MUSEO DI PALEONTOLOGIA DELL'ACCADEMIA DEI FISIOCRITICI

PIETRO CUSCANI POLITI

THE *RHINOCEROS ETRUSCUS* FROM CASTELNUOVO BERARDENGA NEAR SIENA (TUSCANY) POSITIVELY BELONGS TO THE PLIOCENE

TIP SENESE - SIENA 1972

Reprinted synthesis of two preceding works published in the « Atti dell'Accademia dei Fisiocritici » Sez. Agr. - Ser. II - Vol. X - Siena, 1963: « *Resti di Rhinoceros (Dicerorhinus) etruscus rinvenuti nel Pliocene del senese* » e « *Prove paleontologiche della plioceniciti della formazione argillosa in cui sono stati rinvenuti resti di Rhinoceros etruscus nel Senese* ».

We are reprinting in synthesis the content of two preceding works with the view of acquainting a larger number of readers with their subject-matter, and are presenting the new text in English for the benefit of foreign readers.

The finding of remains of Rhinoceros etruscus *in a clayey formation which positively belongs to the Pliocene is a paleontological event that well deserves the attention of all the scientists engaged in the study of fossil mammals. It offers us the opportunity to demonstrate once again the inconsistency of certain opinions and prejudices concerning the identification of fossil remains of* Rhinoceros etruscus *and the assignment of the ground in which they lay to the Pliocene.*

The true description and clear illustration of the fossils (1) lead to the unquestionable conclusion that those remains of

---

(1) All our preceding works have been carried out with the same scientific caution. We beg to call our reader's attention to the papers published from 1960 to 1970: 1) *Ancora una nuova specie di «Balaenula pliocenica» - Con considerazioni introduttive su alcuni Misticeti dei nostri Musei* (pp. 31, figg. 2, tavv. 4) - 2) *Resti di « Ovis palustris » rinvenuti in una grotta nel calcare cavernoso di Monte Maggio (Senese)* (pp. 28, figg. 5, tavv. 3) - 3) *Resti di Mammiferi rinvenuti nel territorio senese e sue adiacenze* (pp. 32, figg. 4, tavv. 2) - 4) *Resto di « Megaceros » rinvenuto nel Senese* (pp. 20, figg. 2, tav. 1 a colori) - 5) *Anche il « Rhinoceros megarhinus » nel Pliocene dei dintorni di Siena* (pp. 27, fig. 1, tavv. 3) - 6) *L'Ippopotamo (Hippopotamus amphibius var. major) di Poggio ai Venti (Massa Marittima)* (pp. 71, figg. 13, tavv. 6) - 7) *Resti di Ippopotami provenienti dalla zona di Chiusi* (pp. 32, figg. 4, tavv. 3) - 8) *Ancora sulla valutazione sistematica del Grande Ippopotamo (Hippopotamus amphibius var. major)* (pp. 40) - 9) *Pollini di tipo arcaico rinvenuti nel bacino lacustre di Poggio ai Venti (Massa Marittima), già depositario di resti di Hippopotamus major - Qualche considerazione sul Villafranchiano* (pp. 31, figg. 2, tavv. 2) - 10) *Densa malacofauna pliocenica particolarmente oligotipica in strati litorali salmastri della zona nordica di Siena* (pp. 14, fig. 1, tavv. 2). These works, respectively documented with rich bibliographies, together with those on *Rhinoceros etruscus* formerly mentioned, are now in the « Atti dell'Accademia dei Fisiocritici » of Siena.

Rhinoceros etruscus, *and the paleontological data deduced from the presence of Molluscs and Foraminifera, firmly establish that the clayey sedimentations we are describing are Pliocene. There is no room even for the slightest doubt about this geochronological evaluation because the remains were found at about thirty metres depth from the surface of the local hilly ground, firmly set in a clayey mass (undoubtedly Pliocene) in a striking original posture.* (1).

(1) Other significant skeletal remains of the same *Rhinoceros etruscus* from Castelnuovo Berardenga are described and illustrated in a forthcoming work.

FOREWORD

The remains of fossil rhinoceroses which form the subject-matter of this study came to light during the excavations in the clayey ground of « I Sodi » near the railway station of Castelnuovo Berardenga (Siena). A man digging up clay on the south, south-west side of the hill at about 70 metres north, north-east from the railroad to extract material for the local brick-kiln found some fossilized bones.

The news was given us by Prof. Pietro Omodeo, the Director of the Institute of Biology of the University of Siena, and together with him we at once went to visit the cave. Dott. Pietro Passerini, Assistant at the Institute of Geology of Florence, was there waiting. Though it was a rainy day we succeeded in isolating plastering and casing the blocks of clay in order to carry them away without impairing the organic relics they contained.

These fossil remains were found at 30 metres depth from the top surface of the hill, at about 230 metres above sea level. There, the soil has the typical bluish colour, darker in the lower strata, that characterizes the vast clayey extent lying east, south-east of Siena. Geologists of the past, for instance Campana, Cappellini, De Stefani Carlo, Pantanelli, Lotti and others, and even more recent scientists such as Fossa-Mancini, Sestini etc., describe it as marine Pliocene. The Authors of *Folio 121* of the new Geological Map of Italy (Jacobacci, Malatesta, Martelli) also assign that region to the Pliocene ([**39**], from page 51 onwards).

We wish to point out again that in consequence of the continuous excavations the structure of the ground now under study is deeply changed, as can easily be seen by comparing the topographical map of some years ago with the actual. During

these last six months, that is, about four years after the finding of our remains, the south side of that hilly region has gradually been flattened right down to the railway station for an extent of about 150 metres from the rail road and of about 300 metres in the parallel direction. On the spot where the fossils were found now lies a pond (1) which is mentioned in *folio 121* of the new topographical map of Italy. This practically means that during these last five years several million cubic metres of clay have been removed for the local brick-kiln (Fig. 1 and fig. 2).

The fossil remains found this time awake the greatest interest and attention because the parts that first came to light and the position in which they lay did not at first suggest any reliable identification, nor reference to any particular marine or land species. In the Sienese Pliocene formations many different kinds of Cetaceans have been found (*Balaena, Balaenula, Balaenotus,* etc.) as well as Ungulates (*Bos, Cervus, Rhinoceros* etc.) and Proboscideans (*Mastodon, Elephas,* etc.), and other mammals. This is why we were so anxious to set to work to free the new shattered remains from the clay in which they lay buried and study them to establish which of the above mentioned species, or any other species of the mammalian fauna, they belonged to.

Once the remains were properly put together — even the smallest fragments — their essential osteomorphological characteristics became manifest, and were so evident that we could ascertain that they were not the bones of a marine species and also establish the right orientation for their identification.

During these last years we visited many times in succession the Paleontological Museums of Turin, Bologna and Florence to study similar material for comparison and have also consulted general and specific papers belonging to the libraries of the Institutes of Geology annexed to those Museums. Finally, we reached the conclusion that our fossil remains positively belong to *Rhinoceros* (*Dicerorhinus*) *etruscus* Falc.

The unusual finding of remains of such mammal species in a ground generally described as belonging to the Pliocene advised the study of the many marine fossil molluscs found in the same formation, and also the micro-paleontological analysis of sam-

(1) Lack of water from the underground (springs) and on the surface (streams and rivers) made the collection of rain water in artificial basins necessary for the brick-kiln.

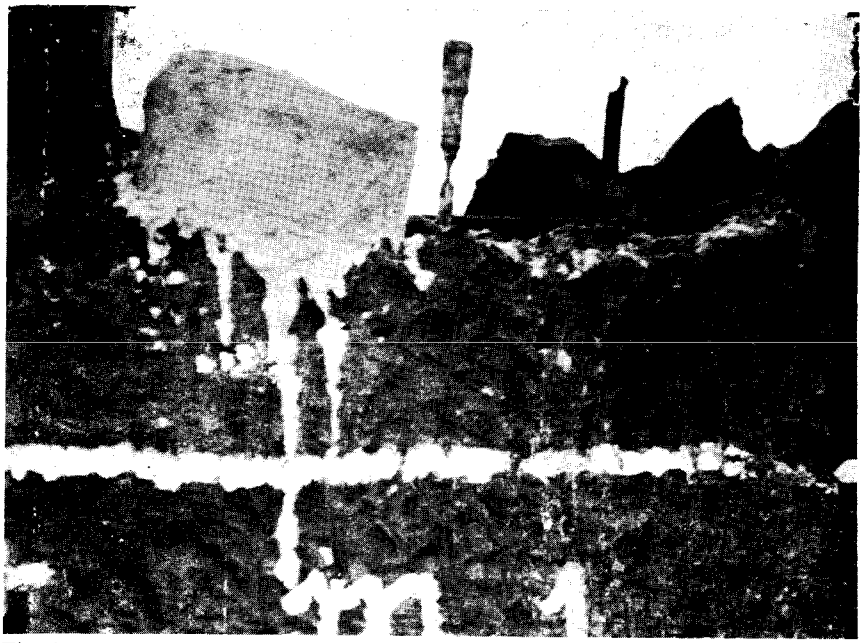


Fig. 1 - The compact clayey formation in which the remains of *Rhinoceros etruscus* were found (December 1958). On the left is the wooden frame containing the second block of clay with the organic relics, carefully plastered and packed.

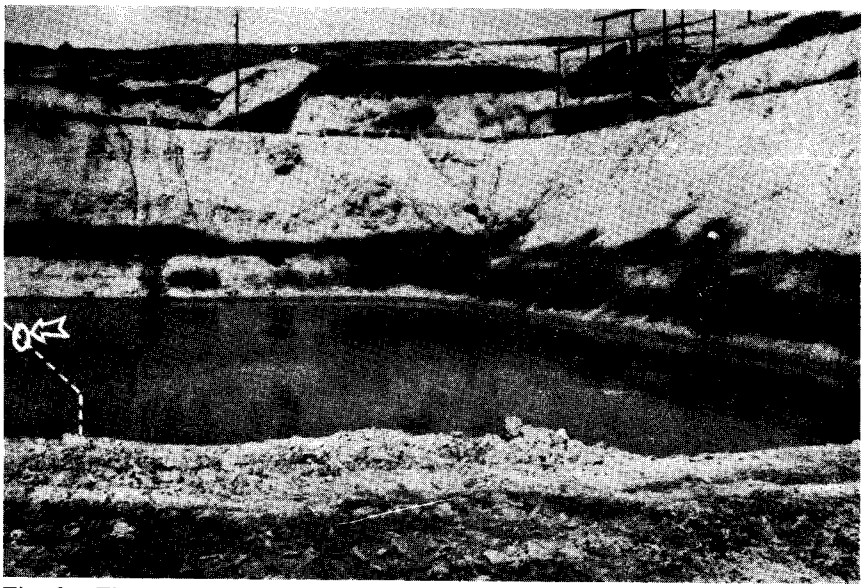


Fig. 2 - The pond created by the excavations (September 1963). The white circlet on the left approximately marks the original location of the stratum of clay seen in fig. 1.

ples of the same clayey formation in order to confirm the stratigraphic evalutation (1) here above stated. The results confirmed that clayey ground as belonging to the Pliocene.

We wish to close this brief preface with a word of thanks and gratitude to Prof. Malaroda, Prof. Selli and Prof. Merla (Directors of the Institutes of Geology we visited) for their kindness and for having so generously placed at our disposal books and fossil material for comparison. Thanks also to Prof. Vialli and Prof. Azzaroli, respectively the holders of the Chairs of Paleontology of the Universities of Bologna and of Florence. Our warmest thanks also to Prof. Omodeo, mentioned above, for having enabled us to gather the fossil remains we are now describing.

DESCRIPTION OF THE BONES

Before describing the osteological and osteometrical characteristics of the main fossil remains, we wish to point out that they all show great consistency as the result of the depth at which they lay. Their colour is iron-grey with touches of yellow even in the deeper layers of the tissues (2).

It is a miracle that the material we have gathered escaped destruction by the machinery used to dig up clay. We have almost all the bones of the front left foot and many fragments of long bones but some are almost shapeless, deteriorated to such an extent that they are difficult to define.

---

(1) Contemporary paleontologists generally assign *Rhinoceros etruscus* to the upper Villafranchian, which corresponds to the lower Pleistocene. Earlier Authors such as Cortesi, Issel, De Stefani, Ugolini, etc. assigned the remains of this rhinoceros to the Italian Pliocene. Even the rhinoceroses found in the lower Valdarno, now assigned by Azzaroli to the *megarhinus* species, were at first described as belonging to the *etruscus*.

(2) The fossil remains here described differ in colour and consistency from those of *Rhinoceros etruscus* of the Paleontological Museum of Florence. The latter, in fact, still show the porosity of bones in general and are yellowish. These differences are no doubt due to the characteristics of the ground in which fossilization developed.

FRAGMENTS OF LONG BONES

The *humerus* (Plate I, figs. 1 and 2).

We are presenting two fragments of the right humerus. One still shows part of the articular surface joining the head, and the part of the neck that separates the head from the body at the base of the posterior face. The other fragment, which is the larger, presents also much of the articular surface of the trochlea, attached to a small part of diaphysis.

The maximum diameter of this distal extremity in correspondence of the inner condyle is mm 74,5, that is, just half a millimetre larger than that of the humerus of *Rhinoceros etruscus* from Leffe ([**63**], page 27).

The *radius*.

Only a few spoiled fragments have come to light. The inner articular cavity of the proximal epiphysis of the left radius is recognizable in one of them.

THE CARPAL REGION (Plate I, fig. 3)

The *scafoid* (*naviculare*). (Plate II, figs. 1 - 2 and for comparison figs. 5 - 6).

This carpal bone is incomplete; the lower (distal) part in correspondence to the articular facets with the trapezoid and with the os magnum is missing. The upper face instead is almost complete and the large articular concavity for the radius is still clearly visible; it continues down almost all the length of the external face, which is markedly rugose, and also down the internal face characterized by a deep groove and by the articular surface for the semilunar.

The dimensions are approximately the same as those of the scafoid of *Rhinoceros etruscus* from Leffe and Poggio al Pero (1).

(1) The remains of *Rhinoceros etruscus* from Poggio al Pero (upper Valdarno) are now in the Paleontological Museum of the University of Florence.

In all the comparative tables, *CB*, *Le*, *PP* stand respectively for the fossils of Castelnuovo Berardenga, Leffe and Poggio al Pero:

	CB	*Le*	*PP*
Maximum length . . . . mm	76,0	75,0	78,0
Width of the articular surface with the radius . »	42,4	43,0	43,0
Length of the same articular surface . . . . . »	44,0	44,0	44,5

The *semilunar* (*lunatum*). (Plate II, fig. 3 and for comparison fig. 7).

The lower posterior side of this carpal bone is missing; only a few little bits of the articular surfaces for the os magnum and the unciform are in a fairly good state. The inner extremity (in contact with the scafoid) of the articular surface with the radius is also missing.

In spite of these mutilations the general conformation of this bone and its dimensions (measurable or simply traceable) show its similarity to the semilunar of the rhinoceroses from Leffe and Poggio al Pero. The minimum width, measured in front, is almost the same for the three fragments, that is, *CB* - mm 27,5; *Le* - mm 27; *PP* - mm 28.

The *trapezoid* (*trapezoides*). (Plate II, fig. 4 and for comparison fig. 8).

This carpal bone is the most complete of all the samples we have found. The distal and proximal faces (typically concave and articulated respectively with the second metacarpus and with the scafoid), the middle and internal faces, the dorsal and the palmar, present characteristics and dimensions which correspond to those of the trapezoid of *Rhinoceros etruscus* from Leffe (1). No other data can be compared because the trapezoid of *Rhinoceros etruscus* from Poggio al Pero is missing.

(1) As a comparison for the determination of the fossil remains we are describing, we have kept to the illustrations and measurements presented in Vialli's work [**63**]. We have therefore indirectly availed ourselves of the comparative measurements presented by the same Author for other fossil rhinoceroses, as for instance those of Saint-Valliere, Tegelen, Senèze, etc.

Here are some of the most important dimensions:

	CB	*Le*	*PP*
Antero-posterior diameter mm	35,5	38,0	—
Transverse diameter . . »	26,0	25,5	—
Anterior height . . . . »	34,0	34,0	—

The *os magnum* (Plate II, figs 9 - 10 and for comparison 13 - 14).

Even this carpal bone is incomplete; the terminal and the lower parts of the apophysis of the lower posterior face (at the level of the articular face with the second metacarpus) are missing and the inferior margin of the anterior face is spoiled.

The osteological characteristics of the articular faces with the II metacarpus (the inferior), with the semilunar (the superior), with the unciform (the external-lateral), with the trapezoid (the internal-lateral) and also the osteometrical data show great similarity to the corresponding characteristics of the os magnum (capitato) of the rhinoceroses of Leffe and of Poggio al Pero.

Here are the most important dimensions:

(1)	*CB*	*Le*	*PP*
Maximum length of the anterior face . . . mm	45,0	45,0	46,5
Maximum height of the same face . . . . . »	27,5	28,0	28,0
Maximum height measured from inside . . . . . »	(52-)	53,0	53,0

(1) The number in brackets is approximate because, as said above, the spoiled margin of the inferior face does not consent the exact evaluation of the os magnum.

The *unciform* (*uncinatum*). (Plate II, fig. 11 and for comparison fig. 15).

The extremity of the apophysis of the posterior face, the articular surface with the IV metacarpus and consequently the inferior margin of the anterior face of this bone are missing; the height therefore cannot be measured. The conformation and the dimensions of the integral part are in agreement with those of the homologues from Leffe and Poggio al Pero.

Here are some of the most important measurements:

	CB	*Le*	*PP*
Transverse diameter of the anterior face . . . . mm	54,5	55,0	53,5
Lenght of the articular face with the pyramidal, taken transversally . . »	37,0	38,0	38,5
Width of the articular facet with the semilunar . . »	26,5	24,0	26,5

To complete the comparison we wish to point out that, in the same succession, the measurements of the unciform of *Rhinoceros etruscus* from Saint-Vallier 1268 are the following: mm57, mm 36, mm 29 ([**64**], page 156).

This demonstrates that even older fossils which have already been determined and positively assigned to *Rhinoceros etruscus* show certain slight osteometrical differences like those in the table here above. As said elsewhere, such differences are but the normal variations almost always found in the frame of individuals of different strength and height.

A first conclusion can now be drawn. The osteological and osteometrical characteristics of the carpal bones we have briefly described are undoubtedly those of bones of *Rhinoceros etruscus*. This statement is true not only because such bones are similar to the corresponding skeletal parts of *Rhinoceros etruscus* but above all because they differ in shape and size from the homologues of *Rhinoceros megarhinus* and of *Rhinoceros mercki*.

THE METACARPAL REGION (Plate I, fig. 3)

III *Metacarpus* (Plate III, fig. 1 and for comparison fig. 4).

This metacarpal bone, Mc III, often called middle metacarpus, is almost complete: only a piece of the posterior (internal) extremity of the epiphysis and a few marginal fragments of the diaphysis are missing; the posterior side of the distal extremity of the epiphysis is slightly spoiled. The general conformation and size, however, make it easily recognizable; in fact, in agreement with Viret's indications ([**64**], page 156) confirmed by Vialli ([**63**], page 34) it is rather long, narrow, markedly flat on the antero-posterior side and the osteometrical characteristics are similar to those of the homologues of *Rhinoceros etruscus*.

In this bone in particular, it is easy to see that the articular face with the os magnum is small and leaves room for the articular facet with the unciform in the proximal epiphysis which is consequently but slightly bent outwards. We are producing a comparative table with the dimensions of the above mentioned facets taken on the anterior edge of the articular extremity of the bone, from left to right (first the facet with the unciform and then the facet with the os magnum), respectively *U* and *M*.

		U	*M*
Rhinoceros etruscus from Castelnuovo Berardenga	mm	20,5	35,5
Rhinoceros etruscus from Leffe . . .	»	20,0	33,0
Rhinoceros etruscus from Poggio al Pero	»	20,5	35,0
Rhinoceros megarhinus from Montopoli	»	22,1	46,0
Rhinoceros mercki from Taubach . .	»	23,0	45,0

In our bone the relation *U/M* is approximately mm 0,58, which corresponds more or less to the same relation in the metacarpal bones from Leffe (0,60) and from Poggio al Pero

(0,58) and is far superior to the same relation found in homologues of *Rhinoceros megarhinus* and of *Rhinoceros mercki* (1).

It seems superfluous here to indulge in the description of other particular osteological details since they have already been described by many Authors and are plainly visible in the fossil remains in the Paleontological Museums of the Universities of Bologna and Florence. We are giving a table of comparative measurements (in millimetres) relative to some fossils. The fossil remains of *Rhinoceros etruscus* from Castelnuovo Berardenga. Leffe, Poggio al Pero and Saint-Vallier 186 are respectively marked 1 - 2 - 3 - 4; the remains of *Rhinoceros megarhinus* from Montopoli and Montepellier respectively 5-6 and the remains of *Rhinoceros mercki* from Taubach and Phöben 7-8 ([**63**], page 34 - [**63**], page 157).

The II *metacarpus* (Plate III, figs 2 - 3 and for comparison figs. 5 - 6).

Though some of the parts of this metacarpal bone are slightly spoiled its general configuration and consequently the osteological characteristics are unimpaired.

		Rhinoceros etruscus				*Rh. megarh.*		*Rh. mercki*	
		1	2	3	4	5	6	7	8
Total length	mm	220	189	219	220	233	223	206	219
Transverse diameter in the middle of the diaphysis	»	49,5	45,5	50,0	52,0	61,5	65,2	57,0	64,0
Antero-posterior diameter in the middle of the diaphysis . . .	»	21,5	18,0	20,2	18,5	23,5	—	23,5	23,0
Transverse diameter of the distal epiphysis	»	45,0	46,0	45,0	47,0	55,0	57,0	57,0	62,0

(1)The *U/M* index for *Rhinoceros etruscus* has almost the same value, otherwise it is higher than 0,60; for *Rhinoceros megarhinus* and *Rhinoceros mercki* the said index is almost the same, or lower than 0,50 ([**63**], page 35).

It is slender, light, the epiphysis moderately developed but can easily be distinguished from the homologues of *Rhinoceros megarhinus* and of *Rhinoceros mercki* because the latter are shorter, more robust and have stronger extremities ([**63**], page 34).

In the proximal epiphysis the articular facet with the trapezoid is rather small; in the distal epiphysis the trochlea is asymmetrical and markedly bent outwards. This osteological characteristic is noticeable in all the remains of *Rhinoceros etruscus* from Leffe, Poggio al Pero and Saint-Vallier 212. Viret and Vialli affirm that it is a specific character of the species ([**64**], page 159).

We are completing this brief description with a comparative table of the measurements (as usual, in millimetres) of the II metacarpus of several rhinoceros remains. The samples of *Rhinoceros etruscus* from Castelnuovo Berardenga, Leffe, Poggio al Pero and Saint-Vallier 212 are marked respectively 1 - 2 - 3 - 4; the samples of *Rhinoceros megarhinus* from Montopoli and those of *Rhinoceros mercki* from Taubach respectively 5 and 6 (1).

	Rhinoceros etruscus				*Rhin. meg.*	*Rhin. mercki*
	1	2	3	4	5	6
Total length . . . . mm	177	168	165	184	207	196
Diameter of the proximal epiphysis . . . . »	43	42	45	43	49	54
Antero-posterior diameter of the distal epiphysis (trochlea) . . »	36	37	37	39	45	49

(1) We wish to point out that the length of the II metacarpus is not a reliable element for the differentiation of the many species of rhinoceroses ([**63**], page 34).

A simple comparison between the main osteological data leads to the conclusion that the II metacarpus here above described is to be assigned to *Rhinoceros etruscus*.

THE DIGITAL REGION

The *phalange* (Plate II, fig. 12 and for comparison fig. 16).

Of all the bones of the digital region we have only found the first phalange of the fourth toe of the left foot. Its shape is characteristic as the proximal articular facet is hollow and markedly bent from right to left, the outline is subcircular and the distal articular facet is slightly concave with an antero-posterior-upward movement. The maximum external-anterior height is 35 mm, that is, almost the same as that of the homologous bone of the fossil remains from Leffe ([**63**], page 37 and 38). The general conformation and dimensions are more or less those of the same phalange of the rhinoceros of Poggio al Pero, now in the Paleontological Museum of Florence (as said above) which served as a control for the determination of the digital bone we are now describing.

We can now formulate some final conclusions: the osteological and osteometrical characteristics of all the bones here described advise us to assign them, without exceptions, to *Rhinoceros* (*Dicerorhinus*) *etruscus* Falc. (1).

---

(1) We wish to add that the fossil bones (both carpal and metacarpal) found by us and here described are recorded in the list of those skeletal parts of fossil remains which are recomended for a reliable osteological diagnosis. In fact, according to Viret and other Authors specialized in the study of fossil mammals, the comparative studies of the « hands » and « feet » of rhincceroses have contributed much to the problems of taxonomical differentiation between the several species of Pliocene and Pleistocene rhinoceroses ([**63**], page 29).

PALEONTOLOGICAL DEMONSTRATIONS

In this part of our work we want to demonstrate that the ground in which the fossil remains here described were found is marine Pliocene.

Though certain formations in other parts of Italy, and of Tuscany in particular, at first considered as Pliocene were later on assigned to the Calabrian we insist again upon the fact that there are no reasons whatever to assign this ground to the Calabrian (*folio 121* of the Geological Map of Italy).

This alternative is to be excluded because the clayey formation we are describing does not contain *Cyprina islandica*, that is, the fossil that together with other « cold species » characterizes the Calabrian, and also because several species belonging exclusively to the Pliocene, or extremely diffused in that age, are instead present.

THE MACROFAUNA (Plates IV and V)

Here is a list of the species of molluscs found in the superficial as well as in the deep strata of the Sienese clayey formation during our investigations, which were most frequent in the year 1963 (1).

Dentalium sexangulum Schröt.
Arca diluvii Lamk.
Limopsis aurita Brocchi
Amussium cristatum Bronn
Pecten bipartitus Foresti
Clamys inflexa Poli
Clamys angelonii Menegh.
Pycnodonta cochlear Poli.
var. *navicularis* Brocchi
Chama gryphoides Lamk.
Venus multilamella Lamk.
Architectonica millegranum Lamk.

(1) We do not mean to say that all the molluscs existing in the formation here described are comprised in this list. Some may have escaped attention in spite of our care and others may still be found in future excavations. We only wish to point out that some species of thin shelled gasteropods and of lamellibranchia of different sizes, which were certainly different from those we succeeded in gathering, were so firmly set that they could not be extracted without risking complete destruction.

Architectonica monilifera Bronn
Architectonica pseudoperspecta Brocchi
Architectonica semisquamosa Bronn
Natica raropunctata Lamk. (1)
Polynices catena Da Costa
Turritella communis Risso
Turritella subangulata Brocchi
Turritella tornata Brocchi
Vermetus intortus Lamk.
Vermetus arenarius Linn.
Sveltia lyrata Brocchi
Chenopus uttingerianus Risso
Fusus longiroster Brocchi
Admete (Bonellitia) bonelli Bellardi
Admete (Bonellitia) serrata Bronn.
Brocchina mitraeformis Brocchi
Charonia appenninica Sassi
Cymatium (Lampusia) affine Desh.
Pyrene (Mitrella) subulata Brocchi
Pyrene (Mitrella) nassoides Grat.
Nassa (Amyclina) italica Mayer
Euthria cornea Linn.
Eocypraea (Apiocypraea) pyrula Lamk.
Pleurotomella calliope Brocchi.
Turris rotata Brocchi
Turris turrifera Nyst
Bathytoma cataphracta Brocchi
Pseudotoma bonellii Bellardi
Turricula dimidiata Brocchi
Clavatula interrupta Brocchi
Turricula allionii Bellardi

DESCRIPTIVE SYNTHESIS OF PART OF THE MACROFAUNA

As said in the preface to this work, we are giving a synthetic description of some of the most significant, or diffuse, Pliocene species:

Dentalium sexangulatum Schröt.

Plate IV, fig. A.

1814 *Dentalium sexangulum* Linneo - ([**72**], pag. 262, tav. XV, fig. 25).
1876 » *sexangulare* Lamk. - ([**148**], pag. 262).
1889 » » d'Orbigny - ([**144**], n. 1736).
1897 » *sexangulum* Schröt. - ([**142**], pag. 92, tav. VII, figg. 48-54),
1955 *Dentalium sexangulum* Schröt. - ([**118**], pag. 51).
1961 » *sexangulare* Lamk. - ([**140**], pag. 411).
1963 » *sexangulum* Schröt. - ([**77**], pag. 19).

---

(1) According to Ruggieri's suggestion we have named *Natica raropunctata* the species of Pliocene Natica which was, and still is, usually defined as *Natica millepunctata* ([**137**], page 23).

We are pleased to have the opportunity of thanking Chiar.mo Prof. Giuliano Ruggieri, the Director of the Institute of Geology and Paleontology of the University of Palermo, for his precious indications.

Distribution: Widely spread in Piedmont and Liguria, and also in other parts of Italy, during the *Pliocene*.
Remarks: Certain forms recall *Entalis recta* which, as Sacco says ([**142**], Vol. XXII, page 110, plate X, fig. 3) may easily be mistaken for the *sexangulum* species.

Architectonica millegranum Lamarck.

Plate IV, figs. 6a - b

1814 *Trocus canaliculatus* Lamk. - ([**72**], pag. 359).
1875 *Solarium millegranum* Lamk. - ([**125**], pag. 199).
1876 » » » - ([**148**], pag. 8).
1879 » » » - ([**92**], pag. 84).
1892 » » » - ([**142**], pag. 59, tav. II, fig. 18).
1959 *Architectonica millegranum* Lamk. - ([**138**], pag. 111).

Distribution: *Italian Pliocene* (Liguria, Tuscany, etc.).

Turritella (Haustator) subangulata Brocchi.

Plate IV, fig. 10.

1814 *Turbo subangulatus* n. - ([**72**], pag. 374, tav. VI, fig. 16).
1876 *Turritella subangulata* Brocchi - ([**148**], pag. 100).
1895 *Zaria subangulata* Brocchi - ([**142**], pag. 9, tav. I, fig. 30).
1912 *Turritella (Zaria) subangulata* Brocchi - ([**78**], pag. 159, tav. XXIV, figg. 34-36).
1912 *Turritella (Zaria) subangulata* Brocchi - ([**82**], vol. IX, pag. 113, tav. IX, fig. 9).
1955 *Turritella (Zaria) subangulata* Brocchi - ([**118**], pag. 52).
1955 *Turritella (Zaria) subangulata* Brocchi - ([**135**], pag. 144, fig. 53).
1959 *Turritella (Haustator) subangulata* Brocchi - ([**139**], pag. 106, tav. XXI, figg. 129 a - b).

Distribution: Miocene-Calabrian. Rather diffused in the *Italian Pliocene*.

Turritella tornata Brocchi.

1814 *Turbo tornatus* n. - ([**72**], pag. 372, tav. VI, fig. 11).
1889 » » Brocchi - ([**144**], n. 1903).
1895 *Haustator tornatus* Brocchi - ([**142**], pag. 24, tav. II, fig. 25).
1912 *Turritella (Haustator) tornata* Brocchi - ([**78**], pag. 164, tav. XXV, figg. 7-15).

1955 *Turritella (Haustator) tornata* Brocchi - ([**135**], pag. 107, fig. 49).
1955 *Turritella (Haustator) tornata* Brocchi - ([**118**], pag. 52).
1963 » *tornata* Brocchi - ([**77**], pag. 21).

Distribution: Present in the *Italian Pliocene*. (Piedmont, Tuscany etc.).

Sveltia lyrata Brocchi.
Plate IV, figs. 13 - 14.

1914 *Voluta lyrata* n. - ([**72**], pag. 311, tav. III, fig. 6).
1841 *Cancellaria lyrata* Brocchi - ([**73**], pag. 55).
1868 » » » - ([**99**], pag. 28).
1870 » » » - ([**67**], pag. 288).
1872 » » » - ([**85**], pag. 107, tav. XII, figg. 11a-b; 12a-b).
1875 » » Defr. - ([**125**], pag. 196).
1879 » » Brocchi - ([**92**], pag. 118).
1955 *Sveltia* » » - ([**135**], pag. 270, fig. 144).

Distribution: This species first appeared in the Miocene and reached its greatest develcpment in the *Pliocene*. Found in Italy in the *Pliocene* formations of Piedmont, Modena, Siena, Pisa, Sicily, etc.

Charonia appenninica Sassi.
Plate IV, figs. 16 - 17.

1814 *Mures reticularis* L. var. Brccchi - ([**72**], pag. 403).
1868 *Triton appenninicum* Sassi - ([**99**], pag. 27).
1871 » » » - ([**67**], pag. 284).
1872 » » » - ([**85**], pag. 65, tav. IX, figg. 7a-b).
1872 » » » - ([**71**], pag. 219).
1903 *Triton (Sassia) appenninicum* Sassi - ([**82**], Vol. V, pag. 93, tav. IV, figg. 1 - 2).
1904 » » » » - ([**142**], pag. 37, tav. X, figg. 18-19).
1953 » » » » - ([**135**], pag. 172, fig. 89).
1959 *Charcnia appenninica* Sassi - ([**138**], pag. 15, tav. II, fig. 10; tav. III, figg. 18 a - b, 22).
1962 » » » - ([**141**], pag. 49).

Distribution: European Miocene and *Mediterranean Pliocene*.

Cymatium (Lampusia) affine Desh.
Plate V, fig. 1.

1814 *Murex intermedius* n. - ([**72**], pag. 400, tav. VII, fig. 10).
1963 *Triton affine* Desh. - ([**93**], pag. 335).
1872 » » » - ([**85**], pag. 72, tav. IX, figg. 6a-b).
1872 » » » - ([**71**], pag. 211, tav. XV, fig. 1).

1875 *Triton affine* Desk. - ([**148**], pag. 342).
1903 *Tritonium (Lampusia) affine* Desh. - ([**82**], Vol. V, pag. 92, tav. III, fig. 32).
1911 *Tritonium (Lampusia) affine* Desh. - ([**78**], pag. 265, tav. XXV, figg. 19-20).
1959 *Cymatium (Lampusia) corrugatum* (Lamk.) *affine* Desh. - ([**138**], pag. 13, tav. III, figg. 12a-b, tav. IV, fig. 19).

Distribution: According to Ruggieri this species is a link between *Cymatium corrugatum* and *Cymatium affine;* it belongs to the European Miocene and to the *Mediterranean Pliocene.*
Remarks: *Cymatium corrugatum* differs from *Cymatium affine* because of the greater gibbosity of the last anfractuosities ([**71**], Vol. I, page 213).

Pyrene (Mitrella) subulata Brocchi.

1814 *Murex subulatus* n. - ([**72**], pag. 426, tav. VIII, fig. 21).
1875 *Columbella subulata* Brocchi - ([**148**], pag. 276).
1890 *Columbella (Tetrastomella) subulata* Brocchi - ([**71**], pag. 44, tav. II, fig. 49).
1911 *Columbella (Macrurella) subulata* Brocchi - ([**78**], pag. 256, tav. XXIII, figg. 66 - 69).
1959 *Pyrene (Mitrella) subulata* Brocchi - ([**138**], pag. 39, tav. IX, figg. 51 a-b).

Distribution: Found in the *Pliocene* formations of Siena, Colli Astesi, Monte Mario and Altavilla.

Pyrene (Mitrella) nassoides Grateloup.
Plate IV, fig. 20.

1875 *Columbella nassoides* Grat. - ([**148**], pag. 276).
1876 » » Bell. - ([**100**], pag. 24).
1880 » » Grat. - ([**149**], pag. 50).
1890 *Columbella (Macrurella) nassoides* Grat. - ([**71**], pag. 51, tav. II, fig. 67).
1909 *Atilia nassoides* (Grat.) *Macrurella* (Sacco) - ([**82**], Vol. VI, pag. 224, tav. X, fig. 25).
1959 *Pyrene (Mitrella) nassoides* Grat. - ([**140**], pag. 41).

Distribution: Miocene and *Italian Pliocene.*

Nassa (Amyclina) italica Mayer.
Plate IV, figs. 21 - 22.

1814 *Buccinum costulatum* n. - ([**72**], pag. 343, tav. V, fig. 9).
1814 *Buccinum exiguum* Brocchi - ([**72**], pag. 655, tav. XV, fig. 20).

1875 *Nassa costulata* » - ([**125**], pag. 196).
1875 » » » - ([**148**], pag. 278).
1878 *Nassa esigua* Brocchi - ([**92**], pag. 101).
1882 *Nassa italica* Mayer - ([**71**], pagg. 140-141, tav. IX, figg. 6 a-b).
1959 *Nassa* (*Amyclina*) *italica* Mayer - ([**138**], pag. 49).

Distribution: Upper Miocene; *Pliocene* in some localities of Piedmont, Liguria, Tuscany (Siena), etc.

Pleurotomella calliope Brocchi.
Plate V, figs. 4 a-b.

1814 *Murex* (*Pleurotoma*) *calliope* n. - ([**72**], pag. 436, tav. IX, figg. 15 a-b).
1847 *Pleurotoma calliope* Brocchi - ([**70**], pag. 62, tav. I, fig. 9).
1870 » » » - ([**67**], pag. 286).
1875 *Clinura calliope* Brocchi - ([**148**], pag. 206).
1875 *Pleurotoma calliope* Brocchi - ([**125**], pag. 197).
1876 *Clinura calliope* Brocchi - ([**100**], pag. 28).
1877 » » » - ([**71**], pag. 205, tav. VII, fig. 1).
1879 » » » - ([**92**], pag. 124).
1896 » » Bellardi - ([**82**], Vol. II, pag. 75, tav. V, fig. 19).
1955 *Pleurotomella* (*Clinuropsis*) *calliope* Brocchi - ([**135**], pag. 305, fig. 163).
1957 *Pleurotomella calliope* Brocchi - ([**137**], pag. 20).

Distribution: Upper Miocene in some European localities, and *Mediterranean Pliocene.*

Turris (Gemmula) turrifera Nyst.
Plate V, figs. 5-6

1814 *Murex turricula* n. - ([**72**], pag. 435, tav. IX, fig. 20).
1841 *Pleurotoma turricula* Brocchi - ([**73**], pag. 52).
1847 » » » - ([**70**], pag. 45).
1868 » » » - ([**99**], pag. 57).
1870 » » » - ([**148**], pag. 204).
1870 » » » - ([**67**], pag. 285).
1876 » » » - ([**100**], pag. 25).
1877 » » » - ([**71**], pag. 39, tav. I, fig. 25).
1896 » » » - ([**82**], Vol. II, tav. V, figg. 11-12).
1914 » » » - ([**79**], pag. 115, tav. XII, figg. 3 a-b).
1955 *Turris* (*Turris*) *turricula* Brocchi - ([**135**], pag. 313, fig. 168).
1959 *Turris* (*Gemmula*) *turrifera* Nyst - ([**139**], pag. 117, tav. XIX, figg. 165-166).

Distribution: Miocene and *Mediterranean Pliocene.*

Turris rotata Brocchi.
Plate V, figs. 7-8.

1814 *Murex rotatus* n. - ([**72**], pag. 434, tav. IX, fig. 11).
1847 *Pleurotoma rotata* Brocchi - ([**70**], pag. 50).

1868 *Pleurotoma rotata* Brocchi - ([**99**], pag. 59).
1870 » » » - ([**67**], pag. 285).
1875 » » » - ([**148**], pag. 206).
1876 » » » - ([**100**], pagg. 25).
1877 » » » - ([**71**], pag. 13, tav. I, fig. 2).
1914 » » » - ([**79**], pag. 114, tav. XII, figg. 1a-b).
1955 *Turris* (*Turris*) *rotata* Brocchi - ([**135**], pag. 315, fig. 169).
1959 *Turris rotata* Brocchi - ([**139**], pag. 115, tav. XXVI, figg. 150-151).

Distribution: Present in the Miocene of many European countries and in the *Mediterranean Pliocene.*
Ruggieri describes a sample found at the basis of the *Cyprina islandica* formation (Calabrian) belonging to the Santerno series (northern Appenines).

Bathytoma cataphracta Brocchi.
Plate V, figs. 9 - 10

1814 *Murex cataphractus* n. - ([**72**], pag. 427, tav. VIII, fig. 16).
1841 *Pleurotoma cataphracta* Brocchi - ([**73**], pag. 52).
1847 » » » - ([**70**], pag. 20, tav. I, fig. 14).
1868 » » » - ([**99**], pag. 56).
1870 » » » - ([**67**], pag. 285).
1875 » » » - ([**125**], pag. 197).
1876 *Dolichotoma cataphracta* Brocchi - ([**100**], pag. 28).
1896 » » » - ([**82**], Vol. II, pag. 101, tav. VIII, figg. 12-14).
1914 » » » - ([**79**], pag. 134, tav. XIII, figg. 1a-b).
1955 *Moniliopsis* (*Bathytoma*) *cataphracta* Brocchi - ([**135**], pag. 329, fig. 177).
1959 *Bathytoma cataphracta* Brocchi - ([**139**], pag. 118, tav. XXX, fig. 168).

Distribution: Present in the Miocene of several European countries and in the *Mediterranean Pliocene.*

Turricula dimidiata Brocchi.
Plate V, figs. 11a - b.

1814 *Murex dimidiatus* n. - ([**72**], pag. 431, tav. VIII, fig. 18).
1847 *Pleurotoma dimidiata* Brocchi - ([**70**], pag. 57).
1868 » » » - ([**99**], pag. 57).
1870 » » » - ([**67**], pag. 285).
1875 » » » - ([**148**], pag. 285).
1875 » » » - ([**125**], pag. 197).
1876 » » » - ([**100**], pag. 25).
1877 *Surcula* » » - ([**71**], pag. 58).
1914 » » » - ([**79**], pag. 130, tav. XII, fig. 24).

1955 *Clavatula (Turricula) (Surcula) dimiadata* Brocchi - ([**135**], pag. 309, fig. 165).
1959 *Turricula dimidiata* Brocchi - ([**139**], pag. 119, tav. XXX, fig. 169).

Distribution: Present in the European Miocene and *Mediterranean Pliocene.*

Clavatula interrupta Brocchi.
Plate V, figs. 12 a - b.

1814 *Murex interruptus* n. ([**72**], pag. 433, tav. IX, fig. 21).
1847 *Pleurotoma interrupta* Brocchi - ([**70**], pag. 31, tav. I, fig. 18).
1870 » » » - ([**67**], pag. 285).
1875 » » » - ([**125**], pag. 197).
1877 *Clavatula interrupta* Brocchi - ([**71**], pag. 169, tav. V, fig. 33).
1879 » » » - ([**92**], pag. 123).
1914 » » » - ([**79**], pag. 126, tav. XII, figg. 17 a-b).
1955 *Clavatula (Turricula) (Surcula) interrupta* Brocchi - ([**135**], pag. 312, fig. 167).
1959 *Clavatula interrupta* Brocchi - ([**139**], pag. 122, tav. XXX, figg. 176-178).

Distribution: *Italian Pliocene.*

Turricula allionii Bellardi.
Plate V, figs. 14 - 15.

1814 *Murex (pleurotoma) cblungus* Brocchi - ([**72**], pag. 429, tav. VIII, fig. 5).
1847 *Pleurotoma brevirostrum* Sow. - ([**70**], pag. 79, tav. IV, fig. 9).
1875 » » » - ([**125**], pag. 197).
1875 *Drillia allionii* Bell. - ([**148**], pag. 206).
1876 » » » - ([**100**], pag. 27).
1877 » » » - ([**71**], pag. 91, tav. III, fig. 17).
1879 » » » - ([**92**], pag. 121).
1896 » » » - ([**82**], Vol. II, pag. 82, tav. VI, figg. 3-5).
1914 » » » - ([**79**], pag. 117, tav. XII, figg. 5a-b).
1955 » *allionii* » - ([**118**], pag. 54).
1957 » » » - ([**137**], pag. 19).
1959 *Turricula allionii* Bell. - ([**139**], pag. 121, tav. XXVIII, figg. 162-164).

Distribution: Miccene of some European countries; *Mediterranean Pliocene.*

In general all these species, and in particular those we have described, seem to represent a fauna which has distinct Pliocene characteristics. The following species alone are sufficient to justify this affirmation: *Architectonica millegranum*

Lamk., *Sveltia lyrata* Brocchi, *Charonia appenninica* Sassi, *Pyrene (Mitrella) subulata* Brocchi, *Pyrene (Mitrella) nassoides* Grat., *Nassa (Amyclina) italica* Mayer, *Pleurotomella calliope* Brocchi, *Turris (Gemmula) turrifera* Nyst, *Bathytoma cataphracta* Brocchi, *Turricula dimidiata* Brocchi, *Clavatula interrupta* Brocchi, *Turricula allionii* Bell., etc.

Besides, the substantial presence of *Pycnodonta navicularis* (fig. 3) a fossil so frequently found at the basis of Pliocene formations, advises us to place the clayey sedimentations of « I Sodi » as far back as the lower Pliocene (1).

Fig. 3 - Left valve of *Pycnodonta navicularis*. (nat. size).

We have, therefore all the most valid elements for the assignment of the ground we are describing to the marine Pliocene and consequently — in line with the subject-matter of this work — for the affirmation that the remains of *Rhinoceros etruscus* found in this same formation are undeniably of that same Age. Here we deem it advisable to quote De Stefani's and Pantanelli's statement: « *As to the Age these grounds belong to* (the Authors refer to the Sienese hills) *all the many kinds of fossils, land mammals included, together with the molluscs stand to prove their exclusive relation to the Pliocene...; those scientists who are of the opinion that such mammals (land mammals in particular) are characteristic of the post-Pliocene only have to come to Siena to be convinced that they must either be considered as typical of the Pliocene or the Pliocene itself must be eliminated* ». (**92**, page 71).

---

(1) Ruggieri ascribes to « Zone A » — which corresponds to the lower Pliocene in Romagna — the following species now extinct, or at least, no longer present in the Mediterranean: *Admete serrata* Bronn, *Sveltia lyrata* Brocchi, *Charonia appenninica* Sassi, *Pyrene nassoides* Grat., *Turris rorata* Brocchi, *Turris turrifera* Nyst, *Bathytoma cataphracta* Brocchi, *Turricula dimidiata* Brocchi, *Turricula allionii* Bellardi and even *Pycnodonta navicularis* Brocchi ([**141**], page 49 and 50).

LIST OF THE MICROFAUNA (Plates VI and VII)

We are producing a list of the Foraminifera found in four samples of clay from the same formation in which we found the molluscs formerly described, together with the remains of *Rhinoceros etruscus* determined and described in the first part of this work. The same block contained also an unrecognisable large Rhinoceros bone fragment (1). The second block extracted and the third lay right and left of, and not far from, the first; the fourth comes from a layer situated about 7 metres above the other three and a little further north.

Sample n. 1 (taken from the large block containing Rhinoceros bones). Species present:

Bigenerina nodosaria d'Orbigny
Dorothia gibbosa d'Orbigny
Dorothia cfr. *brevis* Cushman e Stainforth
Martinottiella communis d'Orbigny
Quinqueleculina vulgaris d'Orbigny
Sigmoilina tenuis Czjzek
Spiroloculina excavata d'Orbigny
Robulus cfr. *rzehaki* Schubert
Robulus cultratus Montfort
Lenticulina peregrina Schwager
Marginulina crebricosta Seguenza
Marginulina costata Batsch
Globulina Gibba tubercolata d'Orbigny
Glandulina laevigata d'Orbigny
Nonion commune d'Orbigny
Nonion soldanii d'Orbigny
Nonion depressulum Walker e Jacob
Astronion stelligerum d'Orbigny
Entosolenia staphyllearia Schwager
Bulimina aculeata d'Orbigny
Bulimina aculeata basispinosa Zanmatti e Tedeschi
Bulimina affinis d'Orbigny
Bulimina buchiana d'Orbigny
Bulimina echinata d'Orbigny
Bolivina dilatata Reuss
Bolivina subspinescens Cushman
Bolivina aenariensis Costa
Bolivina midwyensis Cushman
Uvigerina peregrina Cushman
Valvulineria complanata Cushman
Gyroidina soldanii d'Orbigny
Eponides umbonatus Reuss
Eponides umbonatus stellatus Silvestri

(1) We do not hesitate to ascribe this bone fragment to *Rhinoceros etruscus* as it lay near the remains we have been able to determine and even because its colour and degree of fossilization are the same as that of the other remains.

Rotalia beccari Linneo
Spheroidina bullcides d'Orbigny
Pullenia bulloides d'Orbigny
Cassidulina laevigata carinata Silvestri
Cassidulina subglobosa Brady
Globigerina bulloides d'Orbigny
Globigerina bulloides cryptomphala Glaessner
Orbulina universa d'Orbigny
Globigerinoides elongatus d'Orbigny
Globigerinoides helicinus d'Orbigny
Globigerinoides gomitulus Seguenza
Hastigerina subcretacea Lomnicki
Cibicides lobatulus Walker e Jacob
Cibicides pseudoungerianus Cushman
Cibicides bellincionii Giannini e Tavani
Cibicides robertsonianus Brady
Cibicides boueanus d'Orbigny
Cibicides ungerianus d'Orbigny
Planulina ariminensis d'Orbigny
Planorbulina mediterranensis d'Orbigny.

*Sample n.*2 (from the right side of sample 1). Species present:

Bigenerina nodosaria d'Orbigny
Dorothia gibbosa d'Orbigny
Robulus crassus d'Orbigny
Lenticulina peregrina Schwager
Marginulina glabra d'Orbigny
Lagena hexagona Williamson
Lagena elongata Ehrenberg
Globulina gibba tubercolata d'Orbigny
Bulimina buchiana d'Orbigny
Virgulina squamosa d'Orbigny
Virgulina complanata Egger
Bolivina pseudoplicata Hern-Allen e Earland
Bolivina midwayensis Cushman
Bolivina spathulata Williamson
Bolivina dilatata Reuss
Bolivina subspinescens Cushman
Bolivina elongata lappa Cushman e Parker
Bolivina aenariensis Costa
Rectuvigerina siphogerinoides Lipparini
Trifarina bradyi Cushman
Angulogerina angulosa Williamson
Gyroidina umbonata Silvestri
Gyroidina soldanii d'Orbigny
Rotalia beccarii Linneo
Cancris auriculus Fichtel e Moll
Cassidulina laevigata d'Orbigny
Cassidulina laevigata carinata Silvestri
Globigerina bulloides d'Orbigny
Globigerinita naparimaensis Bronnimann
Globigerinoides trilobus Reuss
Globigerinoides elongatus d'Orbigny
Globigerinoides sacculifer Brady
Orbulina universa d'Orbigny
Orbulina saturalis Bronnimann
Cibicides bellincionii Giannini e Tavani
Planulina ariminensis d'Orbigny

*Sample n.*3 (from the left side of sample 1). Species present:

Bigenerina nodosaria d'Orbigny
Dorothia cfr. *brevis* Cushman e Stainforth
Saracenaria arcuata d'Orbigny
Robulus crassus d'Orbigny
Glandulina laevigata d'Orbigny
Virgulina complanata Egger
Virgulina squamosa d'Orbigny
Bolivina dilatata Reuss
Bolivina midwayensis Cushman
Bolivina pseudoplicata Heron-Allen e Earland
Bolivina subspinescens Cushman
Bolivina spathulata Williamson
Bolivina aenariensis Costa
Lenticulina peregrina Schwager
Bulimina elongata lappa Cushman e Parker
Bulimina echinata d'Orbigny
Bulimina buchiana d'Orbigny
Rectuvigerina siphogenerinoides Lipparini
Trifarina bradyi Cushman
Gyroidina soldanii d'Orbigny
Gyroidina umbonata Silvestri
Cassidulina laevigata carinata Silvestri
Cancris auriculus Fichtel e Moll
Cassidulinoides bradyi Norman
Pullenia salisburyi R. E. e K. G. Stewart
Pullenia spheroides d'Orbigny
Sphaeroidina bulloides d'Orbigny
Globigerina bulloides d'Orbigny
Globigerinoides helicinus d'Orbigny
Globigerinoides elongatus d'Orbigny
Globigerinoides sacculifer Brady
Orbulina universa d'Orbigny
Hastigerina subcretacea Lomnicki
Cibicides lobatulus Walker e Jacob
Cibicides refulgens Montfort
Cibicides pseudoungerianus Cushman

*Sample n.*4 (extracted from a layer above the other three blocks and a little further north). Species present:

Bigenerina nodosaria d'Orbigny
Dorothia gibbosa d'Orbigny
Textularia sp.
Martinottiella communis d'Orbigny
Quinqueloculina vulgaris d'Orbigny
Sigmoilina tenuis Czjzek
Robulus vortex Fichtel e Moll
Robulus cultratus Montfort
Lenticulina peregrina Schwager
Marginulina costata Batsch
Marginulina crebricosta Seguenza
Saracenaria arcuata d'Orbigny
Saracenaria italica Defrance
Dimorphina tuberosa d'Orbigny
Lagena striata d'Orbigny
Lagena squamosa Montagu
Lagena acuticosta Reuss
Guttulina communis d'Orbigny

Globulina gibba d'Orbigny
Globulina gibba tubercolata d'Orbigny
Lagena gracilis Williamson
Dentalina inflexa Reuss
Dentalina leguminiformis Batsch
Nonion padanum Perconig
Nonion saldanii d'Orbigny
Nonionella turgida Williamson
Nonion commune d'Orbigny
Elphidium decipiens Costa
Plectofrondicularia inaequalis denticulata Silvestri
Entosclenia staphyllearia Schwager
Siphonodosaria scalaris Batsch
Siphonodosaria proxima Silvestri
Siphonodosaria hispida d'Orbigny
Uvigerina pymaea d'Orbigny
Uvigerina peregrina Cushman
Bolivina pseudoplicata Heron-Allen e Earland
Bolivina dilatata Reuss
Bolivina aenariensis Costa
Bolivina punctata d'Orbigny
Rectuvigerina siphogenerinoides Lipparini
Virgulina schreibersiana Czjzek
Angulogerina angulosa Williamson
Trifarina bradyi Cushman
Bulimina ovata d'Orbigny
Bulimina aculeata d'Orbigny
Bulimina affinis d'Orbigny
Valvulineria complanata Cushman
Eponides umbonatus stellatus Silvestri
Rotalia beccari Linneo
Gyroidina soldanii d'Orbigny
Discorbis globularis d'Orbigny
Cancris auriculus Fichtel e Moll
Chilostomella oolina Schwager
Pullenia bulloides d'Orbigny
Cassidulina leavigata carinata Silvestri
Cassidulinoides bradyi Norman
Sphaeroidina bulloides d'Orbigny
Globigerina bulloides d'Orbigny
Globigerinoides elongatus d'Orbigny
Globigerinoides trilobus d'Orbigny
Orbulina universa d'Orbigny
Globorotalia hirsuta d'Orbigny
Hastigerina subcretacea Lomnicki
Anomalina helicina Costa
Anomalina grosserugosa bedenensis d'Orbigny
Cibicides pseudoungerianus Cushman
Cibicides bellincionii Giannini e Tavani
Planulina ariminensis d'Orbigny (1).

---

(1) Not having at our disposal the material necessary for the analyses, we applied to Dott.ssa Laura Nardi Dallan (assistant at the Institute of Geology and Paleontology of the University of Pisa). We thank her warmly for her kindness and precious help.

DESCRIPTIVE SYNTHESIS OF SOME OF THE MICROFAUNA

We are now giving a brief description of the most indicative and widespread Pliocene species, in the same order as indicated for the classification of Foraminifera, without indicating families and genera (1).

Robulus cultratus Montfort.
Plate VI, fig. 17 *s*. - Plate VII, fig. 8 *i* (2).

1846 *Robulina cultrata* d'Orbigny - ([**98**], pag. 96, tav. IV, figg. 10-13).
1899 *Cristellaria cultrata* Montf. - ([**154**], pag. 195, tav. VII, figg. 11 a-b).
1908 *Robulina cultrata* Montf. - ([**110**], pag. 43, tav. II, fig. 10).
1952 *Robulus cultratus* Montf. - ([**130**], pag. 6).
1953 » » » - ([**114**], pag. 226).
1957 » » » - ([**65**], tav. IX, figg. 7-7 a).
1960 » » » - ([**113**], pag. 37).

Distribution: Middle Eocene - Extant. This species is most frequent in the Tortonian, and in the *lower Pliocene.*

Robulus vortex Fichtel e Moll.
Plate VII, fig. 3 *i.*

1883 *Cristellaria vortex* Fichtel e Moll - ([**104**], pag. 179).
1891 » » » » - ([**94**], pag. 640).
1895 » » » » - ([**88**], pag. 42).
1899 » » » » - ([**154**], pag. 189, tav. VII, fig. 11).
1952 *Robulus vortex* » » - ([**130**], pagg. 5-6).
1957 » » » » - ([**65**], tav. XI, figg. 1-1a).
1961 » » » » - ([**159**], pag. 97, tav. XI, fig. 16).

Distribution: Oligocene - Extant. Found in the Po Plain all through the *Pliocene;* most frequently present in the Elvetian and Tortonian, and during the *lower Pliocene.*

Robulus crassus d'Orbigny.
Plate VI, fig. 31 *i* - Plate VII, fig. 31 *s.*

1846 *Cristellaria crassa* d'Orbigny - ([**98**], pag. 90, tav. VI figg. 1-3).
1880 » » » - ([**149**], pag. 141-223).
1899 » » » - ([**154**], pag. 193).

---

(1) For the sake of brevity and in consideration of the limited number of species described, Families and Genera have not been mentioned.

(2) The letters « *s* » and « *i* » after the figures referring to the plates indicate respectively the microfossils we found in sample-blocks 1 and 3, 2 and 4.

1957 *Robulus crassus* d'Orbigny - ([**65**], tav. IX, figg. 6-6 a).
1961 » » » - ([**140**], pag. 407).

Distribution: Miocene - *Pliocene.* According to Ruggieri *Robulus crassus,* and all its forms, seem to characterize the lower sub-zone (Sub-zone B) of the *Italian Pliocene* ([**140**], page 407).

Lenticulina peregrina Schwager.
Plate VI, figs. 29 *s* - 25 *i* - Plate VII, fig. 13 *s.*

1952 *Lenticulina peregrina* Schwager - ([**130**], pag. 6).
1953 » » » - ([**114**], pag. 230).
1957 » » » - ([**65**], tav. XI, fig. 2).
1960 » » » - ([**113**], pag. 39).
1961 » » » - ([**159**]. pag. 98).

Distribution: Miocene - Extant. Present in the upper Miocene and, more frequently, in the *lower Pliocene.*
Remarks: This species is known also as *Cristellaria peregrina* or *Cristellaria variabilis;* it is not mentioned in Alfredo Silvestri's list of the Foraminifera of the Sienese *Pliocene.*

Marginulina costata Batsch.
Plate VI, fig. 16 *s.*

1880 *Marginulina raphanus* Batsch - ([**149**], pagg. 90-140-223-374).
1883 » » » - ([**104**], pag. 178).
1893 » *costata* » - ([**86**], pag. 111).
1896 » » » - ([**153**], pag. 200, tav. VI figg. 9 a-b).
1953 » » » - ([**114**], pag. 234).
1957 » » » - ([**65**], tav. XII, fig. 2).
1960 » » » - ([**113**], pag. 40, tav. V, fig. 9).
1961 » » » - ([**159**], pag. 99, tav. X, fig. 1).
1962 » » » - ([**88**], pag. 409, tav. XXIX, fig. 2).

Distribution: Present ever since the Mesozoic and still living. In the Po Plain it is most diffused in the Tortonian, and in the *lower Pliocene.*

Saracenaria italica Defrance.

1883 *Cristellaria italica* Defr. - ([**104**], pag. 178).
1891 » » » - ([**94**], pag. 603).
1893 » » » - ([**86**], pag. 409).
1899 » » » - ([**154**], pag. 179).
1957 *Saracenaria italica* Defr. - ([**65**], tav. XV, fig. 1).
1960 » » » - ([**113**], pag. 42).
1961 » » » - ([**159**], pag. 105, tav. X, fig. 10).

Distribution: Oligocene - Extant. In the Po Plain it is most abundant in the Tortonian, and in the *lower Pliocene.*

Saracenaria arcuata d'Orbigny.

Plate VI, figs. 36 *s* - 27 *i* - Plate VII, fig. 12 *s*.

1846 *Cristellaria arcuata* d'Orbigny - ([**98**], pag. 87, tav. III, figg. 34-36).
1953 *Saracenaria* » » - ([**114**], pag. 223, tav. XV, fig. 9).
1960 » » » - ([**113**], pag. 41).

Distribution: Oligocene - *lower Pliocene.*
Remarks: This species is not mentioned in Silvestri's list of Pliocene Foraminifera of the Province of Siena.

Globulina gibba tubercolata d'Orbigny.

Plate VI, fig. 24 *i*.

1846 *Globulina gibba tubercolata* d'Orbigny - ([**98**], pag. 230, tav. XIII, figg. 22-22).
1957 *Globulina gibba tubercolata* d'Orbigny - ([**65**], tav. XX, fig. 3).
1960 *Globulina gibba tubercolata* d'Orbigny - ([**113**], pag. 45, tav. VI, fig. 9).

Distribution: Eocene - *Pliocene.* In the Po Plain present only in the *lower Pliocene.*
Remarks: This species is not specifically mentioned in Silvestri's list of the *Pliocene* Foraminifera of the Province of Siena. This Author describes only *Polymorphina gibba,* sometimes called *Globulina gibba,* and mentions a *tubercolata* variety only for *Polymorphina pliocaena* ([**153**], Pages 228 and 236).

Nonion soldanii d'Orbigny.

Plate VI, fig. 2 *s* - Plate VII, fig. 13 *i*.

1846 *Nonionina soldanii* d'Orbigny - ([**98**], pag. 109, tav. V, figg. 15-16).
1880 » *formosa* » - ([**149**], pag. 63, tav. VII, fig. 6).
1957 *Nonion soldanii* d'Orbigny - ([**65**], tav. XXI, fig. 5).
1960 » » » - ([**113**], pag. 48, tav. VII, fig. 4).
1961 » » » - ([**159**], pag. 119, tav. X, fig. 7; tav. XIII, fig. 4).
1962 » » » - ([**120**], pag. 85, tav. VII, fig. 1).

Distribution: From the Miocene to the *Pliocene* (the *lower* in particular).
Remarks: Silvestri names this species *Nonionina umbilicatula* ([**154**], page 331). This same denomination has been used even for another species ([**119**], page 82). Other Authors name this same species *Nonion pompilioides* Fichtel and Moll. This troublesome confusion is clarified in Giannini and Taviani's work ([**113**], page 47).

Bulimina aculeata d'Orbigny.

Plate VI, fig. 12 *s*.

1862 *Bulimina spinosa* d'Orbigny - ([**147**], pag. 23, tav. I, fig.. 8 - 8 a).
1886 *Bulimina aculeata* d'Orbigny - ([**105**], pagg. 85-87).

1896 *Bulimina aculeata* d'Orbigny - ([**153**], pag. 96).
1957 » » » - ([**65**], tav. 25, fig. 8).
1960 » » » - ([**113**], pag. 51).
1961 » » » - ([**159**], pag. 123).
1962 » » » - ([**88**], pag. 410).

Distribution: Miocene - Extant. Present in the Po Plain in the upper Miocene and in the *lower Pliocene*, in Val di Trossa (Tuscany) and even in the *Piacenzian*.

Bulimina elongata lappa Cushman e Parker.

1953 *Bulimina elongata lappa*
Cushman e Parker - ([**114**], pag. 259).
1954 *Bulimina elongata lappa*
Cushman e Parker - ([**119**], pag. 90).
1957 *Bulimina elongata lappa*
Cushman e Parker - ([**65**], tav. XXVI, fig. 10).
1959 *Bulimina elongata lappa*
Cushman e Parker ([**113**], pag. 52).

Distribution: Miocene - Quaternary. Widespread in the *Piedmontese Pliocene* (particulary the *lower* and *middle*).
Remarks: This species is not mentioned in Silvestri's list of Foraminifera of the Province of Siena.

Bolivina subspinescens Cushman.
Plate VII, figs. 16 *s* - 27 *i*.

1953 *Bolivina subspinescens* Cushman - ([**132**], pag. 8).
1954 » » » - ([**119**], pag. 84).
1957 » » » - ([**65**], tav. XXXI, fig. 5).
1960 » » » - ([**113**], pag. 59).

Distribution: *Pliocene* - Extant. Particularly abundant in the *Piedmontese Pliocene* (*lower* and *middle*) ([**139**], page 83).
Remarks: Silvestri does not mention this species among the Foraminifera of the Province of Siena.

Uvigerina pygmaea d'Orbigny.
Plate VII, fig. 29 *i*.

1846 *Uvigerina pygmaea* d'Orbigny - ([**98**], pag. 190, tav. XI, figg. 25-26).
1862 » *striata* » - ([**147**], pag. 26).
1883 » *pygmaea* » - ([**104**], pag. 180).
1892 » » » - ([**117**], pag. 97).
1895 » » » - ([**87**], pag. 48).
1899 » » » - ([**154**], pag. 239, tav. IX, figg. 5 a-b).
1952 » » » - ([**68**], pag. 173).
1957 » » » - ([**65**], tav. XXXIV, figg. 3-3 bis).
1960 » » » - ([**113**], pag. 61).

1961 *Uvigerina pygmaea* d'Orbigny - ([**159**], pag. 136, tav. XI, fig. 6).
1962 » » » - ([**88**], pag. 412).

Distribution: Miocene - Extant. Common in the *lower Pliocene.*

Pullenia salisburyi R. E. e K. C. Stewart.
Plate VII, fig. 24 *s.*

1952 *Pullenia salisburyi* R. E. e K. C. Stewart - ([**130**] pag. 6).
1954 *Pullenia salisburyi* R. E. e K. C. Stewart - ([**119**], pag. 89).
1957 *Pullenia salisburyi* R. E. e K. C. Stewart - ([**65**], tav. XLV, figg. 1-1 a).

Distribution: Present in the *Pliocene* of Cortemaggiore and in Piedmont.
Remarks: This species is not mentioned in Silvestri's list of the Pliocene Foraminifera of the Province of Siena.

Globorotalia hirsuta d'Orbigny.
Plate VII, fig. 19 *i.*

1839 *Rotolina hirsuta* d'Orbigny - ([**97**], pag. 131, tav. I, figg. 37-39).
1952 *Globorotalia hirsuta* d'Orbigny - ([**130**], pag. 6).
1953 » » » - ([**131**], pag. 146).
1954 » » » - ([**119**], pag. 89).
1957 » » » - ([**65**], tav. XLVIII, fig. 4).
1961 » » » - ([**159**], pag. 163).
1963 » » » - ([**116**], pag. 278, tav. XVII, figg. 1-2).

Distribution: In Italy, from the middle Miocene (Elvezian) to the *middle Pliocene.* Particularly diffused in the Tortonian and in the *lower Pliocene* of the Po Plain.
Remarks: Not even this species is to be found in Silvestri's list of Pliccene Foraminifera of the Province of Siena.

Anomalina helicina Costa.

1855 *Nonionina helicina* Costa - ([**83**], pag. 123, tav. I, figg. 12 a-b).
1953 *Anomalina* » » - ([**132**], pag. 9).
1954 » » » - ([**119**], pag. 124, tav. VII, fig. 12).
1957 » » » ([**65**], tav. XLIX, fig. 9).
1960 » » » - ([**113**], pag. 76).
1961 » » » - ([**159**], pag. 166).
1962 » » » - ([**120**], pag. 90, tav. VII, fig. 13).

Distribution: Miocene - *middle* and *lower Pliocene.*
Remarks: Silvestri does not mention this form among the Pliocene Foraminifera of the Province of Siena.

Cibicides bellincionii Giannini e Tavani.
Plate VI, fig. 1 *i* - Plate VII, fig. 1 *i*.

1960 *Cibicides bellincionii* Giannini e Tavani - ([**112**], pag. 418-421, tavv. I-II).
1960 *Cibicides bellincionii* Giannini e Tavani - ([**113**], pag. 77, tav. X, figg. 5-8).

Distribution: Oligocene - *Pliocene;* most frequent from the Tortorian to the *lower Pliocene.*
Remarks: A new species; not mentioned by Silvestri among the Pliocene Foraminifera of the Province of Siena.

On the whole the species of Foraminifera in this list, those described in particular, even on the basis of a simple associative evaluation seem to represent a fauna which is obviously Pliocene. In fact, among the forms referable to the earlier stages of the *Pliocene* we find: *Robulus crassus* d'Orbigny, *Saracenaria arcuata* d'Orbigny, *Nonion soldanii* d'Orbigny, *Uvigerina pygmaea* d'Orbigny, *Globorotalia hirsuta* d'Orbigny, (1), *Anomalina helicina* Costa, *Cibicides bellincionii* Giannini and Tavani; among the forms that play an important role in the lower Pliocene we find: *Robulus cultratus* Montfort, *Robulus vortex* Fichtel and Moll, *Lenticulina peregrina* Schwager, *Marginulina costata* Batsch, *Saracenaria italica* Defrance, etc.; among the forms remarkably diffused in the lower Pliocene we have: *Bulimina aculeata* d'Orbigny, *Bolivina subspinescens* Cushmann, *Pullenia salisburyi* R.E. and K.C., Stewart, etc.

We have, therefore, valid data to assign the clayey sedimentations of « I Sodi » also to the lower Pliocene (2).

Now it seems time to close this chapter because the specific data concerning the statistical and ecological study of the microfauna we have described do not seem useful to the purpose of this work. We shall discuss them elsewhere.

---

(1) Ruggieri places *Globorotalia hirsuta* among the forms that characterize the Pliocene inferior sub-zone (sub-zone B). (cfr. [**140**], page 407).

(2) The lower Pliocene is characterized also by its microfaunal associations and Miocene affinities ([**130**], page 12). The forms found in our fourth sample of clay seem to us particularly fit for this consideration.

Conclusion

The contents of the preceding chapters seems sufficient for the formulation of definite conclusions, so the final significance of this study can be stressed.

At first we only meant to describe the fossil remains recently found near Castelnuovo Berardenga railway station to contribute to the determination of other mammal remains in the Sienese territory which is well known for its rich fossil content but, as we proceeded with our work, we realized that the consultations of specific papers and of fossil material for comparisons were making our task ever more complex.

Other integrative elements which had not been foreseen at the beginning became by and by indispensable for the stratigraphic evaluation of the ground. As a rule however we prefer to deal only with what concerns vertebrates, mammals in particular. We hope our efforts will not prove useless.

Now that we have described and compared the fossils found in the clayey formation of « I Sodi » we feel that, on the basis of their osteological and osteometrical characters, we have good, reasons to confirm that they are remains of *Rhinoceros etruscus*.

We have demonstrated with paleontological data that the clayey sedimentations in which they lay are positively Pliocene. In fact, the paleontological and lithological data in some ways seem to recall the piacenzian type.

All these observations are valid presuppositions for the affirmation that *Rhinoceros* (*Dicerorhinus*) *etruscus* appeared in times as far back as the earliest Pliocene.

All the uncertainties concerning the existence of this kind of rhinoceros during the Pliocene ([14], page 17) are absolutely out of the question and so is the idea of using *Rhinoceros etruscus* as a guide-fossil of the Villafranchian ([163], page 10).

BIBLIOGRAPHY

Part. I

[1] AIRAGHI C., *Considerazioni filogenetiche sui Rinoceronti d'Europa.* Riv. Ital. Paleont., Anno XXXII, Fasc. I-III. Milano, 1926.

[2] AZZAROLI A., *Osservazioni sulla formazione villafranchiana di Olivola in Val di Magra.* Atti Scc. Tosc. Sc. Nat. Mem., Vol. LVII. Pisa, 1950.

[3] AZZAROLI A., *Validità della specie Rhinoceros hemitoechus Falconer.* Estr. Palaeontographia Italica, Vol. LVII. Pisa, 1963.

[4] AZZAROLI A., *Rinoceronti pliocenici del Valdarno inferiore.* Estr. Palaeontogr. Ital., Vol. LVII. Pisa, 1963.

[5] AZZAROLI A., *Villafranchian correlations based on large Mammals.* Giornale di Geologia, Ann. Mus. Geol. Bol., Vol. XXXV, Fasc. 1 (Committee on Mediterranean Neogene Stratigraphy - Proceedings of the fourth Session in Bologna, 19-30 September 1967, Part. 1). Bologna 1970.

[6] BARETTI M., *Resti fossili di rinoceronti nel territorio di Dusino.* Atti R. Acc. Sc. Tor., Vol. XV. Torino, 1880.

[7] BORTOLOTTI C., *Intorno ad alcuni resti di Rinoceronte dei dintorni di Perugia.* Riv. Ital. Paleont., Vol. IX. Perugia, 1903.

[8] BOULE M., - VALLOIS H. V., *Les hommes fossiles. Éléments de Paléontologie humaine.* Quatrième Édition. Masson, 1952.

[9] CACCIA V., *Su un cranio fossile di Rhinoceros Merckianus Etruriae (Falconer) rinvenuto in territorio di S. Colombano al Lambro con particolare considerazione dell'apparato dentale.* Nuova Rassegna di Odontoiatria, Vol. VI. Milano, 1928.

[10] CAPELLINI G., *Rinoceronti fossili del Museo di Bologna.* Estr. Mem. R. Acc. Sc. Ist. Bologna, Ser. 5ª, Tomo IV. Bologna, 1894.

[11] CAPELLINI G., *Resti di mammiferi nelle argille terziarie di Ponzano Magra.* Estr. Mem. R. Acc. Ist. Bol. Cl. Sc. Fis. Sez. Sc. Nat. Ser. 4ª, Tomo X. Bologna, 1912-1913.

[12] CORTESI G., *Sugli scheletri d'un Rinoceronte africano e d'una Balena.* Ediz. della Torre. Milano, 1909.

[13] CORTESI G., *Saggi geologici degli strati di Parma e di Piacenza.* Ediz. Del Majano. Piacenza, 1819.

[14] CORTESI G., *Sulla scoperta dello scheletro di un quadrupede colossale fra gli strati marini in un colle del Piacentino.* Ediz. Del Majno. Piacenza, 1834.

[15] CROIZET et JOBERT., *Recherches sur les ossements fossiles du département du Puy-de-Dôme.* Paris, 1828.

[16] CUSCANI POLITI P., *Resti di Rhinoceros (Dicerarhinus) etruscus rinvenuti nel Pliocene del Senese.* Estr. Atti Accademia Fisiocritici, Sez. Agr., Sez. 2ª, Vol. X. Siena, 1963.

[17] CUVIER G., *Recherches sur les ossements fossiles.* Quatrième Édition, Tome troisième. Paris, 1834 - Atlas, Tome premier. Paris, 1836.

[18] DE ANGELIS D'OSSAT G., *Il "Rhinoceros (Coelolonta) etruscus Falc." nella provincia romana.* Atti Acc. Gioenia Sc. Nat. Catania, 1895.

[19] DE BLAINVILLE DUCROTAY M., *Ostéographie ou description iconographique comparée des mammifères recents et fossiles.* Genre Rhinoceros, Tome IV. Paris, 1839-1864.

[20] DE CHRISTOL J., *Recherches sur les caractères des grandes espèces de Rhinocéros fossiles.* Ann. Sc. Nat., Ser. 2ª, Tome III. Paris, 1835.

[21] DELFORTRIE M., *Rhinoceros tichorhinus.* Estr. Actes Soc. Linn., Tome XXX. Bordeaux, 1875.

[22] DEL PRATO A., *Rinoceronte fossile nel Parmense.* Boll. Soc. Geol. Ital., Vol. V. Roma, 1886.

[23] DEPÉRET CH., *Description géologique du bassin tertiaire du Roussillon,* Ann. Sc. Géol., Vol. VII. Paris, 1885.

[24] DEPÉRET CH., *Les animaux pliocènes du Roussillon.* Mém. Soc. Géol. de France. Paléontologie. Paris, 1891.

[25] DEPÉRET CH. - MAYET L., *Le gisement de mammifères pliocènes de Senèze (Haute-Loire).* Estrait du Volume des Comptes rendus de l'«Association Française pour l'Avancement des Sciences». Paris, 1911.

[26] DE STEFANI C., *Le Ligniti del bacino di Castelnuovo di Garfagnana.* Boll. R. Com. Geol. Ital., Vol. XVIII. Roma, 1887.

[27] DE STEFANO G., *L'Elephas meridionalis e il Rhinoceros Mercki nel Quaternario calabrese.* Boll. Soc. Geol. Ital., Vol. XVIII. Roma, 1899.

[28] D'ERASMO G., *La fauna della Grotta di Loretello presso Venosa.* Estr. Atti R. Acc. Sc. Fis. Mat. di Napoli, Ser. 2ª, Vol. XIX. Napoli 1932.

[29] DE ZIGNO A., *Sulle ossa fossili di rinoceronti trovate in Italia.* Tip. Sicca. Padova, 1855.

[30] FABIANI R., *I mammiferi quaternari della Regione Veneta.* Mem. Ist. Geol. Univ. Padova, Vol. V. Padova, 1818.

[31] FLORES E., *Catalogo dei mammiferi fossili nell'Italia meridionale e continentale.* Estr. Atti Acc. Pontan., Vol. XXV. Napoli, 1895.

[32] FLORES E., *L'Elephas antiquus Falc. e il Rhinoceros Mercki Jaeg. in provincia di Reggio Calabria.* Boll. Soc. Geol. Ital., Vol. XIX. Roma, 1900.

[33] FORSYTH MAJOR C. J., *Remarques sur quelques mammifères post-tertiaires de l'Italie, ecc.* Atti Soc. Ital. Sc. Nat., Vol. XV, Fasc. 5°. Milano, 1873.

[34] FORSYTH MAJOR C. J., *Sopra alcuni rinoceronti fossili in Italia.* Boll. Com. Geol. Ital., Vol. V. Roma, 1874.

[35] FORSYTH MAJOR C. J., *Considerazioni sulla fauna dei mammiferi pliocenici e post-pliocenici della Toscana.* Atti Soc. Tosc. Sc. Nat. Mem. Vol. I. Pisa, 1875.

[36] GAUDRY A. et BOULE M., *L'Elasmotherium. Materiaux pour l'histoire des temps quaternaires.* Trois. Fasc. Paris, 1888.

[37] GIOLI G., *Sopra alcuni resti di Rhinoceros etruscus rinvenuti a Prata presso Massa Marittima.* Atti Soc. Tosc. Sc. Nat. Proc. Verb., Vol. VIII. Pisa, 1890.

[38] ISSEL A., *Alcuni mammiferi fossili del Genovesano e del Savonese.* Estr. Acc. Lincei, Ser. 5ª, Vol. VIII. Roma, 1910.

[39] JACOBACCI A. - MALATESTA A. - MARTELLI G., *Note illustrative della*

Carta Geologica d'Italia. Foglio 121. Estr. Boll. Soc. Geol. Ital. Roma, 1969.

[40] HUE E., *Musée ostéologique. Étude de la faune quaternaire. Ostéométrie des mammifères.* Voll. I-II. Paris, 1907.

[41] LARTET E., *Notes sur deux têtes de Carnassiers fossiles et sur quelques débris de Rhinoceros du midi de la France.* Ann. Sc. Nat. Zoolog., Tome VIII. Paris, 1857.

[42] LEONARDI P., *Resti fossili inediti di rinoceronti conservati nelle collezioni dell'Istituto Geologico dell'Università di Padova.* Mem. Ist. Geol. Univ. Padova, Vol. XV. Padova, 1947.

[43] LEONARDI P., *Resti fossili di rinoceronti del Museo di Storia Naturale di Trieste.* Atti Mus. Civ. St. Nat. Trieste, Vol. XVI. Trieste, 1947.

[44] LOSS R., *Resti di Rhinoceros dalla località Becchi di Castelnuovo San Bosco (Colle S. Bosco, Torino).* Riv. Sc. Nat. "Natura", Vol. XXXVI, Torino, 1945.

[45] LOTTI B., *Memorie descrittive della Carta Geologica d'Italia (Carta della Toscana).* Vol. XIII. Roma, 1910.

[46] MELI R., *Rinvenimento di ossa fossili nei dintorni di Roma.* Boll. Soc. Geol. d'Ital., Vol. XII. Roma, 1881.

[47] MELI R., *Sopra alcune ossa fossili rinvenute nelle ghiaie alluvionali presso via Nomentana, al 3° Km. da Roma.* Boll. Com. Geol. Ital., Vol. XVIII. Roma, 1886.

[48] MERLA G., *I leptobos Rütim. Italiani.* Estr. Palaeontogr. Italica, Vol. XLVI. Pisa, 1949.

[49] MERLA G., *Geologia dell'Appennino Settentrionale.* Estr. Boll. Soc. Geol. Ital., Vol. LXX, Roma, 1952.

[50] MIRIGLIANO G., *Avanzi di vertebrati quaternari di Melpignano (Lecce).* Estr. Atti R. Acc. Sc. Fis. e Mat. Soc. Real. di Napoli, Ser. 3ª, Vol. II. Napoli, 1942.

[51] PAULOW M., *Les Rhinocérides de la Russie et le développement des Rhinocéridae en général.* Bull. Soc. Imp. des Natur. de Moscou, Vol. VI. Moscou, 1892.

[52] POMEL A., *Les Rhinocéros quaternaires.* Paléont. Monogr. Carte Géol de l'Algerie. Alger, 1895.

[53] SACCO F., *Le Rhinocéros de Dusino (Rhinocéros etruscus Falc. var. astensis Sacco).* Archiv. Hist. Nat. Lyon. Tome VI. Lyon, 1895.

[54] SACCO F., *Resti fossili di Rinoceronti dell'Astigiana.* Estr. Mem. R. Acc. Sc. Tor., Ser. 2ª, Vol. LVI. Torino, 1905.

[55] SESTINI A., *Stratigrafia dei terreni fluvio-lacustri del Valdarno superiore.* Atti Soc. Tosc. Sc. Nat. Proc. Verb., Vol. XLV. Pisa, 1936.

[56] SIGNORINI R., *Sguardo d'insieme alla Geologia della Toscana a sud dell'Arno.* Estr. Mem. Soc. Geol. Ital., Vol. IV. Roma, 1962.

[57] SIMONELLI V., *I rinoceronti fossili del Museo di Parma.* Estr. Palaeontogr. Ital., Vol. III. Pisa, 1897.

[58] TERMIER H et TERMIER G., *Histoire Géologique de la Biosphère.* Édit. Masson. Paris, 1952.

[59] TUCCIMEI G., *Alcuni mammiferi fossili delle provincie umbra e romana.* Mem. Pontan. Nuovi Lincei, Vol. VII. Roma, 1891.

[60] UGOLINI R., *Il Rhinoceros mercki Jaeg. nei terreni quaternari della*

Val di Chiana. Estr. Ann. Univ. Tosc., Vol. XXV. Pisa, 1906.

[61] UGOLINI R., *Il Rhinoceros etruscus Falc. del Pliocene di Barga.* Estr. Palaeontogr. Ital., Vol. XXIV. Pisa, 1918.

[62] VENZO S., *Stadi della Glaciazione del "Donau" sotto al Günz e al Mindel nella serie lacustre di Leffe (Bergamo). Limite tra Pliocene e Pleistocene.* Actes du Congr. Intern. Inqua. Roma-Pisa, 1953.

[63] VIALLI V., *Sul Rinoceronte e l'Elefante dei livelli superiori della serie lacustre di Leffe (Bergamo).* Mem. Soc. Ital. Sc. Nat. e del Mus. Civ. St. Nat. di Milano, Vol. XII, Fasc. I. Milano, 1956.

[64] VIRET J., *Le loess à bancs durcis de Saint-Vallier (Drôme) et sa faune des mammifères villafranchiens.* Nouv. Arch. du Mus. Hist. Nat. de Lyon, Fasc. IV. Lyon, 1954.

Part. II

[65] A.G.I.P. MINERARIA. *Foraminiferi padani (Terziario e Quaternario).* Milano, 1957.

[66] APPELIUS F., *Le conchiglie del Mar Tirreno.* Bull. Malac. Ital., Vol. II. Pisa, 1869.

[67] APPELIUS F., *Catal. conch. foss. Livorn.* Bull. Malac. Ital., Vol. III, Pisa, 1870.

[68] BARBIERI F., *Il Pliocene di Val Recchio (Parma).* Serv. Geol. Ital., Vol. LXXIV. Roma, 1952.

[69] BARBIERI F., *La serie pliocenica di Castell'Arquato.* Guida Colloquio Intern. Micropaleont. in Italia. Milano, 1958.

[70] BELLARDI L., *Monografia delle Pleurotome del Piemonte.* Estr. Mem. Acc. Sc. Tor., Ser. 2ª, Vol. IX. Torino, 1847.

[71] BELLARDI L., *I Molluschi dei terreni terziari del Piemonte e della Liguria.* Voll. I-II-III-IV-V-VI. Torino, 1872 - 1877 - 1882 - 1884 - 1887 e 1888 - 1890.

[72] BROCCHI G., *Conchiologia fossile subapennina con osservazioni geologiche.* Tomi I-II. Milano, 1914.

[73] CALCARA P., *Memoria sopra alcune conchiglie fossili rinvenute nella contrada d'Altavilla.* Stamp. Muratori. Palermo, 1841.

[74] CAMPANI G., *Siena e il suo territorio (Geologia).* Tip. Istit. Sordomuti. Siena, 1962.

[75] CAPELLINI G., *Su i terreni terziari di una parte del versante settentrionale dell'Appennino.* Mem. Acc. Sc. Ist. Bologna, Ser. 3ª, Tomo VI. Bologna, 1876.

[76] CAPELLINI G., *L'uomo pliocenico in Toscana.* Atti Acc. Real. Lincei Ser. 2ª, Tomo III. Roma 1876.

[77] CARETTO P. G., *Nuovi dati sulla estensione della formazione a facies piacenziana ad Ovest della città di Asti.* Estr. Atti Soc. Ital. Sc. Nat. e Mus. Civ. St. Nat. in Milano, Vol. CII, Fasc. I. Milano, 1963.

[78] CERULLI - IRELLI S., *Fauna malacologica mariana.* Palaeontogr. Ital., Voll. XIII-XVII-XVIII-XX. Pisa, 1907 - 1911 - 1912 - 1914.

[79] CIPOLLA F., *Le pleurotomidi del Pliocene di Altavilla.* Palaeontogr. Ital., Vol. XX. Pisa, 1914.

[80] CLERICI E., *Resoconto sommario delle escursioni fatte nei dintorni di Siena e al Monte Amiata nel settembre 1903.* Boll. Soc. Geol. Ital., Vol. XXII. Roma, 1903.

[81] COPPI F., *Paleontologia modenese.* Società Tipografica. Modena, 1881.

[82] COSSMAN M., *Essais de Paléoconchologie comparée.* Voll. 1-12. Paris, 1895-1921.

[83] COSTA O. G., *Foraminiferi fossili delle marne terziarie di Messina.* Mem. Acc. Sc. Nap., Vol. II. Napoli, 1855.

[84] CUSCANI POLITI P., *Prove paleontologiche della "pliocenicità" della formazione argillosa in cui sono stati rinvenuti resti di Rhinoceros etruscus nel Senese.* Estr. Atti. Acc. Fisiocr., Sez. Agr., Ser. 2ª, Vol. X, Siena, 1963.

[85] D'ANCONA C., *Malacologia pliocenica italiana.* Voll. I-II. Firenze, 1871-1872.

[86] DE AMICIS G. A., *Contribuzione alla conoscenza dei Foraminiferi pliocenici. I Foraminiferi del Pliocene inferiore di Trineté-Victor (Nizzardo).* Boll. Scc. Geol. Ital., Vol. XII. Roma, 1893.

[87] DE AMICIS G. A., *I Foraminiferi del Pliocene di Bonfornello presso Termini Imerese (Sicilia).* Estr. « Naturalista Siciliano », Vol. XIV. Palermo, 1895.

[88] DECIMA A., *Osservazioni sulle argille ritenute plioceniche del versante meridionale delle Madonie (Sicilia centro-settentrionale).* Riv. Paleont. Ital. e Strat., Vol. LXVIII. Milano, 1962.

[89] DE LA CONCHA S., *Informe sobre alumbramiento de aguas subterràneas en la Zona de Soberania de Melilla (Axeno núm.* 5 - *Resumen de los estudios de Microfauna realizados por don Enrico Perconig en el Laboratorio Micropaleontologico de la E. N. Adaro de Investigaciones Mineras).* Estracto de Notas y Comunicaciones del Instituto Geòlogico y Minero de España, N. 52. Madrid, 1958.

[90] DE STEFANI C., *Molluschi continentali sino ad ora notati in Italia nei terreni pliocenici ed ordinamento di questi ultimi.* Atti Soc. Tosc. Sc. Nat., Vol. II. Pisa, 1876.

[91] DE STEFANI C., *Descrizione degli strati pliocenici dei dintorni di Siena.* Estr. Boll. R. Com. Geol. d'Italia. Anno 1877, numeri 5-8. Roma, 1877.

[92] DE STEFANI C. e PANTANELLI D., *Molluschi pliocenici dei dintorni di Siena.* Bull. Soc. Malacol. Ital., Vol. IV. Pisa, 1879.

[93] DE MORTILLET G., *Coupe géologique de la colline de Sienne.* Atti Soc. Ital. Sc. Nat., Vol. V. Milano, 1863.

[94] DERVIEUX E., *Il genere Cristellaria Lamarck studiato nelle sue specie.* Boll. Soc. Geol. Ital., Vol. X. Roma, 1891.

[95] DERVIEUX E., *Studio sui Foraminiferi pliocenici di Villalvernia.* Atti R. Acc. Sc. Tor., Vol. XXVII. Torino, 1892.

[96] DI NAPOLI ALLIATA E., *Contributo alla conoscenza della stratigrafia del Pliocene e del Calabriano nella regione di Rovigo.* Riv. Ital. Paleont. e Stratigr., Vol. LII. Milano, 1946.

[97] D'ORBIGNY A., *Foraminifères des Iles Canaries.* In Barker, Webb e Berthelot, *Histoire naturelle des Iles Canaries.* Vol. II, Zool. Paris, 1839.

[98] D'ORBIGNY A., *Foraminifères fossiles du bassin tertiaire de Vienne (Autriche)*. Paris, 1846.

[99] FORESTI L., *Catalogo dei Molluschi pliocenici delle colline bolognesi*. Tip. Gamberini e Parmeggiani. Bologna, 1868.

[100] FORESTI L., *Cenni geologici e paleontologici sul Pliocene antico di Castrocaro*. Mem. Acc. Sc. Ist. Bol., Vol. VI. Bologna, 1876.

[101] FORESTI L., *Contribuzione alla conchiologia fossile italiana*. Mem. Acc. Sc. Ist. Bol., Vol. X. Bologna, 1879.

[102] FORESTI L., *Ostrea cochlear e di alcune sue varietà*. Rend. Acc. Sc. Ist. Bologna, Anno Accademico 1879-80.

[103] FORESTI L., *Enumerazione dei Brachiopodi e dei Molluschi pliocenici dei dintorni di Bologna* (Parte 2ª). Boll. Soc. Malac. Ital., Vol. XVIII. Pisa, 1895.

[104] FORNASINI C., *Nota preliminare sui Foraminiferi della marna pliocenica del Ponticello di Savena nel Bolognese*. Boll. Soc. Geol. Ital., Vol. II. Roma, 1883.

[105] FORNASINI C., *Foraminiferi illustrati da Soldani e citati dagli Autori*. Estr. Boll. Soc. Geol. Ital., Vol. V. Roma, 1886.

[106] FORNASINI C., *Foraminiferi pliocenici del Ponticello di Savena presso Bologna*. Tip. Fava e Caragnani. Bologna, 1891.

[107] FORNASINI C., *Note micropaleontologiche*. Rend. Acc. Sc. Ist. Bol., Nuov. Ser., Vol. I. Bologna, 1897.

[108] FORNASINI C., *Di alcuni Foraminiferi miocenici del Bolognese illustrati in una tavola pubblicata dallo stesso Fornasini nell'anno 1889*. Rend. R. Acc. Sc. Bol., Vol. I. Bologna, 1897.

[109] FORNASINI C., *Decimo contributo alla conoscenza della microfauna terziaria italiana. Foraminiferi del Pliocene superiore di S. Pietro in Lama presso Lecce*. Mem. R. Acc. Sc. Bol., Vol. VII. Bologna, 1898.

[110] FORNASINI C., *Illustrazione di alcune specie orbignyane di Nodosaridi, di Rotalidi e d'altri Foraminiferi, istituite nel 1826*. Mem. R. Acc. Sc. Bol., Ser. 6ª, Tomo V. Bologna, 1908.

[111] FOSSA-MANCINI E., *Le condizioni batimetriche del mare toscano nei tempi pliocenici*. Atti VIII Congr. Geogr. Ital., Vol. II, Firenze, 1923.

[112] GIANNINI E. e TAVANI G., *Una nuova specie di "Cibicides" del terziario*. Estr. Atti Soc. Tosc. Sc. Nat., Ser. A, Vol. LXVI. Pisa, 1960.

[113] GIANNINI E. e TAVANI G., *Foraminiferi miocenici e pliocenici di un sondaggio effettuato in Val di Trossa (Toscana)*. Estr. Palaeontogr. Ital., Vol. LV. Pisa, 1960.

[114] GIANNOTTI A., *Microfaune della serie tortoniana del Rio Mazzapiedi-Castellania (Tortona-Alessandria)*. In *Studi stratigrafici e micropaleontologici sull'Appennino Tortonese*. Riv. Ital. Paleont. e Stratigr., Mem. VI. Milano, 1953.

[115] GIGNOUX M., *Les formations marines pliocènes et quaternaires de l'Italie du Sud et de la Sicile*. Annales Université de Lyon, Nouvelle Série, Vol. XXXVI. Lyon-Paris, 1913.

[116] IACCARINO S., *Il Pliocene inferiore del Rio Lombasino (S. Andrea Bagni-Parma)*. Riv. Paleont. Ital. e Stratigr., Vol. LXIX. Milano, 1963.

[117] MALAGOLI M., *Foraminiferi pliocenici di Castell'Arquato e Lugagnano nella provincia di Piacenza*. Boll. Soc. Geol. Ital., Vol. XI. Roma, 1892.

[118] MALARODA R., *Contributo alle conoscenze paleontologiche del Pliocene dei dintorni di Strongoli, nel Crotonese (Catanzaro)*. Estr. Rend. Acc. Naz. Lincei Cl. Sc. Fis. Mat. e Nat., Ser. 8ª, Vol. XIX, Fasc. I, e II. Roma, 1955.

[119] MARTINIS B., *Ricerche stratigrafiche e micropaleontologiche sul Pliocene piemontese*. Estr. Riv. Ital. Paleont. e Strat., Vol. LX, Milano, 1954.

[120] MARTINIS B., *Notizie geologiche e paleontologiche sui terreni dei dintorni di Corigliano d'Otranto*. Riv. Ital. Paleont. e Strat., Vol. LXVIII. Milano, 1962.

[121] MARTINOTTI A., *Foraminiferi pliocenici di Castrocaro (Forlì)*. Atti Soc. Ital. Sc. Nat., Vol. LXVIII. Milano, 1920.

[122] MASTRORILLI V. I., *I Molluschi del Pliocene ligure nella collezione dell'Istituto di Geologia dell'Università di Genova e i microfossili delle formazioni che li ricettavano*. Estr. Atti Ist. Geol. Univ. Gen., Vol. VII, Fasc. 1. Genova. 1969.

[123] PALLA P., *Lamellibranchi pliocenici della bassa Val d'Elsa (Toscana occidentale)*. Riv. Ital. Paleont. Stratigr., Vol. LXXII, N. 2. Milano, 1966.

[124] PALLA P., *Gasteropodi pliocenici della bassa Val d'Elsa (Toscana occidentale)*. Riv. Ital. Paleont. Stratigr., Vol. LXXIII, N. 3. Milano, 1967.

[125] PANTANELLI D., *Rapporto della Direzione del Museo di Paleontologia dell'Accademia dei Fisiocritici* (Rassegna di 330 specie di Molluschi fossili dei dintorni di Siena). Atti Acc. Fisiocr. Ser. 3ª, Vol. I, Fasc. VI, Siena, 1875.

[126] PANTANELLI D., *Rapporto della Direzione del Museo dell'Accademia dei Fisiocritici* (Contiene un elenco di fossili pliocenici dei dintorni di Staggia). Atti Acc. Fisiocr., Ser. 3ª, Vol. I, Fasc. VII. Siena, 1876.

[127] PANTANELLI D., *Dei terreni terziari intorno a Siena*. Atti Acc. Fisiocr., Ser. 3ª, Vol. I, Fasc. VIII. Siena, 1877.

[128] PANTANELLI D., *Bibliografia geologica e paleontologica della Provincia di Siena*. Ann. Scol. Liceo Guicciardini. Siena, 1878 .

[129] PARETO L., *Sopra alcune alternative di strati marini e fluviali nei terreni di sedimento superiori dei colli subappennini*. Giornale Toscano di Scienze mediche, fisiche e naturali. Tomo I, N. 4. Firenze, 1843.

[130] PERCONIG E., *La stratigrafia del sondaggio profondo di Cortemaggiore*. Estr. Atti VII Convegno Nazionale del Metano e del Petrolio (Aprile, 1952). Palermo, 1952.

[131] PERCONIG E., *La stratigrafia del sondaggio n. 1 di Morrovalle eseguito dall'A.G.I.P. nelle Marche*. Boll. Serv. Geol. Ital., Vol. LXXIV, Fasc. I. Roma, 1953.

[132] PERCONIG E., *Nota informativa sulla presenza del Calabriano nel sottosuolo di Castenedolo (Brescia)*. Tirage à part des « Actes du IV Congr. Intern. du Quaternaire ». Rome-Pise, 1953.

[133] PERCONIG E., *Note paleontologiche sulla zona costiera di Agrigento (Sicilia)*. Estr. Contr. Scienze Geologiche, Vol. III. Roma, 1954.

[134] PERCONIG E., *Ricerche stratigrafiche e micropaleontologiche nella*

regione marchigiana (Foglio Fermo). Boll. Serv. Geol. Ital., Vol. LXXVII. Roma, 1955.

[135] ROSSI RONCHETTI C., *I tipi della « Conchiologia fossile subappennina » di G. Brocchi.* Mem. V, Riv. Ital. Paleont., Voll. I e II. Milano, 1952-1955.

[136] RUGGIERI G. e SELLI R., *Il Pliocene e Postpliocene dell'Emilia.* Estr. Giorn. Geol. Ann. Mus. Geol. Bologna, Ser. 2ª, Vol. XX. Bologna, 1949.

[137] RUGGIERI G., *Geologia e stratigrafia della sommità del Terziario a Castrocaro (Forlì).* Estr. Giorn. Geol. Ann. Mus. Geol. Bologna, Ser. 2ª, Vol. XXIV. Bologna, 1957.

[138] RUGGIERI G. - BRUNO F. - CURTI G., *La malacologia pliocenica di Altavilla (Palermo).* Parte prima Estr. Atti Acc. Sc. Lett. di Palermo, Ser. 4ª, Vol. XVIII. Palermo, 1959.

[139] RUGGIERI G. - CURTI G., *La malacofauna pliocenica di Altavilla (Palermo). Parte seconda.* Estr. Atti Acc. Sc. Lett. di Palermo, Ser. 4ª, Vol. XVIII. Palermo, 1959.

[140] RUGGIERI G., *Alcune zone biogeografiche del Pliocene e del Pleistocene italiano.* Estr. Riv. Ital. Paleont. e Strat., Vol. LXVII. Milano, 1961.

[141] RUGGIERI G., *La serie marina pliocenica e quaternaria della Romagna.* Pubblic. Cam. Comm. Ind. Agr. Forlí, 1962.

[142] SACCO F., *I molluschi dei terreni terziari del Piemonte e della Liguria.* Voll. XII-XVI-XVIII e XIX-XXII-XXIII e XXIV-XXVIII-XXVIII-XXX. Torino, 1892-1894-1895-1896-1897-1898-1900-1904.

[143] SACCO F., *L'Appennino settentrionale. Parte III. La Toscana.* Boll. Soc. Geol. Ital., Vol. XIV. Roma, 1895.

[144] SACCO F., *Catalogo paleontologico del bacino terziario del Piemonte.* Boll. Soc. Geol. Ital., Vol. VIII. Roma, 1899.

[145] SACCO F., *Il Piacenziano sotto Torino.* Boll. Soc. Geol. Ital., Vol. XXIII. Roma, 1904.

[146] SACCO F., *Il Pliocene marino attorno ai colli torinesi.* Atti R. Acc. Sc. Tor., Vol. LXV. Torino, 1930.

[147] SEGUENZA G., *Prime ricerche intorno ai Rizopodi delle argille pleistoceniche dei dintorni di Catania.* Estr. Atti Acc. Gioenia Sc. Nat., Ser. 2ª, Vol. XVIII. Catania, 1862.

[148] SEGUENZA G., *Studi stratigrafici sulle formazioni plioceniche dell'Italia meridionale* (Province di Reggio, Messina, Siracusa, Palermo). Boll. R. Com. Geol. d'Ital., Voll. IV-V-VI-VII-VIII. Roma, 1873-1874-1875-1876-1877.

[149] SEGUENZA G. *Le formazioni terziarie della provincia di Reggio Calabria.* Atti R. Acc. Lincei, Ser. 3ª, Vol. IV. Roma, 1880.

[150] SESTINI A., *Il mare pliocenico della Toscana meridionale.* Estr. Mem. Geol. e Geogr. Giotto Dainelli, Vol. II. Firenze, 1931.

[151] SILVESTRI O., *Catalogo dei Rizopodi (Foraminiferi) delle argille turchine plioceniche senesi.* In *Siena e il suo territorio (Geologia).* Tipogr. Istit. Sordomuti. Siena, 1862.

[152] SILVESTRI O., *Saggio di studi sulla fauna microscopica fossile appartenente al terreno subappennino italiano. Monografia delle Nodosarie.* Atti Acc. Gioenia Sc. Nat., Ser. 3ª, Vol. VII. Catania, 1872.

[153] SILVESTRI A., *Foraminiferi pliocenici della Provincia di Siena.* Parte prima. Mem. Acc. Pont. Nuovi Lincei, Vol. XII. Roma, 1896.

[154] SILVESTRI A., *Foraminiferi pliocenici della Provincia di Siena.* Parte seconda. Mem. Acc. Pont. Nuovi Lincei, Vol. XV. Roma, 1899.

[155] SOLDANI A., *Saggio orittografico ovvero osservazioni sopra le terre nautiliche ed ammonitiche della Toscana con appendice e catalogo di piccoli testacei.* Stamperia V. Pazzini Carli. Siena, 1780.

[156] SOLDANI A., *Testaceographiae ac zoophytographiae parvae et microscopicae.* Tipogr. Francisci Rossi et filii. Siena, 1789-1798.

[157] TORRENTE A., *Contributo alla conoscenza della stratigrafia del Calabriano e del Pliocene superiore e medio della Pianura pontina.* Boll. Serv. Geol. Ital., Vol. LXXIV. Roma, 1952.

[158] TREVISAN L., *Sul complesso sedimentario del Miocene superiore e Pliocene della Val di Cecina, ecc.* Estr. Boll. Soc. Geol. Ital., Vol. LXX. Roma, 1951.

[159] ZAPPI L., *Pliocene di Castel Verrua.* Estr. Atti Soc. Ital. Sc. Nat. e Mus. Civ. St. Nat. in Milano, Vol. C, Fasc. I e II. Milano, 1961.

EXPLANATIONS TO PLATE I

Fig. 1 — Fragment of the proximal epiphysis of the right humerus (of *Rhinoceros etruscus* from Castelnuovo Berardenga); a good part of the articular surface of the head is still visible.

Fig. 2 — Distal fragment of the same bone with part of the articular surface of the trochlea; a small tract of diaphysis is still attached to it.

Fig. 3 — Left front foot: the pyramidal, the IV metacarpus (marked with a dotted line) and all the phalanges are missing. The bones of the proximal carpal range (scafoid, semilunar) and the distal range (trapezoid, os magnum, unciform), and also the metacarpal bones II and III.

All the figures are about half natural size.

From the « ATTI ACCADEMIA FISIOCRITICI SEZ. AGR. - SER. II - VOL. X »
P. CUSCANI POLITI. *Resti di* Rhinoceros (Dicerorhinus) etruscus *rinvenuti nel Pliocene del Senese.*

Fig. 1

Fig. 2

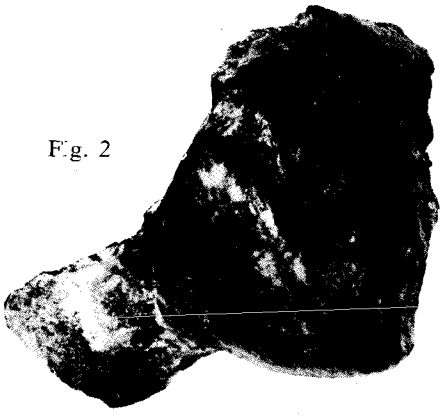
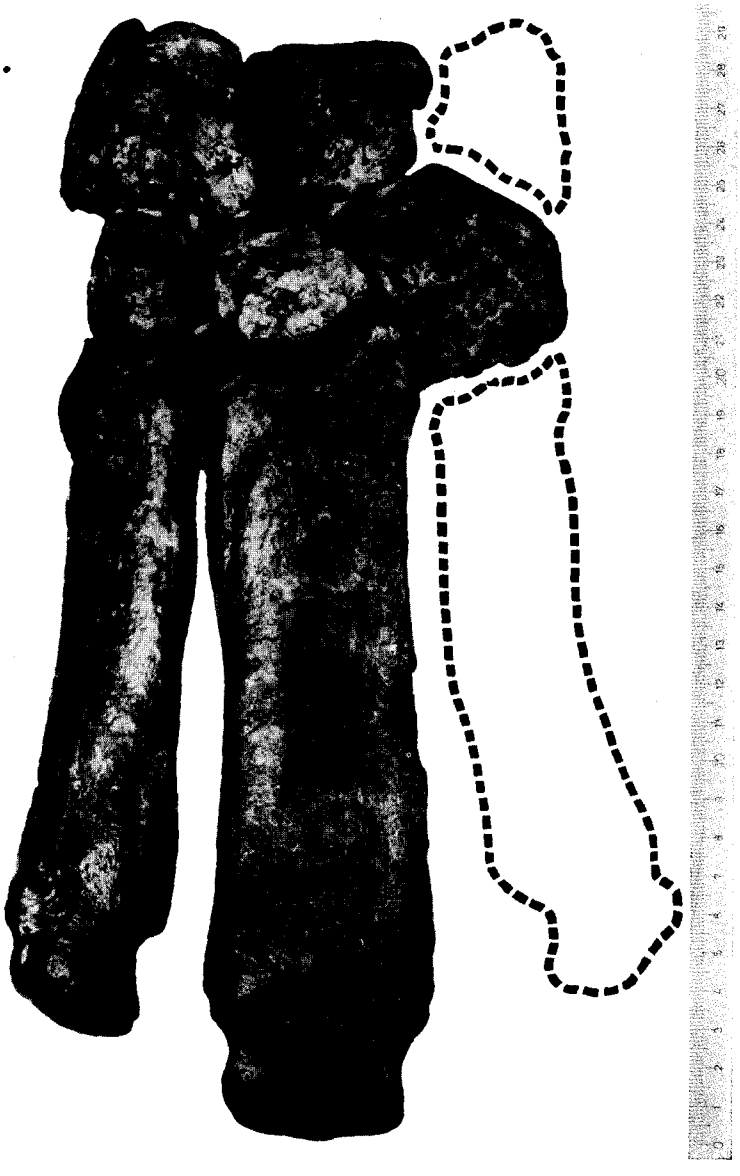


Fig. 3



EXPLANATIONS TO PLATE II

Figs. 1 - 2 - 3 - 4. represent in succession the scafoid seen from the proximal articular surface, from the outer side, the semilunar, and last, the trapezoid of *Rhinoceros etruscus* from Castelnuovo Berardenga.

Figs. 5 - 6 - 7 - 8, represent the homologues of *Rhinoceros etruscus* from Leffe (the first three bones belong to the right foot, the fourth to the left).

Figs. 9 - 10 - 11 - 12, represent in succession the os magnum seen from the outer side, from the lower side, the unciform and the first phalange of the fourth toe of *Rhinoceros etruscus* from Castelnuovo Berardenga.

Figs. 13 - 14 - 15 - 16, represent the homologues of the right foot of *Rhinoceros etruscus* from Leffe.

All the figures are about half natural size.

From the « ATTI ACCADEMIA FISIOCRITICI SEZ. AGR. - SER. II - VOL. X »
P. CUSCANI POLITI. *Resti di* Rhinoceros (Dicerorhinus) etruscus *rinvenuti nel Pliocene del Senese.*

Fig. 1

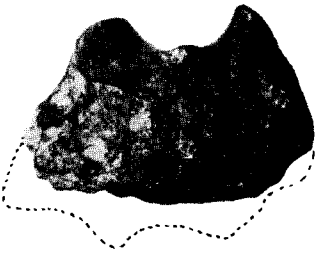


Fig. 2

Fig. 3

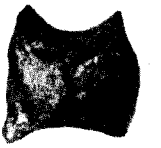


Fig. 4

Fig. 5

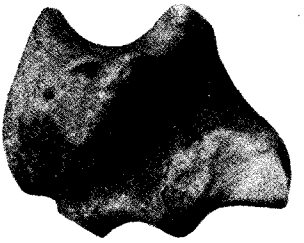


Fig. 6

Fig. 7

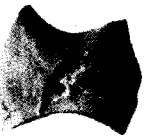


Fig. 8

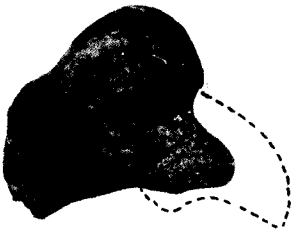


Fig. 9

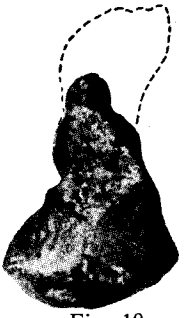


Fig. 10

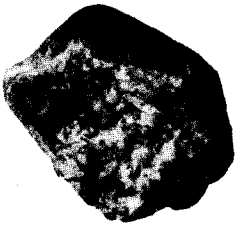


Fig. 11

Fig. 12

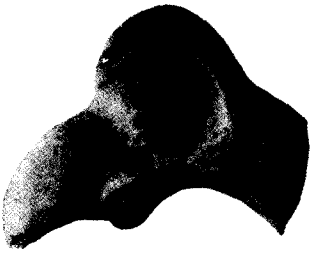


Fig. 13

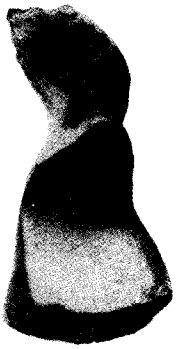


Fig. 14

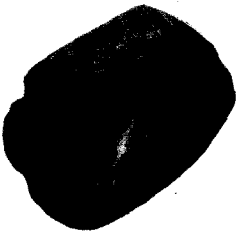


Fig. 15

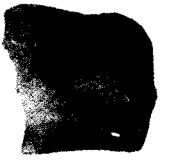


Fig. 16

EXPLANATIONS TO PLATE III

Fig. 1 — III metacarpus (left foot) of *Rhinoceros etruscus* from Castelnuovo Berardenga; front view.

Figs 1-2 — II metacarpus (left foot of the same Rhinoceros); front and outer views.

Figs. 1 - 2 - 3 — The homologues (right foot) of *Rhinoceros etruscus* from Leffe seen from the same sides as above.

The osteometrical differences found when comparing the bones are within the limits characterizing the size variations of bones of *Rhinoceros etruscus* (see the comparative tables in the text).

All the figures are about half natural size.

From the « ATTI ACCADEMIA FISIOCRITICI SEZ. AGR. - SER. II - VOL. X »
P. CUSCANI POLITI. *Resti di* Rhinoceros (Dicerorhinus) etruscus *rinvenuti nel Pliocene del Senese.*

Fig. 1

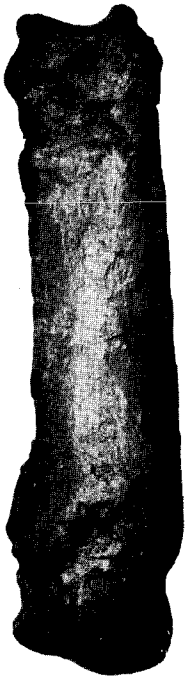


Fig. 2

Fig. 3

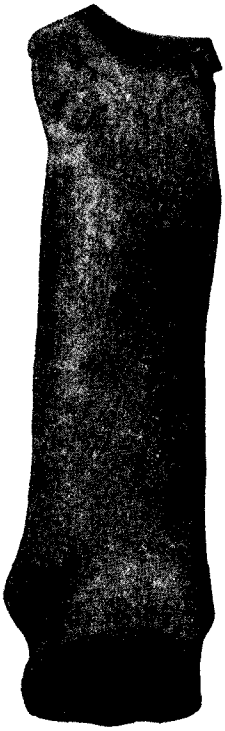


Fig. 4

Fig. 5

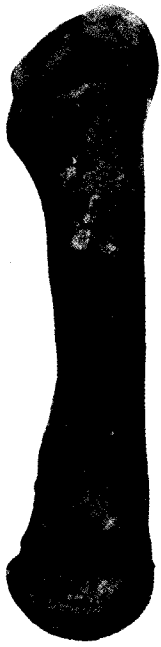


Fig. 6

EXPLANATIONS TO PLATE IV

Fig. A - *Dentalium sexangulum* Schröt.

Figs. 1-2 - *Arca diluvii* Lamk.

Fig. 3 - *Limopsis aurita* Brocchi
» 4 - *Clamys inflexa* Poli
» 5 - *Venus multilamella* Lamk.

Figs. 6a-b - *Architectonica millegranum* Lamk.
» 7a-b - » *monilifera* Bronn

Fig. 8 - *Natica raropunctata* Lamk.
» 9 - *Polynices catena* Da Costa
» 10 - *Turritella subangulata* Brocchi

Figs. 11-12 - *Vermetus intortus* Lamk.
» 13-14 - *Sveltia lyrata* Brocchi

Fig. 15 - *Chenopus uttingerianus* Risso

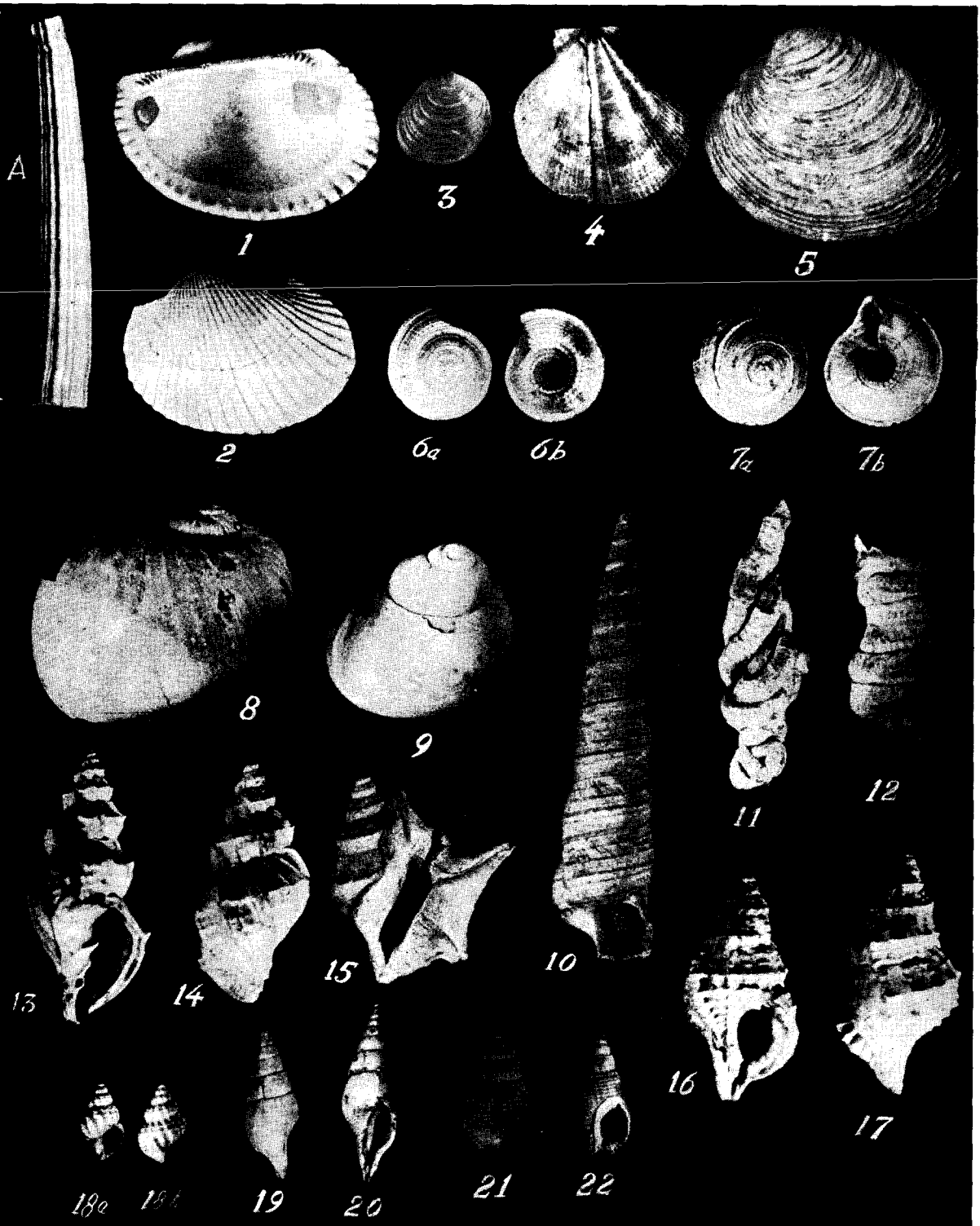
Figs. 16-17 - *Charonia appenninica* Sassi
» 18a-b - *Bonellitia serrata* Bronn

Fig. 19 - *Pyrene* sp. ind.
» 20 - *Pyrene nassoides* Grat.

Figs. 21-22 - *Nassa italica* Mayer

All the figures are natural size.

From the « ATTI ACCADEMIA FISIOCRITICI SEZ. AGR. - Ser. II - Vol. X »
P. CUSCANI POLITI. *Prove paleontologiche della "pliocenicità" della formazione argillosa in cui sono stati rinvenuti resti di* Rhinoceros etruscus *nel Senese.*



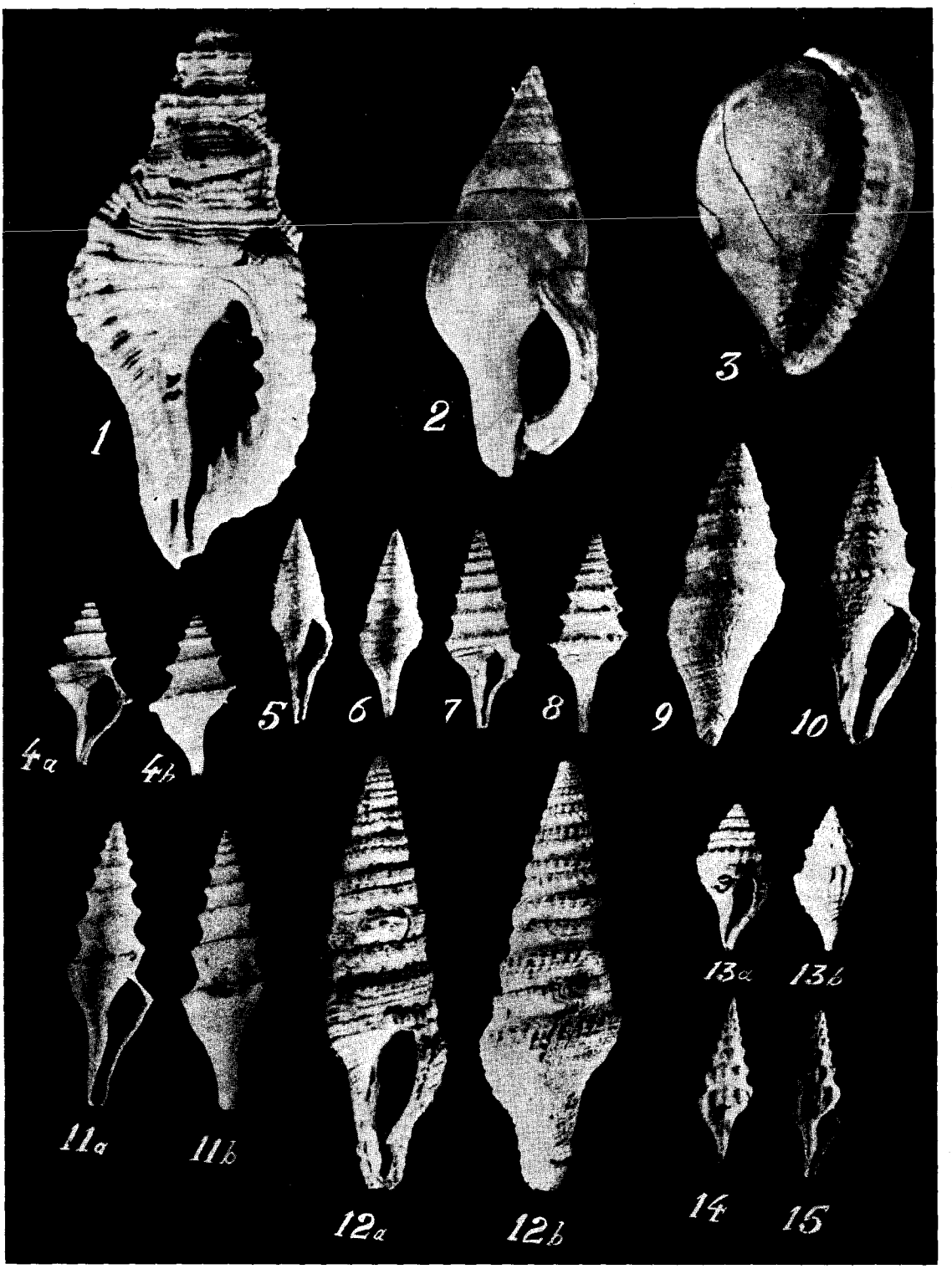
EXPLANATIONS TO PLATE V

Fig. 1 - *Cymatium affine* Desh.
» 2 - *Euthria cornea* Linn.
» 3 - *Eocypraea (Apiocypraea) pyrula* Lamk.

Figs. 4a-b - *Pleurotomella calliope* Brocchi
» 5-6 - *Turris turrifera* Nyst
» 7-8 - *Turris rotata* Brocchi
» 9-10 - *Bathytoma cataphracta* Brocchi
» 11a-b - *Turricula dimidiata* Brocchi
» 12a-b - *Clavatula interrupta* Brocchi
» 13a-b - *Pseudotoma bonellii* Bellardi
» 14-15 - *Turricula allionii* Bellardi

All the figures are natural size.

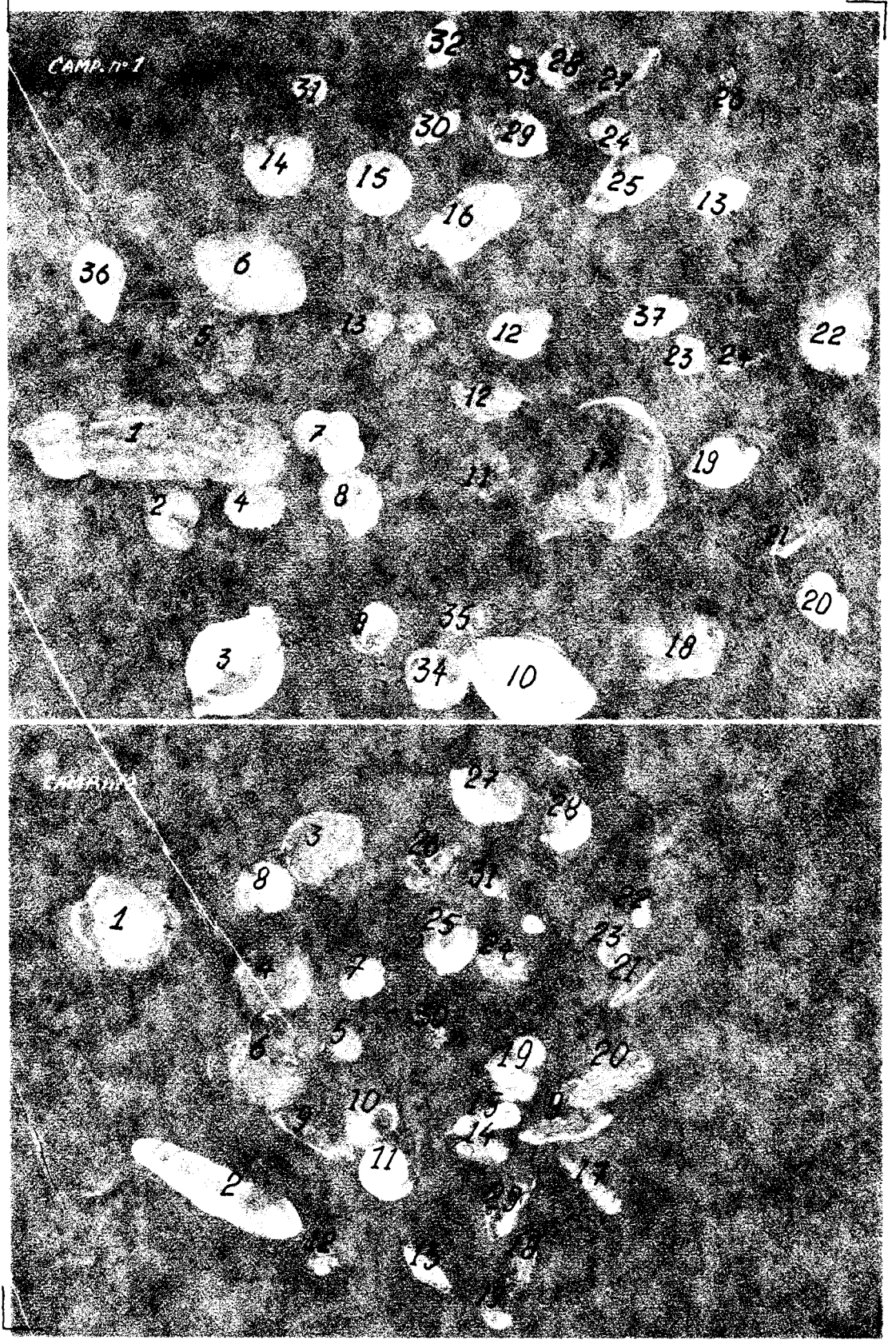
From the « ATTI ACCADEMIA FISIOCRITICI SEZ. AGR. - Ser. II - Vol X »
P. CUSCANI POLITI. *Prove paleontologiche della "pliocenicità" della formazione argillosa in cui sono stati rinvenuti resti di* Rhinoceros etruscus *nel Senese.*



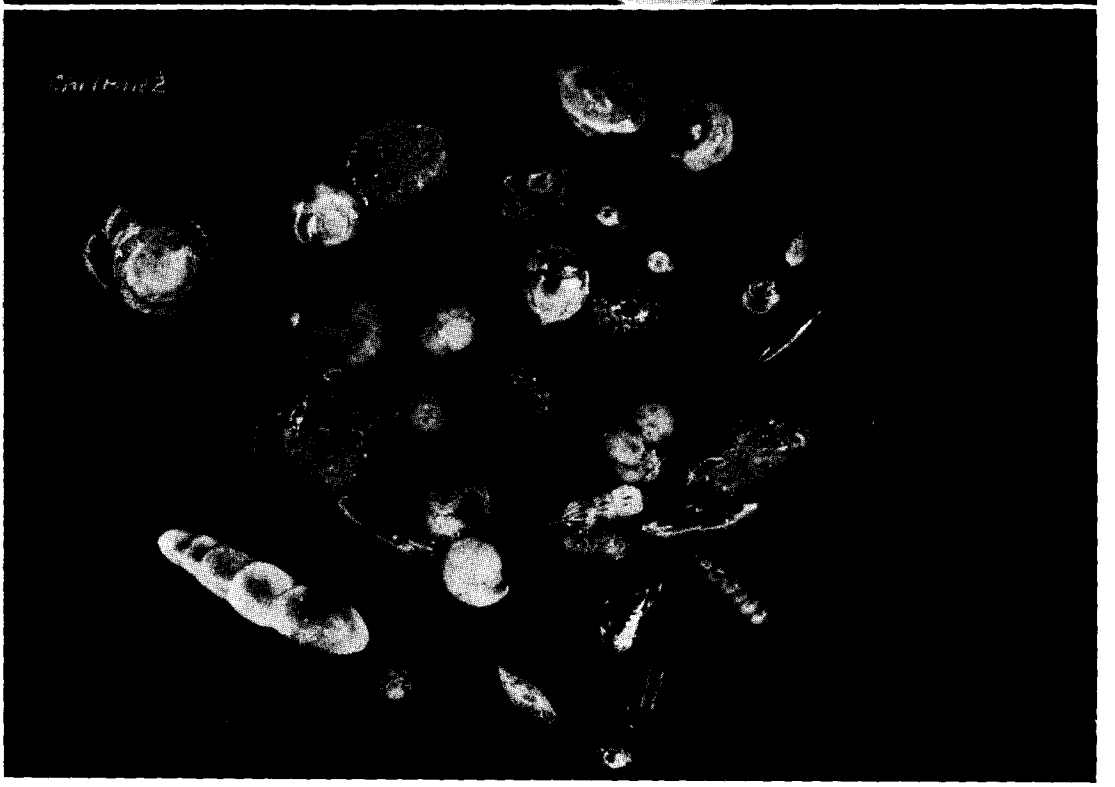
EXPLANATION TO PLATE VI

Sample n. 1 (« *s* »). (*Approximately* x 26).
Fig.
1 - *Marginulina crebricosta* Seg.
2 - *Nonion soldanii* d'Orb.
3 - *Spiroculina excavata* d'Orb.
4 - *Globulina gibba tubercolata* d'Orb.
5 - *Cibicides ungerianus* d'Orb.
6 - *Dorothia gibbosa* d'Orb.
7 - *Hastigerina subcretacea* Lomn.
B - *Nonion depressum* W. e J.
R - *Cibicides boueanus* d'Orb.
10 - *Quinqueloculina vulgaris* d'Orb.
11 - *Planorbulina mediterranensis* d'Orb.
12 - *Bulimina aculeata* d'Orb.
13 - *Bulimina buchiana* d'Orb.
14 - *Cibicides pseudoungerianus* Brad.
15 - *Orbulina universa* d'Orb.
16 - *Marginulina costata* Bath.
17 - *Robulus cultratus* Mont.
18 - *Cibicides lobulatus* W. e J.
19 - *Glandulina laevigata* d'Orb.
20 - *Nonion commune* d'Orb.
21 - *Bolivina aenariensis* Cost.
22 - *Dorotia* cfr. *brevis* Cush. e St.
23 - *Robulus* cfr. *rzehaki* Sch.
24 - *Bulimina affinis* d'Orb.
25 - *Uvigerina peregrina* Cush.
26 - *Trifarina bradyi* Cush.
27 - *Bolivina midwayensis* Cush.
28 - *Gyroidina umbonata* Silv.
29 - *Lenticulina peregrina* Schwag.
30 - *Globigerinoides helicinus* d'Orb.
31 - *Entosolenia staphyllearia* Schwag.
32 - *Bolivina dilatata* Reuss
33 - *Bolivina subspinescens* Cush.
34 - *Eponides umbonatus stellatus* Silv.
35 - *Sphaeroidina bulloides* d'Orb.
36 - *Saracenaria arcuata* d'Orb.
37 - *Bulimina echinata* d'Orb.

Sample n. 2 (« *i* »). (*Approximately* x 26).
Fig.
1 - *Cibicides bellincionii* Giann. e Tav.
2 - *Marginulina glabra* d'Orb.
3 - *Planulina ariminensis* d'Orb.
4 - *Orbulina universa* d'Orb.
5 - *Orbulina saturalis* Bronnim.
6 - *Globigerinoides sacculifer* Brad.
7 - *Globigerina bulloides* d'Orb.
8 - *Gyroidina umbonata* Silv.
9 - *Virgulina squamosa* d'Orb.
10 - *Globigerinoides elongatus* d'Orb.
11 - *Pullenia bulloides* d'Orb.
12 - *Globigerina naparimaensis* Bronnim.
13 - *Virgulina complanata* Egger
14 - *Bolivina dilatata* Reuss
15 - *Siphonodosaria scalaris* Bath.
16 - *Hastigerina subcretacea* Lomn.
17 - *Rectuvigerina siphogenerinoides* Lipp.
18 - *Trifarina bradyi* Cush.
19 - *Bulimina echinata* d'Orb.
20 - *Bigenerina nodosaria* d'Orb.
21 - *Lagena elongata* Ehrenb.
22 - *Lagena hexagona* Will.
23 - *Valvulineria complanata* Cush.
24 - *Globulina gibba tubercolata* d'Orb.
25 - *Lenticulina peregrina* Schwag.
26 - *Globigerinoides helicinus* d'Orb.
27 - *Saracenaria arcuata* d'Orb.
28 - *Gyroidina soldanii* d'Orb.
29 - *Bolivina spathulata* Will.
30 - *Bolivina pseudoplicata* Her.-All. e Earl.
31 - *Robulus crassus* d'Orb.


CAMP. N° 1
32
31
30
29
14
15
16
36
6
5
13
12
37
22
23
1
7
19
11
2
4
8
20
35
3
34
10
18
27
28
3
8
1
25
23
4
7
6
5
19
20
10
14
11
2

From the « ATTI ACCADEMIA FISIOCRITICI SEZ. AGR. - Ser. II - Vol. X »
P. CUSCANI POLITI. *Prove paleontologiche della "pliocenicità" della formazione argillosa in cui sono stati rinvenuti resti di* Rhinoceros etruscus *nel Senese.*



EXPLANATION TO PLATE VII

Sample n. 3 (« s »). (Approximately x 26)

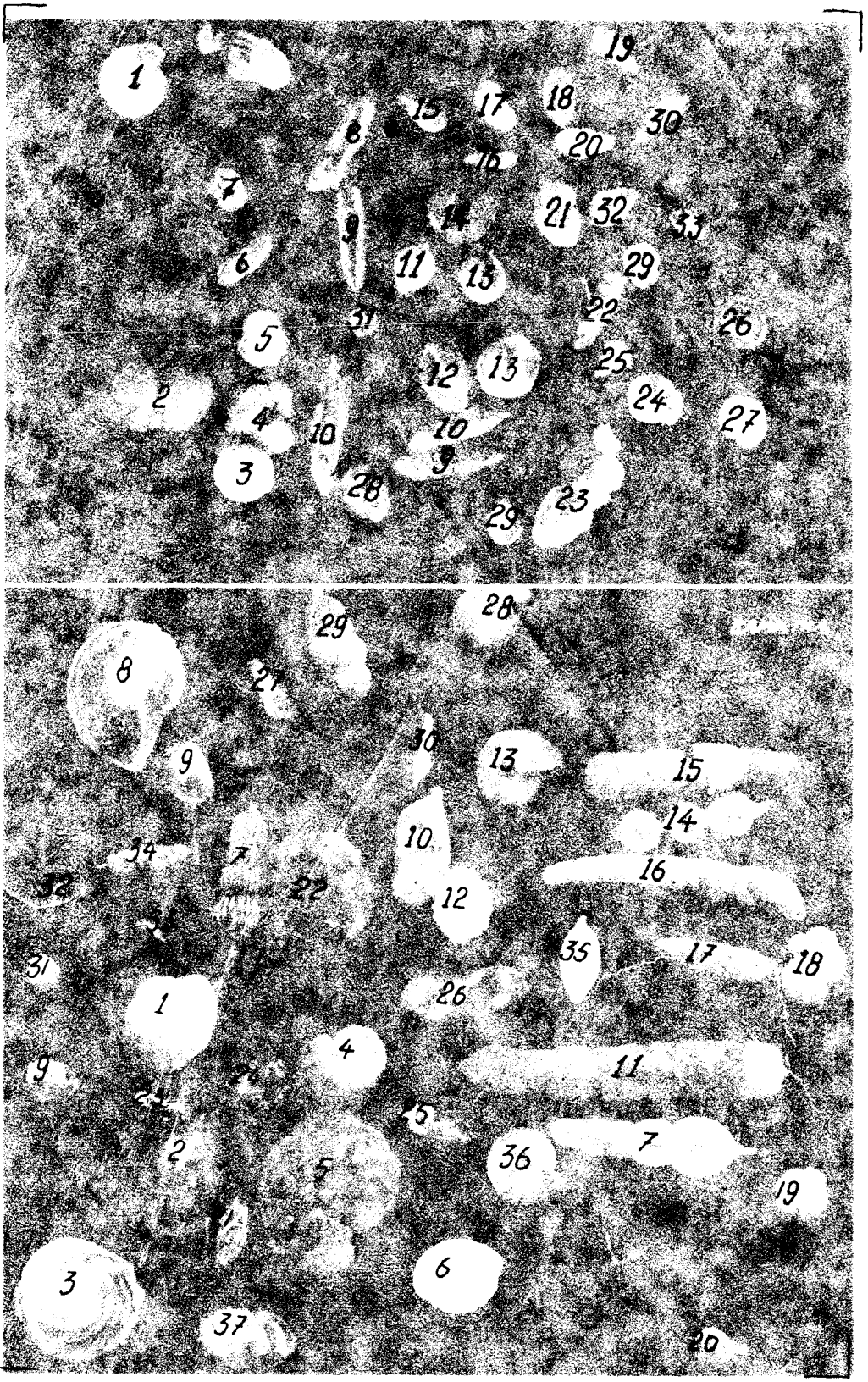
Fig.

1 - *Gyroidina soldanii* d'Orb.
2 - *Globigerinoides sacculifer* Brad.
3 - *Orbulina universa* d'Orb.
4 - *Hastigerina subcretacea* Lomn.
5 - *Cassidulina laevigata carinata* Silv.
6 - *Virgulina complana* Egger
7 - *Globigerina bulloides* d'Orb.
8 - *Marginulina glabra* d'Orb.
9 - *Bolivina midwayensis* Cush.
10 - *Virgulina squamosa* d'Orb.
11 - *Glandulina laevigata* d'Orb.
12 - *Saracenaria arcuata* d'Orb.
13 - *Lenticulina peregrina* Schwag.
14 - *Valvulineria complanata* Cush.
15 - *Bolivina spathulata* Will.
16 - *Bolivina subspinescens* Cush.
17 - *Cassidulinoides bradyi* Norm.
18 - *Bolivina dilatata* Reuss
ER - *Trifanina bradyi* Cush.
20 - *Bulimina elongata lappa* Cush e Park.
21 - *Nonion commune* d'Orb.
22 - *Rectuvigerina siphogenerinoides* Lipp.
23 - *Bigenerina nodosaria* d'Orb.
24 - *Pullenia salisburyi* R. E. - K. G. Stewart.
25 - *Bolivina spinescens* Cush.
26 - *Gyroidina umbonata* Silv.
27 - *Pullenia sphaeroides* d'Orb.
28 - *Globigerinoides helicinus* d'Orb.
29 - *Cibicides refulgens* Mont.
30 - *Bolivina aenariensis* Cost.
31 - *Robulus crassus* d'Orb.
32 - *Bulimina buchiana* d'Orb.
33 - *Bolivina pseudoplicata* Her.-All. e Eearl.

Sample n. 4 (« *i* »). (Approximately x 26).

Fig.

1 - *Cibicides bellincionii* G. e T.
2 - *Saracenaria arcuata* d'Orb.
3 - *Robulus vortex* Ficht. e Moll
4 - Gyroidina soldanii d'Orb.
5 - *Planulina ariminensis* d'Orb.
6 - *Quinqueloculina vulgaris* d'Orb.
7 - *Siphonodosaria scalaris* Batsh.
8 - *Robulus cultratus* Montfort
9 - *Lenticulina peregrina* Schwag.
10 - *Marginulina costata* Batsch
11 - *Martinottiella communis* d'Orb.
12 - *Globulina gibba tubercolata* d'Orb.
13 - *Nonion soldanii* d'Orb.
14 - *Siphonosaria hispida* d'Orb.
15 - *Dimorphina tuberosa* d'Orb.
16 - *Dentalina leguminiformis* Batsch
17 - *Virgulina schreibersiana* Czjz.
18 - *Hastigerina subcretacea* Lomn.
19 - *Globorotalia hirsuta* d'Orb.
20 - *Lagena striata* d'Orb.
21 - *Plectofrondicularia inaequalis dent.* Silv.
22 - *Textularia* sp.
23 - *Chilostomella oolina* Schwag.
24 - *Anomalina grosserugosa bedenensis* d'Orb.
25 - *Siphonodosaria proxima* Silv.
26 - *Cancris auriculus* Ficht. e Moll.
27 - *Bolivina suspinescens* Cush.
28 - *Dorothia gibbosa* d'Orb.
29 - *Uvigerina pygmaea* d'Orb.
30 - *Dentalina inflexa* Reuss
31 - *Entosolenia staphyllearia* Schwag.
32 - *Lagena gracilis* Will.
33 - *Nonionella turgida* Will.
34 - *Rectuvigerina siphogenerinoides* Lipp.
35 - *Sigmoilina tenuis* Czjzek
36 - *Nonion padanum* Perconig
37 - *Bulimina echinata* d'Orb.


1
19
15
17
18
30
8
20
16
7
14
21
32
33
9
6
11
13
29
31
22
26
5
25
12
13
24
27
2
4
10
10
3
9
28
29
23
28
29
8
27
30
13
15
9
14
10
34
7
16
32
22
12
35
17
18
31
1
26
4
11
9
25
2
36
7
5
19
3
6
37
20

From the « ATTI ACCADEMIA FISIOCRITICI SEZ. AGR. - Ser. II - Vol. X »
P. CUSCANI POLITI. *Prove paleontologiche della " pliocenicità " della formazione argillosa in cui sono stati rinvenuti resti di* Rhinoceros etruscus *nel Senese.*