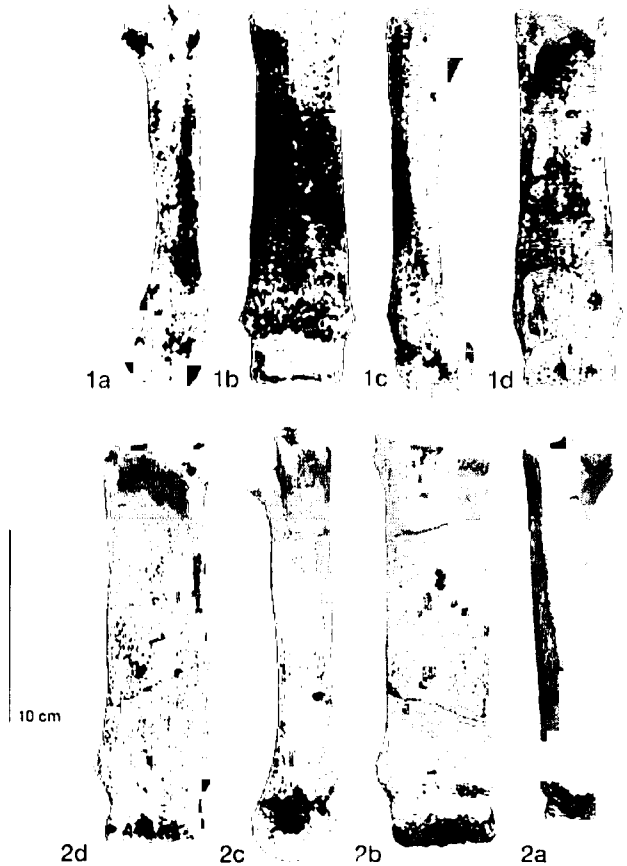


Fig. 27. *Stephanorhinus jeanvireti* (Guérin), third metatarsal bone. Length from Dusmo, 2 left from Rontto a lateral view, b dorsal view, c medial view, d plantar view.

Fig. 27. *Stephanorhinus jeanvireti* (Guérin), third metatarsal bone. Length from Dusmo, 2 left from Rontto a lateral view, b dorsal view, c medial view, d plantar view.

while in those from Rontto the plantar one is elliptical and slightly smaller than the dorsal one. Since there is correspondence between the facets of the large size third metatarsal from Rontto and those of *S. megarhinus* described by Guérin, the differences in these characters from *S. jeanvireti* are believed here to be allometric. This observation can be extended also to the section of the diaphyses.

Fourth metatarsal bone - Fig. 28

Only the two fourth metatarsals from Dusmo are preserved.

The proximal surface is sub-triangular with rounded angles and the dorsal lateral side is the larger. Drawings 1A, 1B and 1C in figure 20 of Guérin (1973) are partially rotated from the normal anatomical position, and thus they are difficult to read.

The dorsal facet for articulation with the third metatarsal is placed in a more dorsal position than the plantar one and forms a dihedral angle with the proximal surface; the plantar facet is well separated from the dorsal facet

Fig. 28. *Stephanorhinus jeanvireti* (Guérin), fourth metatarsal bone from Dusmo: a medial view, b plantar view, c dorsal view, d lateral view.

Fig. 28. *Stephanorhinus jeanvireti* (Guérin), fourth metatarsal bone from Dusmo: a medial view, b plantar view, c dorsal view, d lateral view.

and is slightly smaller. The dorsal facet is quadrangular and the plantar facet subcircular, unlike those described for *S. jeanvireti*.

Fourth metatarsal bone	Dusmo
length	187
prox. breadth	50
prox. depth	49
breadth dia	30
min. breadth/depth (transversal)	[illegible]
depth dia	[illegible]
dist. breadth	40
art. dist. breadth	37.5
dist. depth	46

Phalanges

The following phalanges were collected from Dusmo: all those of the left thoracic limb, the three first phalanges and two (lateral and medial) third ones of the right thoracic limb; the first of the second digit, the three of the third digit, and the third of the fourth digit of the right pelvic limb; the first and third of the second digit, the first of the third digit and the third of the fourth digit of the left pelvic limb.

The phalanges collected from Roatto are the following: the first and second of the second digit, and the three of the third and fourth digits of the left thoracic limb; the first of the second digit, the second and third of the third digit and the first and second of the fourth digit of the right thoracic limb; the first and second of the second digit, the first of the third digit and the second of the fourth digit of the left pelvic limb; the first and second of the second digit, the first of the third digit and the first and second of the fourth digit of the right pelvic limb; and the second and third of the third digit of the right or left pelvic limb. There are also some unidentified phalanx fragments.

For the differences between the phalanges of the various digits of the thoracic and pelvic limbs see Sala & Fortelius (1993).

7. OTHER MATERIAL FOUND (B. Sala)

The sediment in which the skeletal remains of the rhinoceros at Roatto were found, was sieved for micromammals. This led to the discovery of fish teeth and two ungulate teeth. The first is a second lower deciduous jugal tooth of a cervid. As this find is not significant for species determination, it will not be described here.

The second find is a third upper premolar of a suid, whose morphology shows peculiar characteristics which will be described in order to justify the species attribution (Fig. 29).

The tooth, which lacks the root, is not worn; probably it was still erupting and therefore appertained to a young individual. This find has been compared with material of *Sus scrofa*, housed at the Department of Geological and Palaeontological Sciences of the University of Ferrara, of *Sus strozzi*, housed at the Geopalaeontological Museum of the University of Florence, and of *Sus minor* from the Museum of Natural History of Basel which was temporarily housed at the Department of Earth Sciences at the University of Florence.

Sus strozzi and *Sus scrofa* have an upper third premolar which tends to molarize. Normally, in these two species the tooth has a paracone which is slightly higher than the metacone and separated from it by a labial sinus, and a reduced protocone and a particularly developed hypocone separated by a deep groove. In both the species, the tooth has a bilobate profile in occlusal view. A slight mesial cingulum also occurs.

Fig. 29 - *Sus minor*, third right upper premolar from Roatto: a buccal view, b lingual view, c occlusal view.

Fig. 29 - *Sus minor*, terzo premolare superiore destro di Roatto: a vista buccale, b vista linguale, c vista occlusale.

The specimen from Roatto is decidedly smaller and more primitive than the third upper premolar of *Sus strozzi* and *Sus scrofa*. The paracone and the metacone are very close and separated by a labial sinus only at the apex; the protocone is practically absent and the hypocone is well developed.
In occlusal view the profile of the tooth is ovoidal and distally elongated.
There is also a slight cingulum in the mesial part of the tooth.
The dimensions of the specimen are: length 12.5 mm; width 10.2 mm.

The premolar of the suid from Roatto is similar in size and morphology to the third upper premolars of *Sus minor* from the Villafranca d'Asti basin (Berdondini, 1992) housed at the Natural History Museum of Basel. In particular, the finds V.J.1 and V.J.146 are morphologically similar but slightly larger (13.5x13 and 13.8x12.2 mm) while the P3/ of the palate V.J.144 is about the same size (12.4x10 mm). The premolar of the cranium Rss 70 from Perpignan housed at the Basel Museum (Azzaroli, 1954) and another from the same site, which are kept at the Museum at Lyon, of which the Geopalaeontological Museum at Florence has a cast, are also similar.

For these reasons the suid premolar from Roatto is referred here to *Sus minor*.

8. PALAEONTOLOGICAL AND STRATIGRAPHICAL REMARKS (B. Sala)

The study of the posteranial skeletons of the rhinoceroses from Roatto and Dusino have led to the confirmation of some morphological characteristics peculiar to *Stephanorhinus jeanvireti* which were described by Guerin (1972), and also to the recognition of others which may serve for the determination of the species. With repard to this, some of the carpal bones and part of the upper limbs elements turned out to be particularly significant.

There has also been the occasion to describe the fifth metacarpal of a *Stephanorhinus*, which is commonly negletted. Bones of *S. jeanvireti* not yet illustrated in the literature, such as the trapezium and the trapezoid, are presented here for the first time.

The possibility to compare two skeletons of the same species but of very different dimensions gave us the opportunity to evidence individual differences which are commonly thought to be species characteristics. The articular facets between the metapodial bones and the tarsals, for instance, are very variable, as are the pyramidal and uncinate.

In our opinion common characteristics are shared by different species to satisfy similar structural demands. This is the case, for example, with the flattening of the diaphysis of the third metacarpal and the third metatarsal from Roatto and of large individuals of *S. mesorhinus*. This is the most reasonable hypothesis, in our view, even if one cannot exclude that *S. jeanvireti* occupied, at least partially, similar environments to those in which *S. megarhinus* had lived previously and therefore, for purposes of adaptation, had acquired some similar morphological characteristics.

We underline the importance of the concomitant occurrence of *Stephanorhinus jeanvireti* and *Sus minor*, two typical taxa of Lower Villafranchian, therefore enriching our knowledge about the Villafranca d'Asti type area and its vertebrate fauna.

These specimens, included in the Unità S. Martino, allow to ascribe the sediments to Middle Pliocene.

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RIASSUNTO

Viene descritto il cranio di Roatto, nuovo reperto di Villafranca d'Asti, che rappresenta il ritrovamento di cranio più completo di rinoceronte, *Stephanorhinus jeanvireti*, mai fatto. Un terzo premolare superiore di *Sus minor*.

Si presenta brevemente il rilievo geologico dell'area e una revisione preliminare della successione stratigrafica in cui è stato possibile distinguere quattro unità sovrapposte. All'interno dell'Unità Inferiore, comprendente i frammenti ossei del Dusino, è stata trovata una mandibola di tricheco, di evidente habitat marino, sopra l'Unità di San Martino, in corrispondenza della quale si sono rinvenuti i resti ossei, fossilizzati da sedimenti siltoso-sabbiosi di piana deltizia, anche di impronte di foglie, frammenti di tronchi e rami, frutti vegetali e molluschi continentali. Le Unità di Colle della Maretta e Monteu Roero, sovrastanti in discordanza angolare, comprendono sedimenti rispettivamente ascrivibili a ambienti fluviali e a ambienti sterili di origine fluviale.

Lo studio dello scheletro post craniale del rinoceronte di Roatto, unitamente al riesame del reperto simile di Dusino (Sacco, 1897), rinvenuto nel medesimo orizzonte della stessa area, ha portato a riconoscere alcuni caratteri morfologici peculiari di *Stephanorhinus jeanvireti* descritti da Guerin (1972) e a riconoscerne altri che potranno essere utili per la determinazione della specie. In tal senso, importante interesse riveste anche una ossa carpale di fifth metacarpal di *Stephanorhinus*, che non è comunemente noto perché probabilmente spesso confuso con resti di altri mammiferi. Altre ossa di *S. jeanvireti* non ancora illustrate in letteratura, come il trapezio e il trapezoide, vengono presentate per la prima volta.

L'osservazione morfologica di due scheletri riferiti alla stessa specie, ma di taglia molto diversa, ha permesso di attribuire alle stesse differenze individuali alcuni caratteri

che in letteratura erano invece ricordati con le specifiche. Sono visibili nell'esemplare che ha fatto da olotipo (fig. 1), le cui caratteristiche, in particolare il modo delle tubercolazioni, sono molto variabili (vedi come variabili siano nel piccolo esemplare figurato).

Di fatto, non si pensa che la diversità di *S. megarhinus* e di quelli attribuiti a questa specie sia rappresentabile a livello strutturale. Questo è il caso, ad esempio, dell'appartenente all'Italia del terzo inferiore del territorio meridionale, d. Roatto, ricostruibile anche nei due esemplari più grandi di *S. megarhinus*. Questa specie, come già detto, può attribuibile anche se non si può escludere che *S. pavesi* abbia occupato, almeno in parte, lo stesso ambiente in cui viveva in precedenza *S. megarhinus* e quindi, a parità di foglia, abbia acquisito morfologie adattative simili.

Si sottolinea infine l'importanza del rinvenimento congiunto dell'esemplare di *Stephanorhinus pavesi* con un premolare di *Sus strozzi*. Due taxa, tipici delle associazioni faunistiche del Villafranchiano inferiore, permettono di delineare sedimentazione del Bacino di San Mastino del Pliocene medio, assai fondo in cui il mondo le sono ricoperti sull'arcata del Villafranca d'Asti (Torino) fossili vertebrati.

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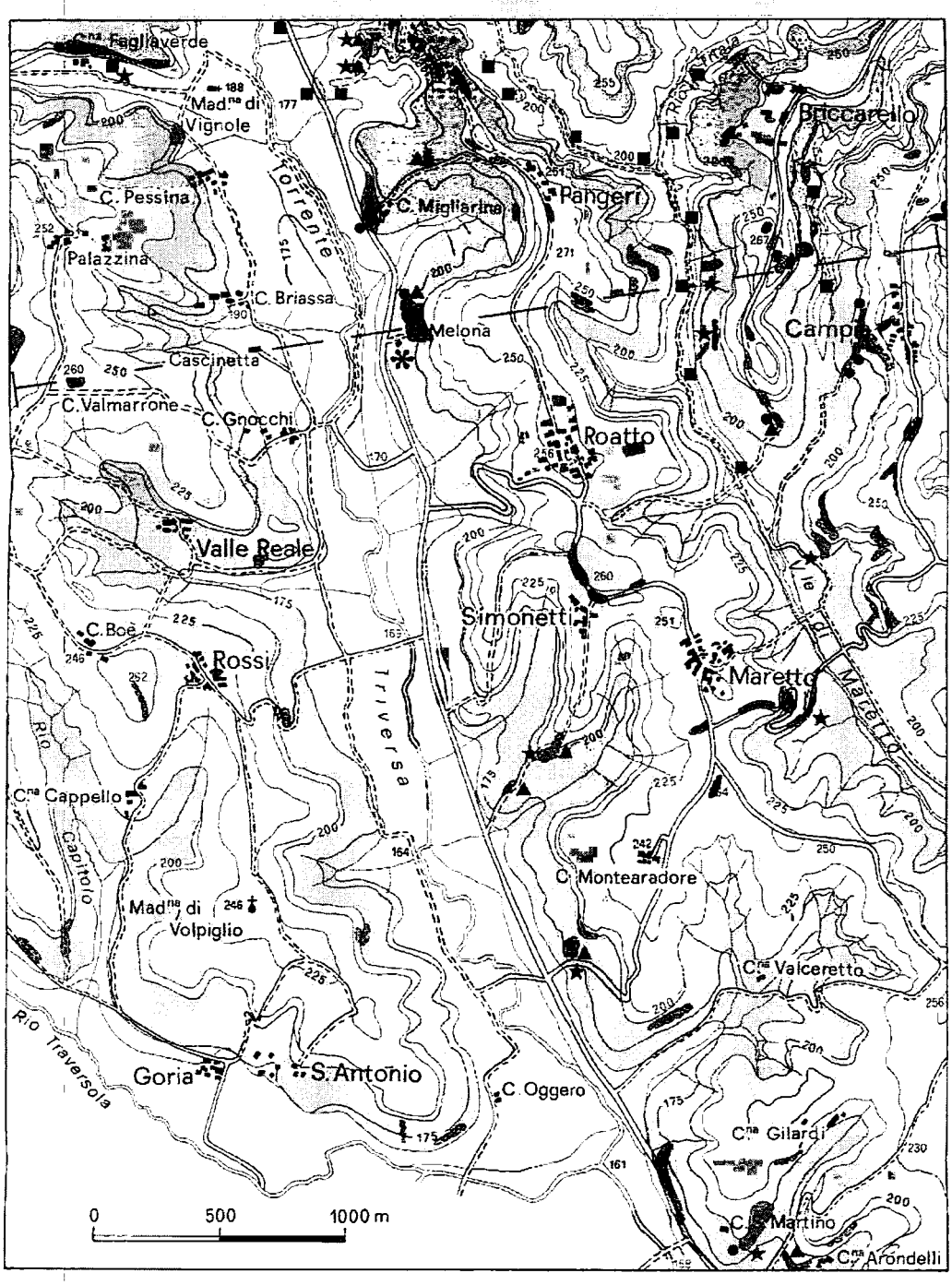
VAL TRIVERSA GEOLOGICAL MAP (

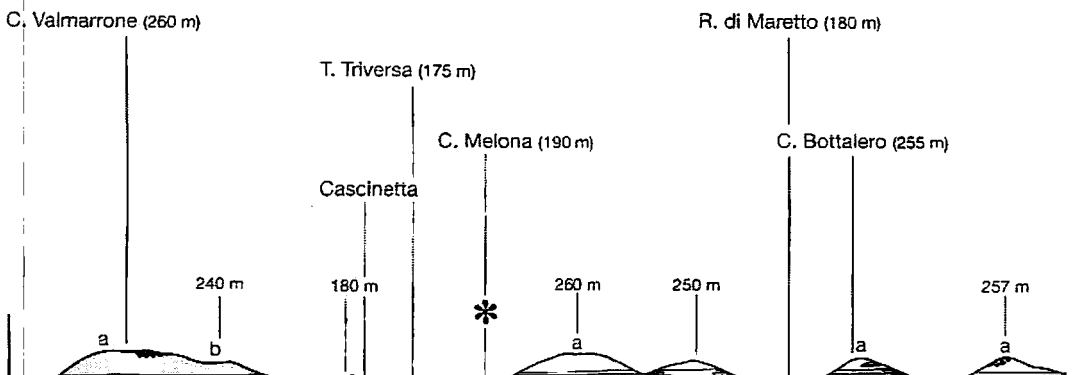
MARÍA GABRIELLA FORNO

MIDDLE-UPPER PLEIST
and HOLOCENE

LOWER PLEISTOCENE

MIDDLE PLIOCENE





MIDDLE-UPPER PLEISTOCENE and HOLOCENE

Fluvial silty-sands or gravels.
Sedimenti sabbioso-siltosi o ghiaiosi fluviali.

LOWER PLEISTOCENE?

a
b

Unità di Maretto. Unstratified fluvial clayey-silts rich in carbonatic concretions: a) outcrops; b) interpolations.
Sedimenti fluviali siltoso-argillosi non stratificati ricchi di concrezioni carbonatiche: a) affioramenti; b) aree di interpolazione.

a
b

Unità di C. Gherba. Trough cross bedded fluvial sands: a) outcrops; b) interpolations.
Sedimenti sabbiosi fluviali con stratificazione incrociata concava: a) affioramenti; b) aree di interpolazione.

MIDDLE PLIOCENE

a
b

Unità di San Martino. Deltaic plain planar laminated silts, with leaf moulds, tree trunks and branch remains, vegetal fragments and land molluscs, alternating with cross laminated sands: a) outcrops; b) interpolations.
Sedimenti di pianura deltizia costituiti da alternanze di silt con laminazione piano-parallela, ricchi di impronte di foglie, frammenti di tronchi e rami, frustoli vegetali e molluschi continentali, e di sabbie con laminazione incrociata: a) affioramenti; b) aree di interpolazione.

a
b

Unità di Ferrere. Trough cross bedded delta front sands with tree trunks and branch remains and infrequent fragments of marine molluscs: a) outcrops; b) interpolations.
Sedimenti sabbiosi di fronte deltizio con stratificazione incrociata concava contenenti resti di tronchi e rami e rari frammenti di molluschi marini: a) affioramenti; b) aree di interpolazione.

a
b

Sabbie di Asti (p.p.). Planar bedded marine sands rich in marine molluscs: a) outcrops; b) interpolations.
Sedimenti sabbiosi marini a stratificazione piano-parallela con frequenti molluschi marini: a) affioramenti; b) aree di interpolazione.

* Rhinoceros remains. *Resti di rinoceronte: Stephanorhinus jeanvireti* (GUÉRIN).

■ Marine molluscs. *Molluschi marini.*

● Land molluscs. *Molluschi continentali.*

▲ Leaf moulds. *Impronte di foglie.*

★ Plant remains: tree trunks, branches and vegetal fragments. *Resti vegetali: tronchi, rami e frustoli.*

Cross section. *Traccia del profilo.*

257 m
a

Cross section of the Val Triversa through the rhinoceros site. The succession of Villafranchian