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CAMPANINO F.*, FORNO M.G.**, MCTTURA A.***, ORMEZZANO D.*, SALA B.****

Stephanorhinus jeanvireti (Guérin) 1972 (Rinocerotidae, 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 *Sus minor* was found in association with these remains: both taxa are typical of the Lower Villafranchian (biochronological stage).

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 this context the Dusino rhinoceros skeleton (Sacco, 1895) found at the end of past century in the same area, is also reviewed.

* Museo Regionale di Scienze Naturali - Torino

** Dipartimento di Scienze della Terra, Università di Torino

*** Dipartimento di Biologia Animale, Università di Torino

**** Dipartimento di Scienze Geologiche e Paleontologiche, Università di Ferrara.

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.

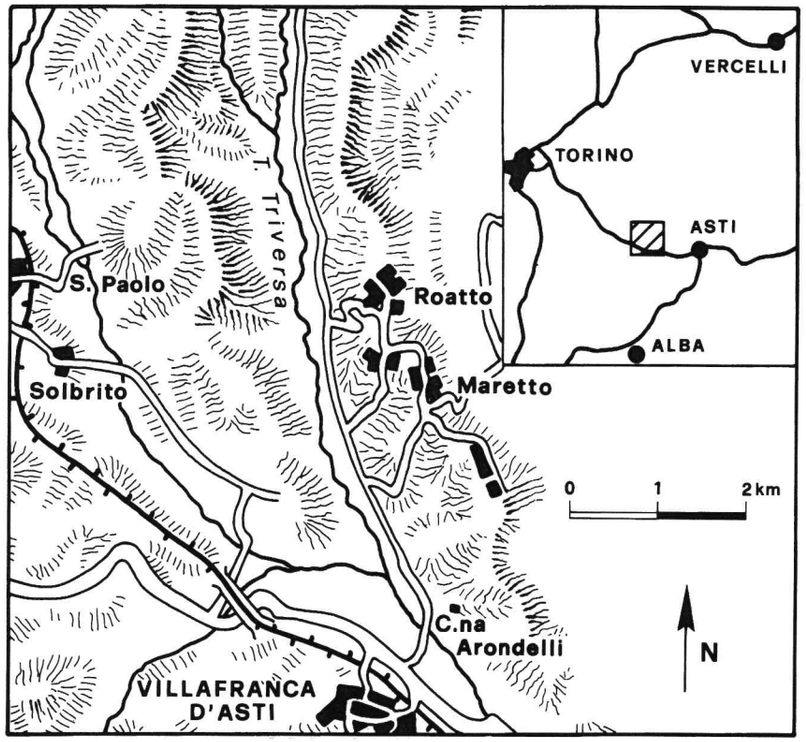

Fig. 1 - Index map. - Fig. 1 - Ubicazione dell'area rilevata.

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 & Tagliavini (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 Maretto". 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.

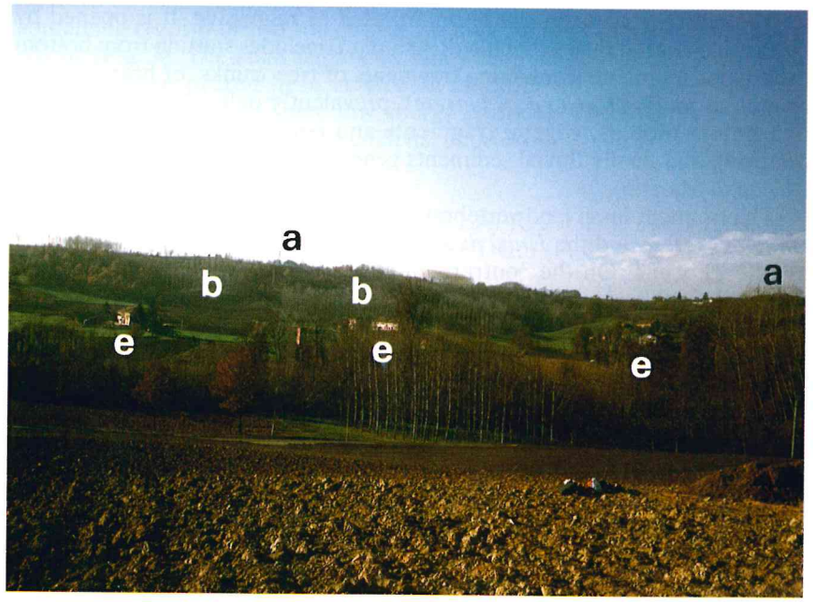

Fig. 2 - The right slope of the Val Triversa, seen from C. Melona. Several episodes of fluvial modelling are marked by a series of terraced surfaces. Particularly evident are the surfaces at about 260 m (**a**) where is located C. Valmarrone, at about 240 m (**b**), at about 180 m (**e**) where C. Gnocchi,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

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 "*mürs*"). 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 E. 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; heterogeneous and unstratified colluvial cover; agricultural soil.

Fig. 3 - Aspetto dello scavo. È visibile al centro l'insieme dei resti fossili. Sulla parete di taglio sullo sfondo, sono osservabili dal basso verso l'alto: sedimenti di pianura deltizia rappresentati da sabbie e da soprastanti silt a laminazione pianoparallela, sottolineata dalla presenza di livelli ossidati; copertura colluviale di natura eterogenea priva di stratificazione; terreno agrario.

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 Poirino 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', of new local fauna and the better definition of the sedimentary succession. In 1967 Hürzeler 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; Vergnaud-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 Truc 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 e Tomadin, 1970) was carried out on some sections of the Villafranca area (C. Crotino, Cava RDB, Cava di 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 & Vialli 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 Triversa". 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.* (1982) the Early Villafranchian fauna of Triversa includes 21 mammalian species.

Esu & Girotti (1991) defined a biostratigrafic 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 got 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

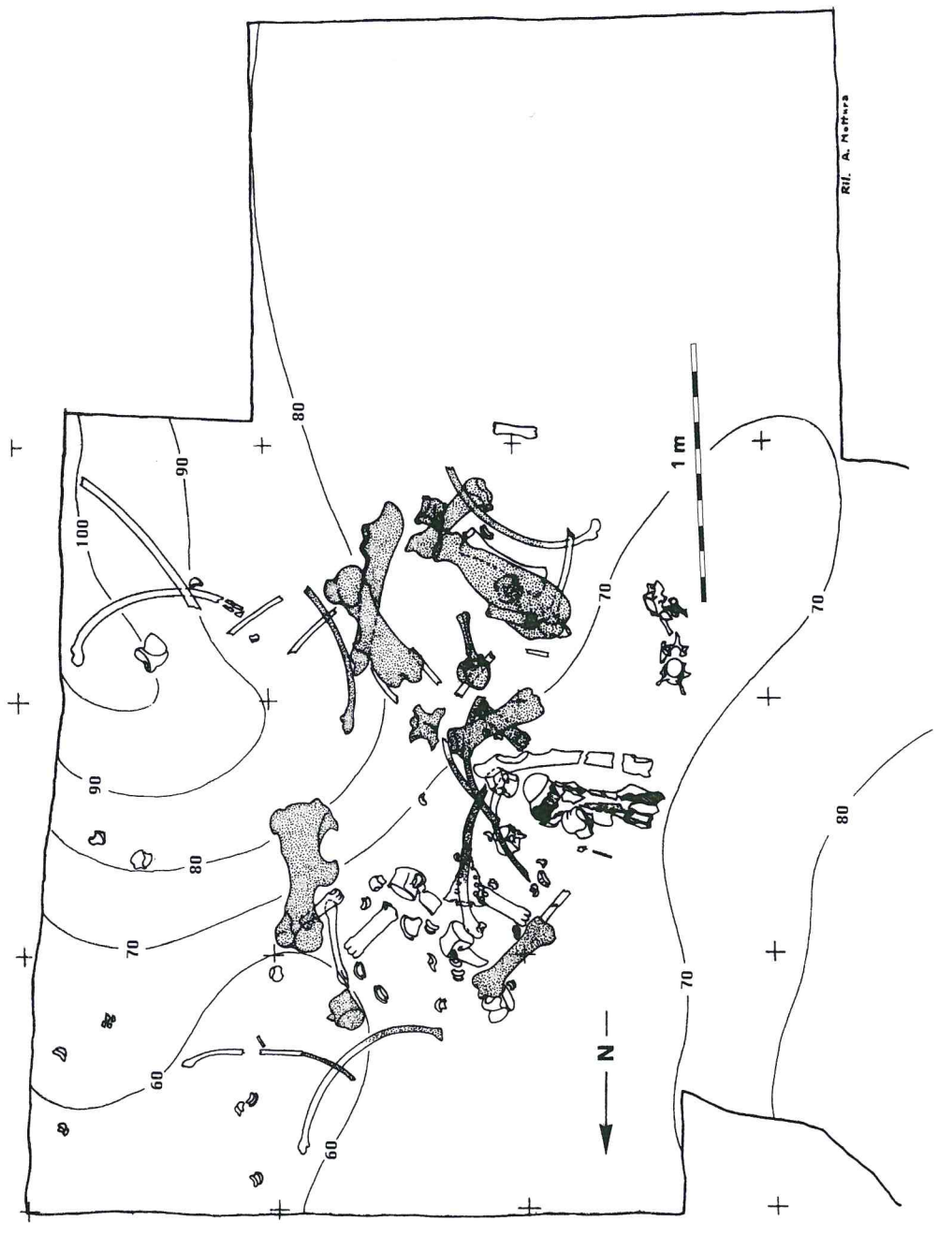

Fig. 4 - Map of the excavation area. The bones contained in the silty sediments or at the sand-silt contact are dotted. The bones contained in the sand are in white. The thick outline of the drawing indicates the excavated area.

Fig. 4 - Rilievo. In puntinato le ossa contenute nei sedimenti limosi o al contatto sabbia-limo. In bianco le ossa contenute nelle sabbie. La linea continua che delimita il disegno corrisponde al contorno dell'area scavata.

carcass, due to a partial erosive reexposition, 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: pg. 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 sligth dislocation of the fragments by crush, the bones were taken to their single 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 Eart 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 Guérin (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 Mottura and Forno 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
dia. = diaphysis
dist. = distal
epi. = epiphysis
lf. = left
max. = maximum (greatest)
min. = minimum
phys. = physiologic
prox. = proximal
rg. = 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

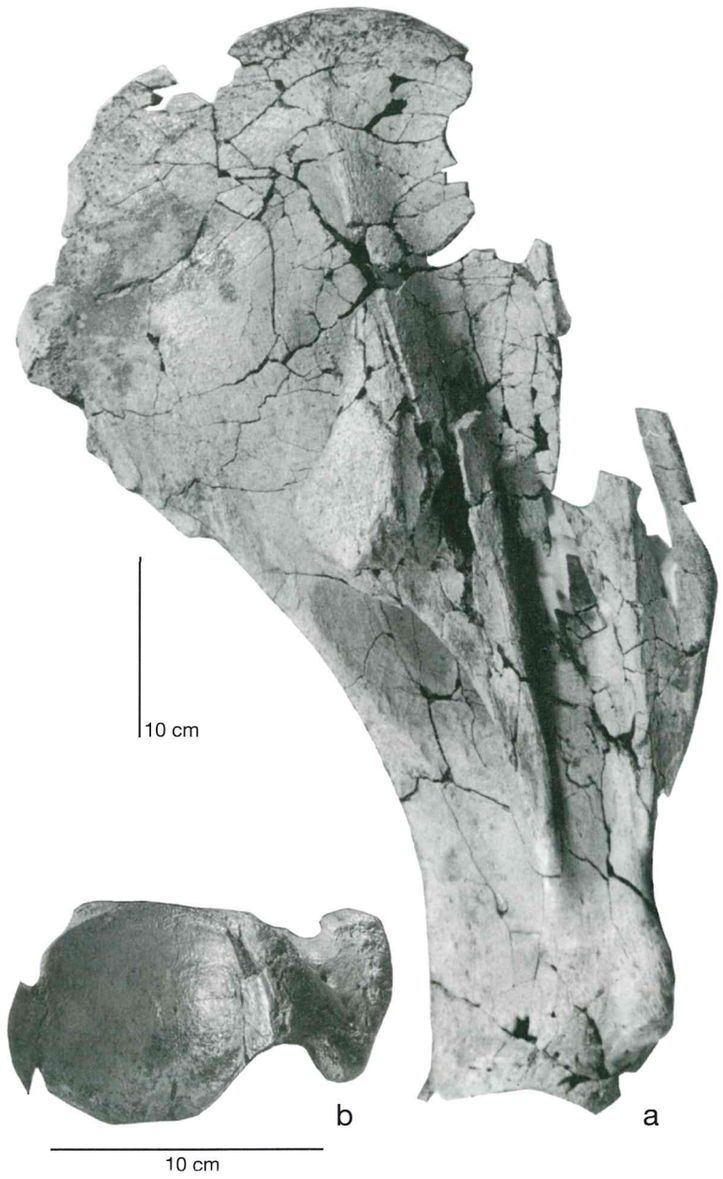

Fig. 5 - *Stephanorhinus jeanvıreti* from Roatto, right scapula: **a** lateral view, **b** distal view.

Fig. 5 - *Stephanorhinus jeanvireti* di Roatto, scapola destra: **a** visione 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 Guérin 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 Guérin, 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 lf.	Roatto lf.
length	476	498
phys. length	423	433
prox. breadth (DT of Guérin)	176	196
prox. depth (DAP of Guérin)	187	(218)
breadth caput	95	103
depth caput	103	105
breadth dia.	56.3	73
depth dia.	57.2	74.5
dist. breadth	153	163
dist. depth	117	119
art. dist. breadth	101	107.5
art. dist. depth troclea (internal)	85	102
art. dist. depth troclea (external)	72.5	81

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.

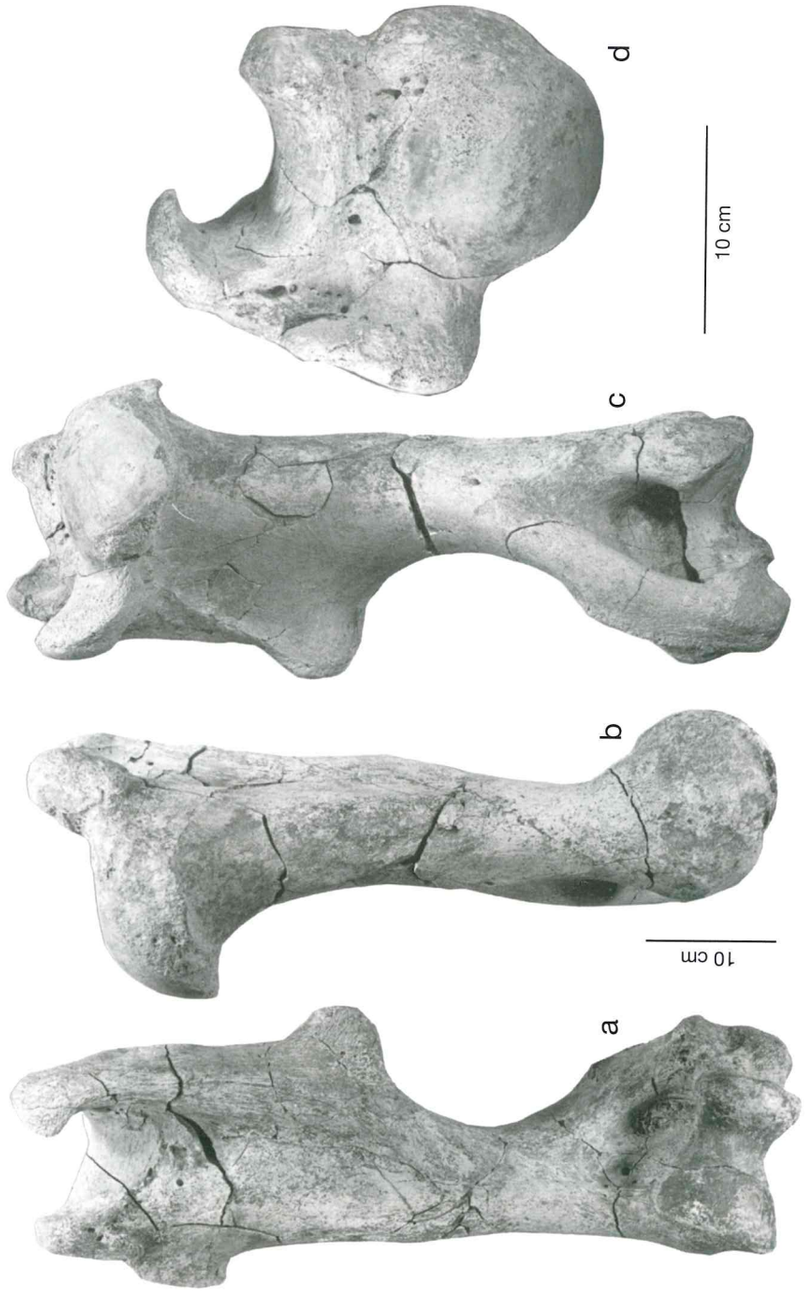

Fig. 6 - *Stephanorhinus jeanvireti* from Roatto, left humerus: **a** cranial view, **b** lateral view, **c** caudal view, **d** proximal view.
Fig. 6 - *Stephanorhinus jeanvireti* di Roatto, omero sinistro: **a** visione craniale, **b** laterale, **c** caudale, **d** prossimale.

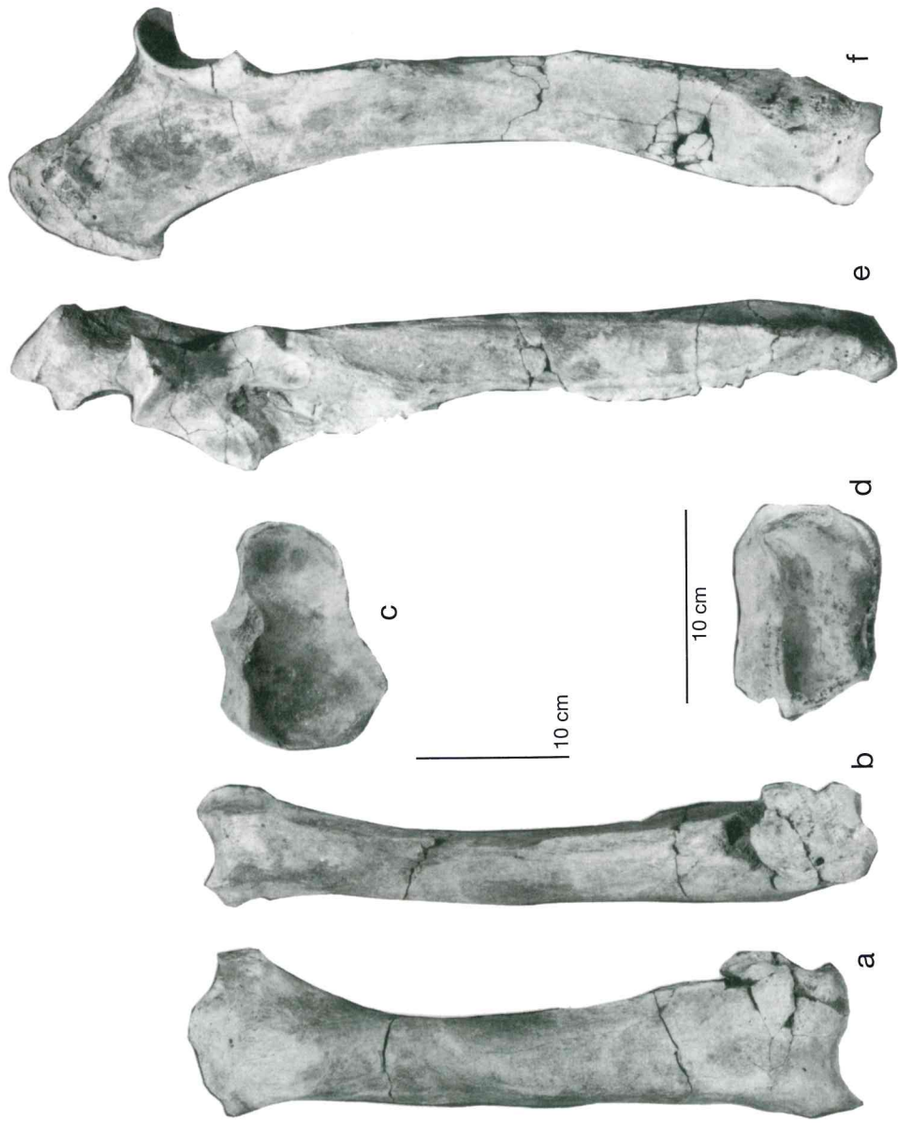

Fig. 7 - *Stephanorhinus jeanvireti* from Roatto, **a**, **b**, **c**, **d**, left radius; **e**, **f** left ulna: **a**, **e** dorsal view, **b** lateral view, **c** proximal view, **d** distal view, **f** medial view.

Fig. 7 - *Stephanorhinus jeanvireti* di Roatto, **a**, **b**, **c**, **d**, radio sinistro, **e**, **f** ulna sinistra: **a**, **e** visione dorsale, **b** laterale, **c** prossimale, **d** distale, **f** mediale.

The only characteristic consistent with the description given by Guérin 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 rg.	Roatto rg.
length	433	460
phys. length	403	440
prox. breadth	102.5	112
prox. depth	70	80
prox. art. breadth	102	106
prox. art. depth	60.5	68.5
min. depth dia.	37	47
dist. breadth	109	111
dist. depth	68	75
art. dist. breadth	90	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 Guérin, 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 rg.	Roatto rg.
length	536	580
length of olecranon	161	169.5
breadth of processus anconaeus	56	56
art. prox. breadth (coronoid process)	91	91.5
breadth tuber	81 (lf.)	-
prox. depth	106	123
min. prox. depth (olecranon)	92.6	98
depth across processus anconaeus	118.5	136
dia. breadth	40	42
dia. depth	44	52
art. dist. breadth	40	40
art. dist. depth	70	74

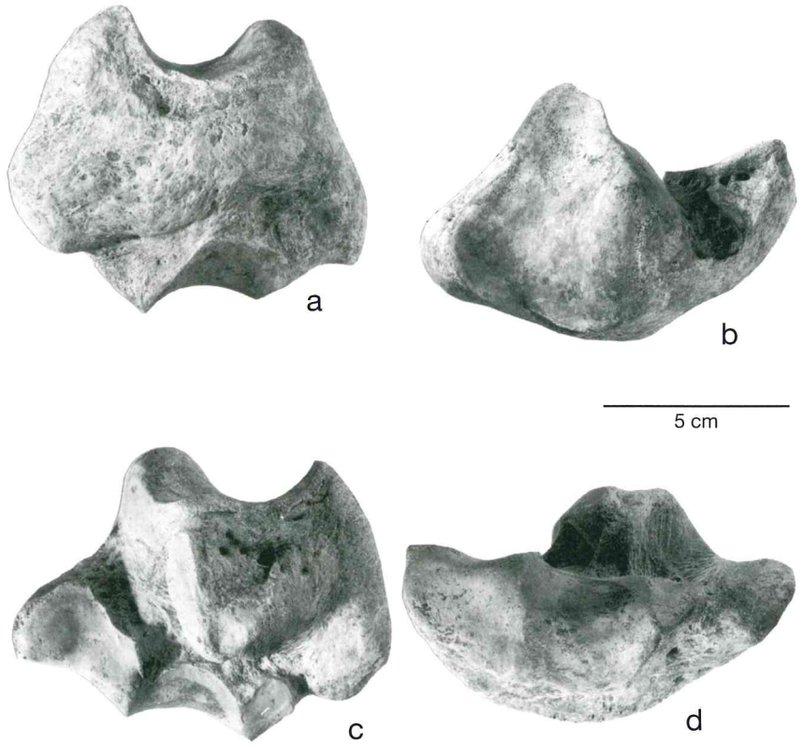

Fig. 8 - *Stephanorhinus jeanvireti* from Roatto, left scaphoid: **a** dorsal view, **b** proximal view, **c** palmar view, **d** distal view.

Fig. 8 - *Stephanorhinus jeanvireti* di Roatto, scafoide sinistro: **a** visione dorsale, **b** prossimale, **c** palmare, **d** distale.

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. 4 of Guérin (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 lf.	Roatto lf.
depth (length of Guérin)	97.5	102
breadth	62	67
length (height)	72.5	79
art. prox. depth	58	58
art. prox. breadth	61	64.5
art. dist. depth	75	79.5
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 lf.	Roatto lf.
max. breadth	56	60
depth	71	76
max. depth	73.5	81
length (height)	55	62.5
art. dist. length	≥ 36	44.5

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.

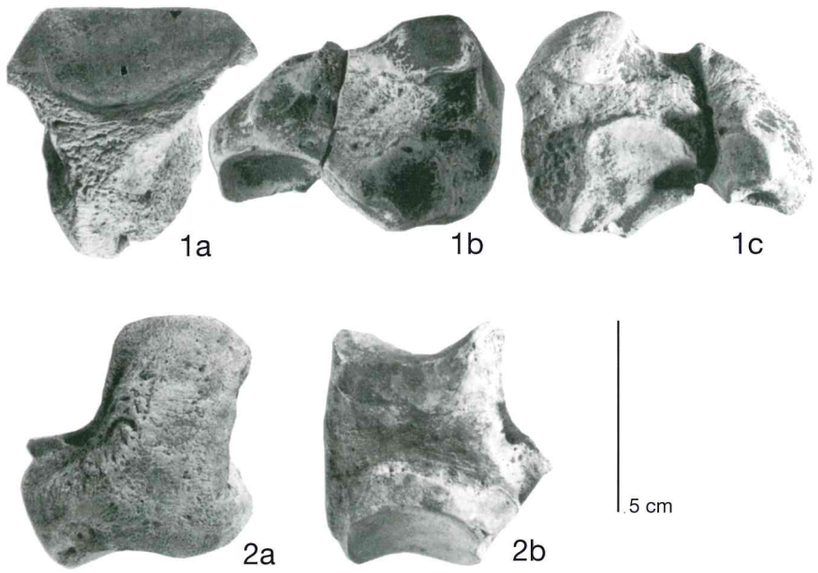

Fig. 9 - *Stephanorhinus jeanvireti* from Roatto, 1 left semilunar, 2 right pyramidal: **a** dorsal view, **b** medial view, **c** lateral view.

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	62	68
depth	45	48
art. prox. depth	38	42
art. prox. breadth	38	38
art. dist. depth	34	36.5
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 rg.
length (height)	39.5
art. length (with trapezoid)	33
art. depth (with trapezoid)	23
max. depth	35
breadth	26

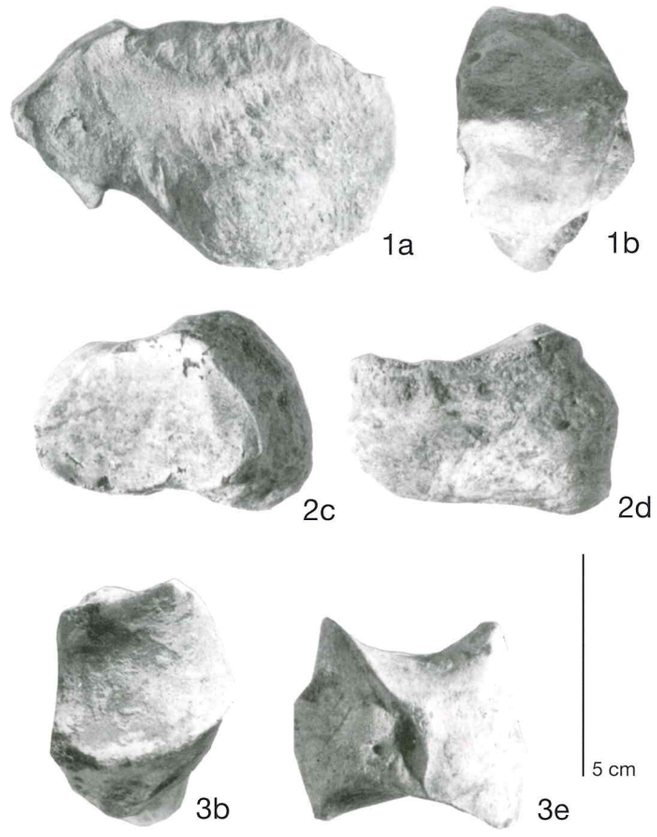

Fig. 10 - *Stephanorhinus jeanvireti*, 1 left pisiform from Dusino, 2 right trapezium from Roatto, 3 right trapezoid from Dusino: **a** dorsal view, **b** proximal view, **c** lateral view, **d** palmar view, **e** medial view.

Fig. 10 - *Stephanorhinus jeanvireti*, 1 pisiforme sinistro di Dusino, 2 trapezio destro di Roatto, 3 trapezoide destro di Dusino: **a** visione dorsale, **b** prossimale, **c** laterale, **d** palmare, **e** mediale.

Trapezoid (second carpal) - Fig. 10.3

All two right trapezoids from Dusino are present.

This carpal was also not described by Guérin. 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 rg.
max. length (height)	37.5
min. phys. length	26
depth	45
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 Guérin (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 lf.
max. length (height)	71
min. breadth dorsal side (transversal)	41
max. breadth	57
depth	103
art. prox. breadth	24

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.