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The rhinoceroses of Isernia La Pineta (early Middle Pleistocene, Southern Italy)

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KEY WORDS - *Rhinoceros, Perissodactyla, Isernia (South Italy), Pleistocene*

ABSTRACT - *The rhinoceros remains found in the prehistoric Isernia la Pineta deposit (Southern Italy), which dates to the early Middle Pleistocene, are described. The remains include, in addition to two fairly well preserved skulls, many teeth and post cranial skeletal elements, belonging to tens of animals, and allow detailed description. They may confidently be referred to* Stephanorhinus hundsheimensis. *The Isernia material also provides an opportunity for a detailed description of the acropodium, often quite unnecessarily neglected.*

In Western Europe at least two sites, Mauer and Mosbach, have a large amount of material of this rhinoceros, but they are less precisely dated and represent longer time spans than Isernia.

For the abundance and the good preservation of the material the rhinoceros of Isernia will serve as a standard for comparison of Stephanorhinus hundsheimensis.

RIASSUNTO - *Vengono descritti i reperti di rinoceronte del giacimento preistorico di Isernia la Pineta (Italia del Sud), datato al primo Pleistocene medio. Il materiale, comprendente oltre due crani abbastanza completi, molti resti dentari e dello scheletro postcraniale, appartenenti a decine di individui, ha permesso uno studio dettagliato di questo rinoceronte che viene determinato come* Stephanorhinus hundsheimensis. *Viene colta l'occasione per descrivere in particolare anche l'acropodio, solitamente trascurato in letteratura.*

In Europa occidentale vi sono almeno altri due siti, Mauer e Mosbach, con materiale di questo rinoceronte molto abbondante, ma sono meno ben datati e rappresentano uno spazio di tempo più lungo di quello compreso ad Isernia.

Per la ricchezza e la buona conservazione dei reperti il rinoceronte di Isernia potrà essere utilizzato come standard di confronto per Stephanorhinus hundsheimensis.

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INTRODUCTION

The Isernia la Pineta deposit is a renowned site containing a prehistoric settlement extremely rich in artifacts and the faunal remains that accumulated as a result of the activities of paleolithic hunters. The faunal elements identified to date include *Ursus deningeri, Panthera leo fossilis, Elephas antiquus, Hippopotamus* cf. *antiquus* (Mazza, pers. comm., 1990), *Sus scrofa, Megaloceros* sp., *Dama* sp., Cervidae indt., *Pliomys episcopalis, Pliomys lenki, Clethrionomys* sp., *Microtus* gr. *arvalis-agrestis, Microtus brecciensis, Microtus* (Terricola) sp., *Arvicola cantiana, Anas platyrhynchos, Tachybaptus ruficollis*, small reptiles, batrachians, and fish, in addition to the rhinoceros that is the object of the present paper (Sala, 1983, 1987, 1990; Tonon, 1989).

Chronologically speaking, the Isernia faunal deposit has been attributed, *sensu* Azzaroli (1977, 1983) and Azzaroli *et al.* (1988), to the earliest Middle Pleistocene (Sala, 1983, 1987, 1990); its fauna correlates with that of the Mauer deposit for the presence of a very primitive *Arvicola cantiana* and of *Panthera leo fossilis* and in particular for the degree of development of *Bison schoetensacki*. K/Ar age determinations performed on the sanidine of the anthropogenic paleosurface have yielded dates of about 0.73 M.A. (Delitala *et al.*, 1983). This age agrees with the paleomagnetic stratigraphy established by McPherron and Schmidt (Coltorti *et al.*, 1982).

Skull

Material

Two skulls, both of which lack teeth, have been recovered from Isernia. One (n. 33085), only slightly compressed dorso-ventrally, is very well preserved and complete. The other (IS.46.32) is slightly larger, also virtually complete, but badly crushed. In addition, the following cranial fragments were found: 7 occipitals with parietals and the distal parts of the temporals (n. 22024; 21844; 20991; 21843; 20836; 20887; IS.120.3), 6 nasals (n. 21826; 20727; 4549; 4546; 20890; 20659), and a palate with M\1 and M\2 (n. 33084).

Description

The skull (pl.1, fig. 1) is long, low, and very similar to skulls from Mauer and Mosbach. It is well above the mean size for *S. etruscus*, and slightly below the mean size for S. hundsheimensis given by Guérin (1980: *Dicerorhinus etruscus brachycephalus*). In lateral view the upper contour of the skull descends from the nuchal crest to a point above the pterygoid processes, rises gently to form an anticline over the frontal hornbase, and then sinks slightly to rise again over the large nasals. The nasals support a rugose horn base with a distinct apex about 2/3 of the way towards the tip, while the frontal hornbase is flat and only slightly rugose laterally. The occipital plane is near vertical; the zygomatic arches descend towards the orbit in a straight line, without levelling out anteriorly. The orbit is situated approximately between M\2 and M\3. The narial incision is very large, reaching back to about M\1, so that the distance between the incision and the orbit is very short. The nasal septum is strongly ossified.

In dorsal view the skull is narrow, with only a slight zygomatic flare. There is a pronunced medial notch in the nuchal crest, and a corresponding notch at the tip of the nasals. The nasal hornbase covers the nasal bones from side to side, and is wider than the portion between the nasal hornbase and the frontals.

In posterior view the occiput is low and trapezoidal, with a deep, double indentation slightly above the midpoint and a curious exostosis just beneath the nuchal notch. Though the skull is damaged ventrally, one can see that the posttympanic process forms a lip on the anterolateral margin of the paroccipital process, closing off the external auditory meatus, as has been described by Loose (1975). The postglenoid processes are stout, but broken apically.

Mandible

Material

Several mandibular fragments were found, including two with P/4-M/3 (n. 2083; 21454), and one with M/1-M/2 (n. 21388). The most complete fragment is a right hemimandible with P/3-M/3 (n. 33083) (pl. 2, fig. 5), from a mature adult individual whose teeth were quite worn. The portion of the bone anterior to P/3 is lacking, as is most of the ascending ramus. The mandible is robust and deep, and gives no signs of shallowing rostrally. The teeth are described separately below.

Teeth

Material

The dental material from Isernia consists mainly of isolated and fragmentary teeth, but there is a good mandible and a number of upper and lower jaw fragments with partial dentitions. The specimens studied are listed below:

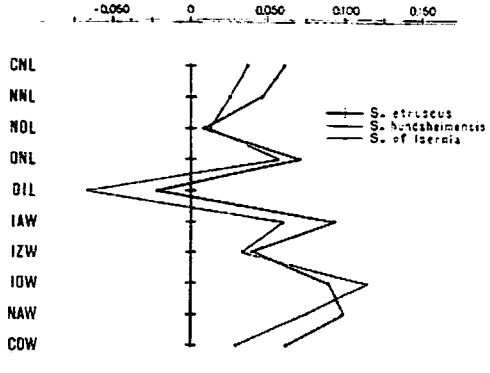
Right maxillary fragment with P\2-P\4 (IS. 85)
Right maxillary fragment with M\1-M\3 (IS. 98)
Right maxillary fragment with M\3 (IS. 87)
Left maxillary fragment with P\2-P\3 (IS. 84)
Right hemimandible with P/3-M/3 (n. 33083)
Right mandibular fragment with P/4-M/3 (n. 20837)
Left mandibular fragment with P/3-M/2 (IS. 21.54)
Left mandibular fragment with M/1-M/2 (IS. 21.69)
Left mandibular fragmant with M/1-M/2 (n. 21388)
Associated left P\2-M\1 (IS. II SO)
Ass. left P\2-P\4 (IS. 83)(pl. 2, fig. 1)
Ass. left P/2-P/3 (IS. 138)
Ass. right P/£-P/4 (IS. 137)
Ass. right M/1-M/2 (IS. 139)
Isolated P\2 (IS. 1; 2; 3; 4; 5; 6;7)
Isol. P\3 (IS. 8; 10; 11; 12; 13; 14; 15; 16; 17; 25; 26; 28)
Isol. P\4 (IS. 9; 18; 19; 20; 21; 22; 23; 24; 29; 32; 33; 34) Isol. M\1 (IS. 31; 33; 37; 47; 50; 53; n. 21214)
Isol. M\2 (IS. 36; 39; 41; 42; 43; 44; 45; 46; 48; 49; 51)
Isol. M\3 (IS. 44; 53; 54; 55; 56; 59; 60; 61; 62; 63; 64; 65; 66; 67; 70, 75; 76; 78; 80; 82, n. 2695)
Isol. P/2 (IS. 88; 89; 90; 91; 92; 93 (pl. 2, fig.2);94; 96; 97)
Isol. P/3 (IS. 98; 99; 100; 104; 107; 126)
Isol. P/4 (IS. 101; 102 (Plate 2, fig. 3); 105; 116; 122)
Isol. M/1 (IS. 108; 111; 113; 115; 116; 117; 121; 130; 134; 140)
Isol. M/2 (IS. 103; 109; 110; 112; 114; 116; 117; 121; 130; 134; 140)
Isol: M/3 (IS. 106; 120; 124; 125 (pl. 2, fig. 4); 128; 129; 132; n. 6O610)

In addition to these specimens, about 40 fragmentary specimens and a few milkteeth were found.

Methods

The teeth were studied using methods described by Fortelius *et al.* (in this volume). For a quantitati-

Table I



ve comparison, ratio diagrams and analysis of variance were used. Isolated teeth were included, since using only toothrows would have rendered the sample size too small for the results to be statistically significant. The use of isolated teeth brings up the problem of separating P3 from P4 and M1 from M2. Separation was carried out subjectively, mainly by size, except in the case of M1, where the presence of a double buccal fold between the meta and hypolophids was used to identify M1 (Fortelius *et al.*, in this volume). The method inevitably exaggerates the apparent mean size difference between these teeth, but no other method is currently available. This complication is considered in the discussion of the result below.

In as far as it was possible, the measurements Guèrin (1980) proposes for postcranial remains were taken. A few additional measurements, described below, were also used.

Description

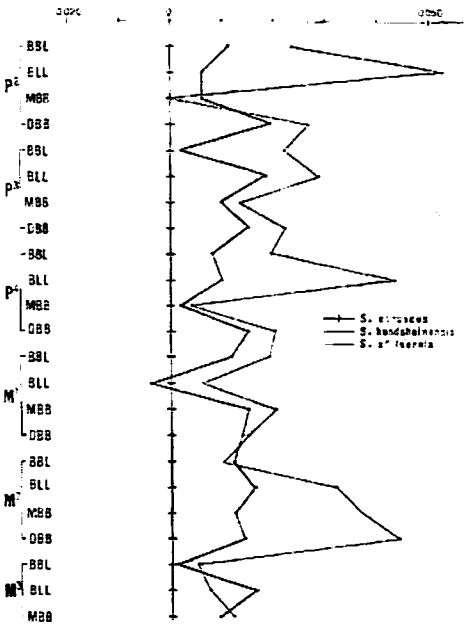
The dentition of the rhinoceros from Isernia is very similar to that of the early Middle Pleistocene species *Stephanorhinus hundsheimensis* well known from a number of sites, including Mosbach, Mauer, Süssenborn, West Runton, Trimingham and Westbury (Fortelius *et al.*, in this volume). Descriptive statistics of the Isernia material are given in tab. 2.

Most of the upper premolars have moderately developed buccal styli, quite strong lingual cingula, a branched crochet, and multiple cristae. The upper molars have a strong recurved crochet that approaches the single crista to form a closed or almost closed fossule.

Most of the lower cheek teeth lack well developed cingula, with the exception of a buccal oblique cingulum on the protoconid.

A thin covering of coronal cement is present on most of the teeth. The enamel surface is sculpted with a fine, mainly vertical relief, and on many of the lower premolars the enamel roughens buccally near the base, forming wart-like enamel pearls. Some of the specimens (e.g., specimen 21.54) have large, vertical wrinkles.

Table 2



Postcranial skeleton

Material

The postcranial rhinoceros remains found are, by comparison, much less abundant than are the teeth and cranial remains. There are a few fragmentary vertebrae, fragments of epiphyses of long bones, a few whole metapodials, carpal and tarsal bones, and phalanges. The varieties of bones present and their fragmentary state are due to the animals having been killed for food by prehistoric man. The paleolithic hunters carried parts of their quarries rather than the whole animals back to their camps, and then systematically broke open all the hollow bones to extract the marrow.

Wherever possible the measurements recommended by Guerin (1980) were taken to make comparisons of the data possible; in some cases other measurements that were deemed especially significant were also made. All the measurements are in mm.

We suggest the reader refer to Fortelius *et al.* (in this volume) for sketches indicating the orientations of the measurements made and the abbreviations used.

Description

Scapula

Only one articular fragment of a left scapula (IS.F.301) was found. The glenoid cavity on the side of the incision is incomplete. The only characteristic feature observable is that the lateral border of the glenoid cavity is slightly re-entrant with respect to the articular surface, whose edges are pronounced.

Humerus

One proximal and three distal humerus fragments were found. The former is a right articular head (IS. F. 307), whose maximum articular width is 96 mm. The distal epiphyses, two right trochleases (IS.93.59; IS.F.306) and one left trochleas (IS.F.305) are fragmented and unmeasurable.

Radius

One proximal right fragment (IS 101.16), poorly

preserved and broken in several points, but including the entire epiphysis and the first third of the diaphysis, was found. The radial and lateral tuberosities are chipped, rendering its maximum width unmeasurable. The reconstructed humeral articular surface has a fairly elevated coronoid process that forms an angle of about 100°-105° with the lateral and medial glenoid cavities. The diaphysis was probably broken at its thinnest point. Its diameters, measured at a slight angle because it is bent with respect to the proximal epiphysis, are 52x42.

Ulna

Nine proximal fragments, almost all anconeal processes, and one distal fragment were found. The anconeal process is easily recognizable in all of the proximal fragments because it is extremely elongated in palmar view, and therefore the trochlear notch is wide and latero-medially rounded. Of the five right proximal articular fragments, one (IS. 317) has part of the olecranon, the articular surfaces, and an almost complete synovial notch; three specimens (IS. 319. IS. 308, and IS.F.312) have just the anconeal process and part of the trochlear notch, and one (IS. 101.50) has part of the trochlear notch and the dorsal side of the diaphysis. Of the four left proximal articular fragments, three (IS.R.318, IS.F.311, and IS.F.309) are just anconeal processes, and one (IS.F.314) is a complete olecranon with tuberosities, anconeal process, trochlear notch, and synovial notch (pl. 3, fig.1). Only the medial side of the trochlear notch is chipped.

The measurements made on IS.F.314 are as follows: DAP olecranon (after Guérin, 1980) 95, BPau (DT olec. after Guérin) approximately 55,DAP prox. (after Guérin) 132. DPa (DAP prox. min.) 113, Do 82. The DPa of IS. 317 is 118.

The distal fragment IS.313 is a left epiphysis whose distal articular surfaces are partially fragmented. Its articular measurements are DDar 59, BDar 37.5.

Carpal bones

No specimens of either the scaphoid or the trapezium have been found in the deposit.

Semilunar

A left semilunar (IS. 53.4), whose measurements are L 72.5, l (52), H 54, H ant. 53, l ventral articular facet 40, and L ventral articular facet 53, was found.

The semilunar is rather long and slim. The inferior articular face with the pyramidal is split down the middle by a deep notch that subdivides it into two distinct faces. In both the anterior and dorsal views, this bone's profile is elongate and slim.

Pyramidal

A left pyramidal (IS. 326) (pl. 4, fig. 1), measuring L 39.5, l 62.5, and H max 49, was found. This bone is fairly deep, and elongate in the dorso-palmar direction; therefore the upper part of the proximal articular surface is more strongly developed dorso-palmarly than laterally.

Pisiform

A right pisiform (IS. 336) (pl. 4, fig. 2), measuring L 68.8, l 42.5, and H 30, was found.

Both the inferior and the superior articular surfaces are triangular and have similar dimensions. The angle between them is about 75°. The body of the pisiform is compressed, pear shaped, and elongate towards the rear.

Trapezoid

Two right trapezoids (IS. 333; IS. 71.107), and two left ones (IS. 332; IS. 331), have the following dimensions:

Specimen N°	333	107	332	331
L	42.5	43.6	42.0	40.5
l	26.0	31.5	29.5	31.0
H	36.0	33.5	35.5	36.0

The dimensions and proportions of the trapezoids from Isernia vary from a thin, high form (IS. 333) to a wide, flattened form (IS. 71.107). Because the ossification of the bones is not spongy, but rather thick and continuous, they are all assumed to be from adult individuals.

Magnum

Three right magnums, two almost complete and one limited to the posterior part of the bone, were found. Though the anterior-internal part of the bone is squashed and the posterior of the body of the bone is missing, specimen IS.F.365 is the best preserved (pl. 4, fig. 5). The non-articular part of the anterior side of specimen IS. 366 is ruined, and the poorly ossified, spongy character of the bone suggests it belonged to a young individual. Specimen IS. 367 consists only of the posterior part of the inferior articular surface and a long posterior tubercle. The following measurements were made on the two better preserved specimens:

Specimen N°	365	366
L	(93)	(90)
l	(43)	(41)
H	-	60
H art.	63	58
Width sup. artic. surf.	19	20.5
Min.length sup. art. surf.	58	(54)

This bone is large, deep, and thin, and therefore appears slim and elongate.

Uncinate

A well preserved right uncinate (IS.F.378) with an abs. L of 88.5, an anat. L of 72, an l of 68, and an H of 52.5, was found.

This bone, like the preceding one, is relatively large in size. The anterior face is fairly wide, as is the posterior apophysis, which is flattened posteriorly.

IV metacarpal

The IV metacarpal, the only anterior metapodial

bone found, is represented by two proximal fragments, one right (IS.F.382) and one left (IS. 383), and one complete left specimen (n. 28926).

Specimen N°	382	383	28926
L	-	-	167
BP	41.8	42.0	45.5
DP	44.3	44.0	44.5
BS	-	-	33.7
DS	-	-	22
BD	-	-	42.2
BD art.	-	-	37
DD	-	-	42

The proximal articular surfaces of the three specimens are very similar. They are concave and shaped like a right triangle, with the major cathetus corresponding to the latero-posterior side. In the complete specimen the diaphysis is rectilineal.

Femur

One right femur (n. 29996), missing the head and the large trocanter, and one distal fragment of a left femur (n. 30318) with part of the diaphysis were the only remains of this bone found. The former was squashed and is extremely deformed and flattened dorso-palmarly; the following measurements were however made: HT > 60; BT > 137; BS 67. The only measurements possible on the second specimen were: BS 73.3; BD 129.5.

Patella

Two patellae were found in the deposits of Isernia. The first, a left patella (IS.F.321), is missing the medial angle and the base. The lateral border and the apex are chipped and rounded. The second, a right patella (IS. 51.71) (pl. 4, fig. 4), is broken in several points but is complete. The following measurements were made:

Specimen N°	321	51.71
L	-	108
L articular face (at the crest)	68	63
DT	-	94
DAP	(43)	43

Despite this bone being rarely described, its morphology is quite characteristic, and always allows at least a generic attribution to be made.

Tibia

A left proximal fragment (IS.F.315) and a right distal fragment (IS.F.302) of this bone were found. The lateral condyle, the posterior portion of the medial condyle, the popliteal notch, and a small amount of the lateral part of the diaphysis are preserved on the proximal fragment.

The distal fragment consists of just the articular part without the lateral malleolus. The made is the DDa, which is 67 mm.

Astragalus

Two fairly well preserved left astragali (IS.F.368 and n. 29814) (pl. 3, fig. 4) have the following measurements:

Specimen N°	368	29814
LL	-	75
ML	85	85
B	85	85
BD	75	74
DD	45	-
BDa	71.5	71
Lmt	77.5	> 59
Dmt	54	50
Llt	76	-
Htt	43.3	-
DL	51	-

Sample n. 29814 is fractured along the groove of the trochlea and its distal palmar edge is chipped.

In proximal view both have a wide, deep groove terminating in a wide sinus that precedes the palmar articular surface for the calcaneum. The edges of the medial and lateral borders are somewhat chipped. In distal view the ligament insertion scars are wide, especially that developed in the sinus of the tarsus.

Calcaneum

A complete right calcaneum (n. 31281) that is broken in several points, one right fragment with well preserved tuberosities (IS. 370), and a right articular fragment including the sustentaculum tali and the tendinous groove (IS. 44) are the three specimens we will consider. They measure as follows:

Specimen N°	370	44	31281
H	-	-	132
DAP somm.	72	-	68.5
DAP beak	-	(73)	-
DT sust.	-	88	-
DT somm.	49.5	-	55
DT min.post.	39.5	43	45

The solid, slightly elongate, and non-blocky shape of the body of the calcaneum, is quite characteristic.

Tarsal bones

No specimens of either the navicular or the first cuneiform have been found.

Cuboid

This bone is well represented, by six right cuboids (IS. 81, IS. 23, IS. 120, IS.F.376, IS. 377, and IS.F.375) (pl. 4, fig. 3), and one left one (IS.F.374). The measurements of the best preserved bones are:

Specimen N°	377	374	375	376
81				
L	69	64.5	67	-
64				
l	47	45.5	40.5	39.5
(40)				
H	64	58	66	57
(57)				
DT art. prox.	41	40.5	42	40,5
(39)				

DAP art. prox. / H ant. face (40)	53	45	53	55
	43	39.5	44.3	44

It is obvious, from the measurements, that some are thinner and higher, while others are wider and more compressed. We attribute the variability of this bone to the position it occupies in the tarsus, where its shape is modified by the manner in which the individual animal places its foot and rests its weight on the ground.

Third Cuneiform

Four specimens of this bone were found, two right (IS. 51.21 and IS. 327) (pl. 4, fig. 6), and two left (IS. 329; IS. 328), with the following measurements:

Specimen N°	51.21	327	329	328
L	45	-	49.5	51.5
l	41	46	44.5	-
H	22	22	26	24
H min. phys.	19	19.4	21.8	21

Even though their dimensions vary, these tarsal bones have quite similar shapes. The central part of the proximal articular surface is distinctly concave; the distal articular surface is slightly convex towards the anterior border and is differentially upraised, forming a saddle shape, towards the palmar border.

Second cuneiform

A single right specimen of this bone (IS. 330) is present amidst the material under investigation. Its L is 32.5, its l is 29, and its H is 16.

II metatarsal

This bone is represented by a right proximal fragment (IS. 381) and a complete right specimen (IS. 379) (pl. 3, fig. 2). The following measurements were made:

Specimen N°	381	379
L	-	161
BP	30	24
DP	41.5	40
BS	-	21
BS at mid diaph.	-	24
DS	-	25
BD	-	36
BD art.	-	33
DD	-	37.5

Even though the dimensions of the two bones differ, the proximal articular surface is reniform and similar in shape in both specimens. The lateral proximal articular surfaces are broad and separated by a sinus. Since the more jutting edges of the complete specimen are partially abraded.

III metatarsal

One complete specimen of this bone (IS. 378) (pl. 3, fig. 3) I.378), broken at mid-diaphysis, was found. The distal, dorsal part of the diaphysis where it meets the epyphysis is in very poor condition. We suspect that the bone was struck many times, perhaps during butchering, or that it was used as a hammer. It has the following measurements: L 182; BP 53.5; DP 43.5; BS min. 41.5; BS at the middle 46; DS 22; BD 56; BDa 46; DD 41.

The proximal articular surface is saddle shaped, and more raised towards the lateral border. The diaphysis is wide, flat, concave on the palmar side and slightly convex on the dorsal side; its medial and lateral borders diverge slightly in the distal direction. The intercondylar ridge of the distal articular surface is clearly defined only on the palmar side. Overall, the bone appears strong but graceful.

IV metatarsal

There is one complete specimen of this bone (IS. 380) (pl. 3, fig. 5), the edges of which are particularly well preserved, with uncommonly dark staining by absorbed iron and manganese oxides. Its measurements are: L 161, BP 43, BP artic. 35.7, DP 41, DP artic. 40, BS 26.5, BS at mid diaph. 29, DS 26, BD 35.5, BD artic. 35.5, DD 41.3.

The dorsal edge of the diaphysis of this metapodial is convex, while the palmar edge is concave. The diaphysis has a sub-circular section. There is a marked bony excrescence on the diaphysis, along the medial side, where the bone was in contact with the diaphysis of the adjacent III metatarsal. The presence of this callus suggests that the bone belonged to either an adult or old animal.

Phalanges

The number of phalanges found is relatively high. They are discussed collectively, as distinguishing those belonging to the forefoot from those belonging to the hind foot was not always possible.

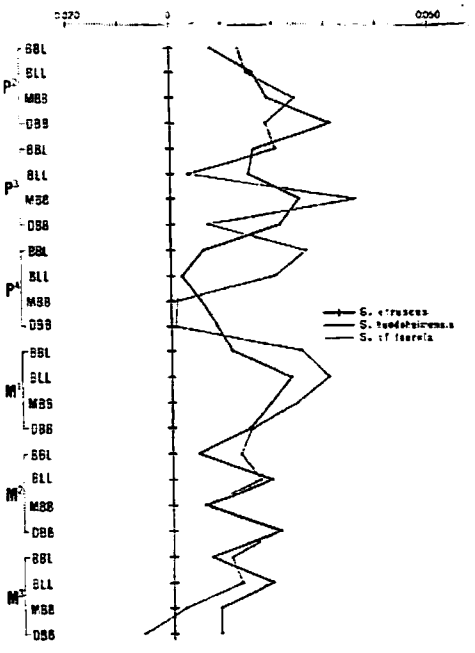
First phalanx

One first phalanx of the second toe of the manus (IS.R.369), and three from the second toe of the hind foot (IS.F.334, IS. 335, and IS. 23.53) (pl. 4, fig. 10) (Tab. 3) can be distinguished because the former is relatively wider and decidedly shorter than the other three.

Five I phalanges of the third toe of the manus (IS. 348, IS. 90.28, IS. 349, IS.F.346, and IS. 347) (pl. 4, fig. 7) and four from the hind foot (IS. 339, IS. 340, IS. 341, and IS. 133.42) (pl. 4, fig.8) (Tab. 4) were found. They can be distinguished because, as is the case for the first lateral phalanges, those of the forefoot are wider and shorter than those of the hind foot. They also display a marked bilateral symmetry, which makes deciding if the phalanges are from the right or left limbs difficult, though not impossible.

Three I phalanges of the fourth toe were found, two attributable to adults (IS.F.371 and IS.F.373) (pl. 4, fig.11) (Tab. 3), and one to a juvenile individual (IS. 372). Having only these specimens, we prefer not to attribute them to the fore or hind foot, even though, given their relatively large dimensions, we suspect they are from the forefoot.

Table 3



Second phalanx

Ten II phalanges from the second and fourth toes of the fore and hind feet, not all of which are well preserved, were found. They are: IS. 361, IS. 364, IS. 356, IS. 363, IS. 92.111, IS. 359, IS. 357, IS. 362, IS. 360, and IS. 358 (pl. 4, figs. 12 and 15) (Tab. 5). Those from the second toe are in fact narrower than the others, while making a distinction between those from the fore and hind feet is quite difficult. Because of the distinctive asymmetry of these phalanges, we feel fewer measurements are necessary, and remind the reader that in this case BDa is a minimum value measured dorsally, while BS is a maximum value.

Three II phalanges of the third toe of the forefoot (IS. 113.108, IS. 338, and IS. 337) (pl. 4, fig 13) can be readily distinguished from four II phalanges of the third toe of the hind foot (IS. 352, IS.F.353, IS. 351, and IS. 350) (pl. 4, fig. 14) (Tab. 6), as the former are more flattened and widened, and shorter than the latter.

Third phalanx

Two III phalanges of the second and fourth toes, IS.R.355, IS. 354) (pl. 4, figs. 16 and 18), one of which is complete, display differences in the position of the articular face; one is sub-horizontal, while the other is oriented more transversally. We do not know if these are individual variations, but we suppose that the first (IS.R.355) is from the second toe, and the latter (IS.354) from the fourth toe.

Table 4

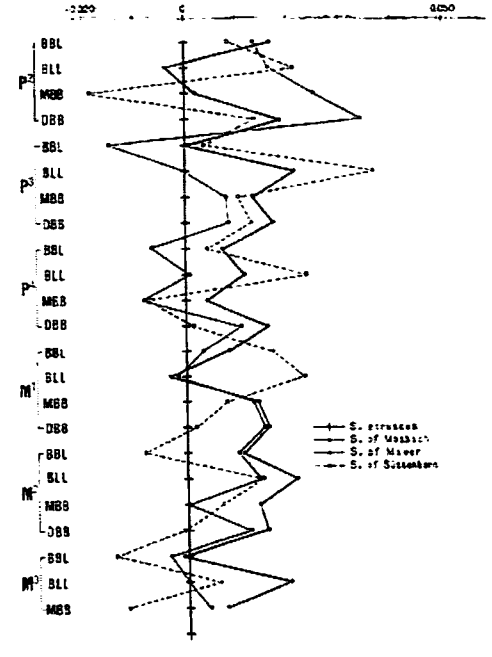
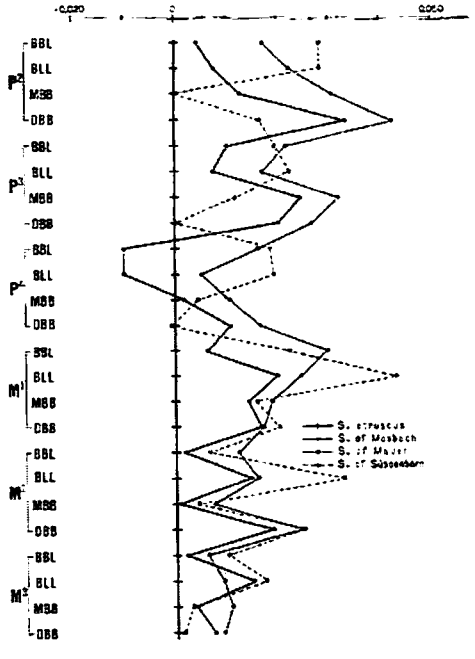


Table 5



It is possible, in the case of four badly fragmented III phalanges of the third toe (IS. 343, IS. 344, IS. 342, and IS.F.345) (pl. 4, fig.17), to distinguish between those from the fore and hind feet. The articular surface of the III phalange of the third toe of the forefoot is extremely flattened and widened with respect to its counterpart in the hind foot. The difference is quite evident.

DISCUSSION

All the material supports the conclusion that the Isernia rhinoceros is referrable to *Stephanorhinus hundsheimensis*. The skull is long and narrow, with narrow zygoma, large nasals and narial incision, a posteriorly placed parieto-frontal syncline, a trapezoidal occiput, etc., characteristics uniting it with this species rather than *S. etruscus*. One should especially note that while all the other dimensions exceed those for *S. etruscus*, the distance between the orbit and the narial incision is smaller, as occurs in *S. hundsheimensis* from Mauer and Mosbach. Also, as occurs in *S. hundsheimensis*, the mandible is stout and does not taper rostrally.

The analysis of the dental measurements indicates that the rhinosceros from Isernia more closely resembled S. hundsheimensis than *S. etruscus* (figs. 2 and 3) (see Fortelius et al. in this volume). In particular, one should note the similarity between the Isernia curve and many details of the *S. hundsheimensis* curve, which indicates that both the proportions of the individual teeth and, in general, the size and proportion of the dentition are similar. Examples of these similarities can be seen in the mesially narrow P4, the lingually short M1 (fig. 2), the lingually long M/1 and the characteristic zig-zag relationship between the lengths and widths of the M/2 (fig. 3). These characteristics are repeated in the curves for Mosbach, Mauer and Süssenborn, suggesting the differences they indicate are real (figs. 4 and 5).

The one-way analysis of variance shows the difference between the Isernia teeth and those of *S.etruscus* to be statistically significant ($P < 0.005$) with regards to the distal width of P3, the lingual length of P4, the mesial and distal widths of M2, and the mesial width of P/3 and M/1. The possibly exaggerated size estimate for P4 and M2 could at most account for 3 out of 6 of the differences, while the other differences may be regarded as genuine. In contrast, three of the four statistically significant differences between the material from Isernia and *S. hundsheimensis* revealed by an identical analysis may partly be due to exaggerated size estimate of P4 and M2 in the Isernia sample (fig. 2: the lingual length of P4, the mesial and distal widths of M2; the fourth significant difference is the greater lingual length of P2 from Isernia). It is possible that the population from Isernia differs from the comparable etruscoid material in having lingually longer upper premolars (cf. fig. 2), but the small sample size does not allow this possibility to be assessed with confidence.

Ratio diagrams of samples (based on associated dentitions only) of *S. hundsheimensis* from Mosbach, Mauer, and Süssenborn are shown for comparison in figs. 4 and 5. The more numerous samples from Mauer and Mosbach are more similar to each other than to the less numerous sample from Süssenborn, which is probably distorted by stochastic small-sample effects. This sort of noise could also account for the deviations observed in the Isernia sample. Nevertheless, the overall similarity between Isernia and *S. hundsheimensis* curves is striking, and strongly supports the identification of the Isernia form as *S. hundsheimensis*.

In addition, the postcranial remains from Isernia la Pineta have been found comparable to the rhinosceros remains attributed to *Stephanorhinus hundsheimensis* found in the Mauer and Mosbach deposits and preserved in the Naturhistorische Museum of Mainz and the Hessischer Landesmuseum of Darmstadt in Germany, and to the remains found in the Forest Bed Formation of Trimingham and Mundsley, preserved in the Natural History Museum of London.

The dimensions and detailed descriptions of remains of *S. hundsheimensis*, including those found at Isernia, and their comparison with those of other Quaternary European species of *Stephanorhinus*, are given in the paper by Fortelius *et al.*, in this volume, to which we refer the reader. Here we have limited ourselves to describing the postcranial remains, so as to avoid repeating a long comparative analysis of every detail of every individual bone. Only the characteristics of some of the remains most useful for determining the species have been discussed.

The long bones, being either incomplete or deformed, are only of little use. On the other hand, the carpals, tarsals, and metapodials are more distinctive. Below, the Isernia rhinoceros and *S. etruscus* of the Valdarno (Tuscany), the species most similar to *S. hunsheimensis*, are compared.

The semilunar, the pyramidal and the magnum of the Isernia form are more compressed lateromedially and more stretched dorso-palmarly (semilunar) and proximo-ventrally (pyramidal and magnum). These bones appear more slender than those of *S. etruscus*.

In the fourth metacarpal, the proximal articular surface, in proximal view, has a relatively shorter dorsal border and a longer medial border.

The astragalus is proportionally broader mediolaterally and more compressed proximo-ventrally. This characteristic is perhaps allometric, because the astragali of the Isernia form are larger than those of *S. etruscus*.

The calcaneum is shorter and stronger.

The cuboid is more elongated dorso-plantarly, with the dorsal face broader and lower, and the proximal articular surface more stretched lateromedially.

The distal articular surface of the second metatarsal is more asymmetrical.

In the third metatarsal the proximal articular surface appears to be more convex dorso-plantarly, the diaphysis enlarges distalwards and is less flat, and the distal articular surface is broader.

In the fourth metatarsal the proximal articular surface is sub-circular, not sub-triangular (as it is in

S. etruscus), the cross section of diaphysis is subcircular (not elliptical), and the distal epiphysis is broader.

These characteristics, which distinguish the Isernia rhinoceros from *S. etruscus*, are peculiar to *S. hundsheimensis*. Only some characteristics are found in common with S. kirchbergensis, but this species differs considerably in dimensions and in other characteristics.

CONCLUSIONS

The abundant rhinoceros remains from Isernia can be attributed to *S. hundsheimensis* with confidence. The material is sufficiently rich to allow the description of the skull, dentition, and much of the skeleton of the species, and will serve as a standard for comparison. Other sites with abundant *S. hundsheimensis* remains exist, for example Mauer and Mosbach, but they are less precisely dated and/or represent longer time spans than Isernia (Delitala *et al.*, 1983; Koenigswald & Tobien, 1987).

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We are very grateful to all the directors and the staffs of the many museums and collections we have visited and enumerated in Fortelius *et al.* (in this volume) and, for want of space, cannot repeat.

Finally, we thank Prof. A. Azzaroli and Prof. D. Torre very much for their criticism of the text.

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PLATE 2

Stephanorhinus hundsheimensis (Toula) from Isernia la Pineta: 1 = associated left P2-P4 (IS. 83), occlusal view; 2 = right P2 (IS. 93), 3 = right P4 (IS. 102), 4 = left M3 (IS. 125), a = occlusal view, b = buccal view, c = lingual view; 5 = right mandible (n. 33083), a = lateral view, b = occlusal view (the teeth are x 1, the mandible x 0.).

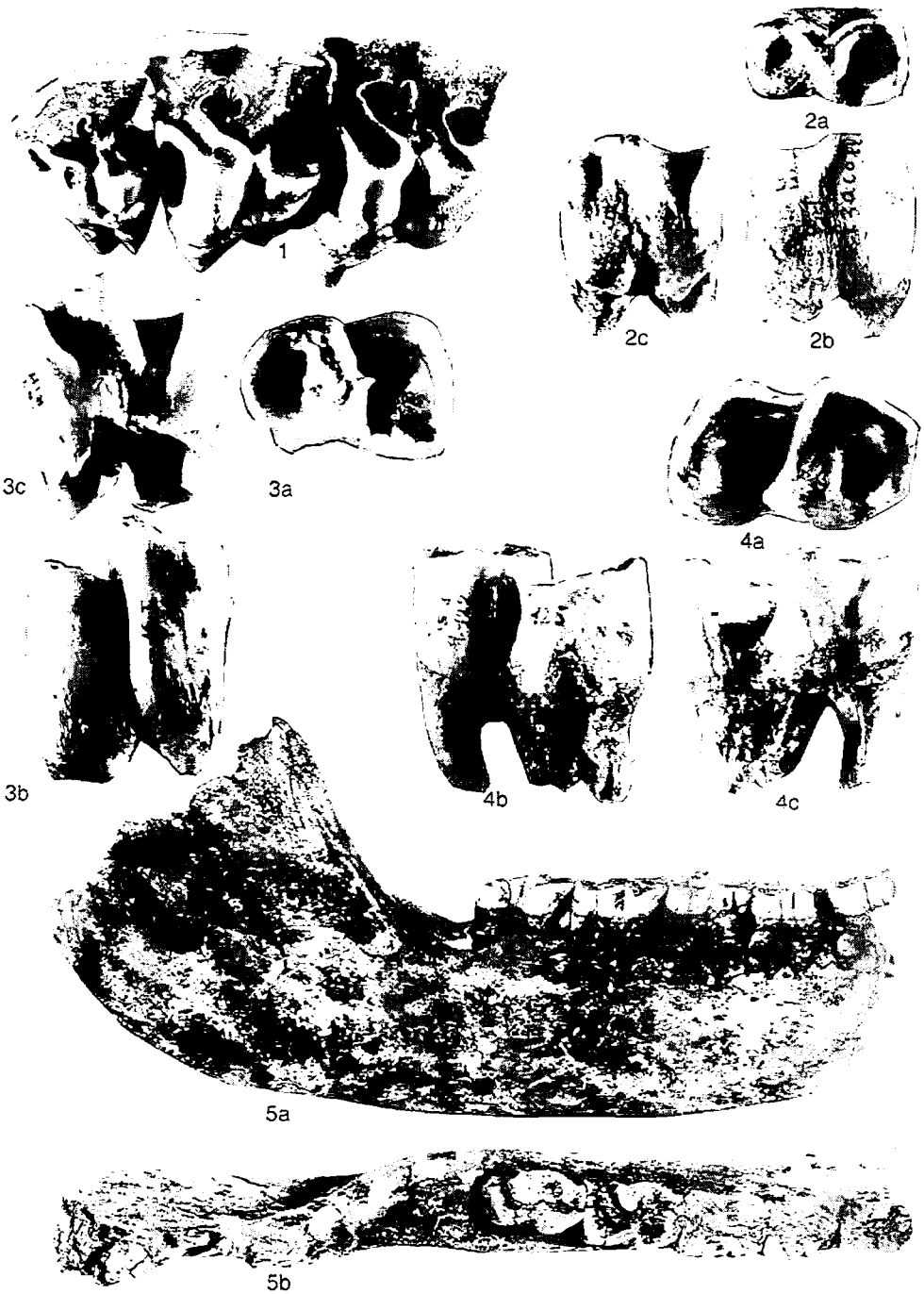

PLATE 2

PLATE 4

Stephanorhinus hundsheimensis (Toula) from Isernia la Pineta: 1 = left pyramidal (IS. 326), assial view; 2 = right pisiform (IS. 336), assial view; 3 = left cuboid (IS. 375), assial view; 4 = right patella (IS. 51.71), articular view; 5 = right magnum (IS. 365), a = proximal view, b = abassial view; 6 = left third cuneiform (IS. 51.21), a = proximal view, b = dorsal view; 7 = first phalange of the third toe of the forefoot (IS.F.346); 8 = first phalange of the third toe of the hind foot (IS. 339); 9 = first phalange of the second toe of the forefoot (IS.R.369); 10 = first phalange of the second toe of the hind foot (IS. 334); 11 = first phalange of the fourth toe (IS.F.373); 12 = second phalange from the second or fourth toe (IS. 359); 13 = second phalange of the third toe of the forefoot (IS. 113.108); 14 = second phalange of the third toe of the hind foot (IS. 358); 15 = second phalange of the second or fourth toe (IS. 357); 16 = third phalange probably of the second toe (IS.R.355); 17 = third phalange of the third toe (IS.F.345); 18 = third phalange probably of the fourth toe (IS.354) (x 0.66).

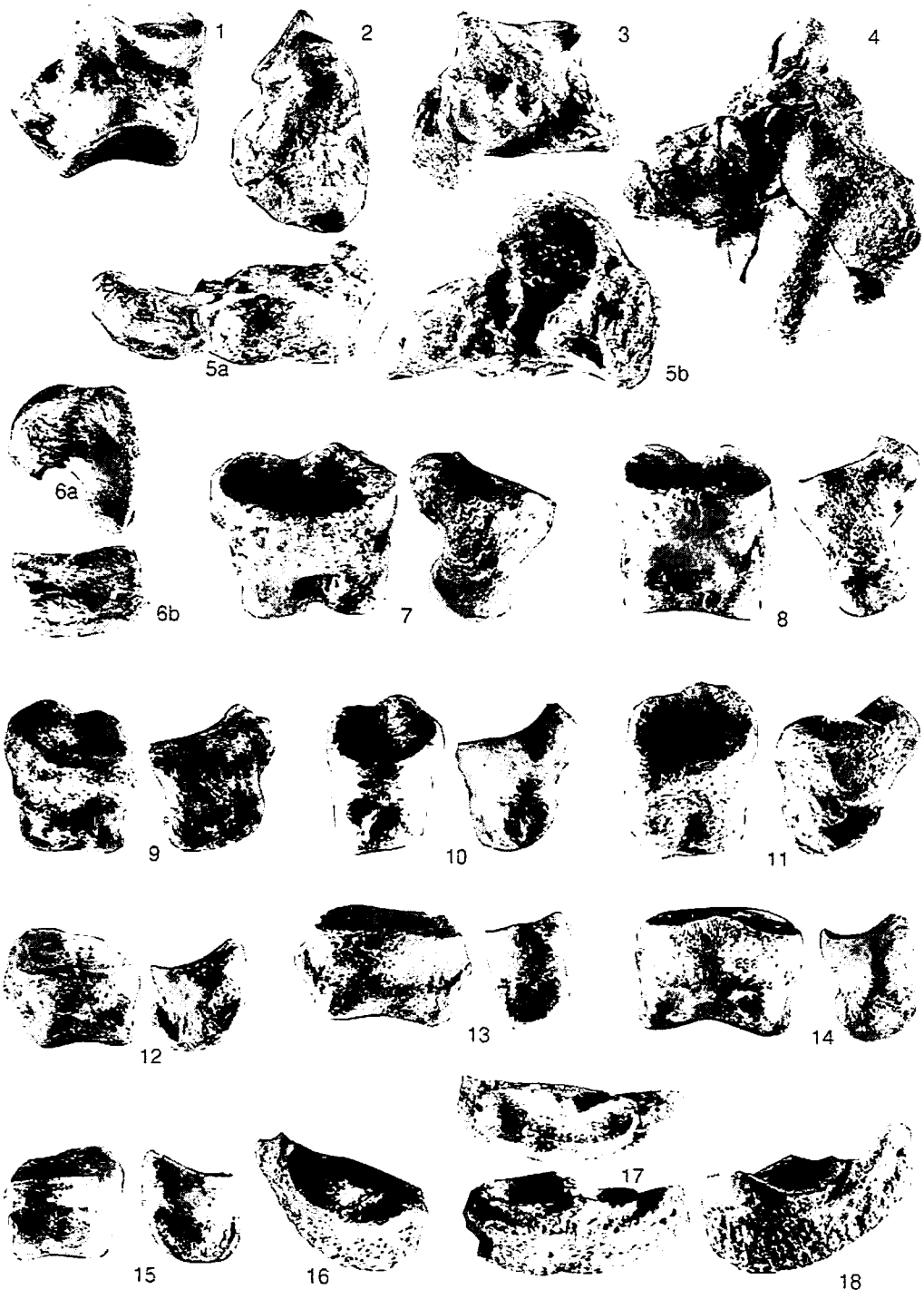

PLATE 4

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