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# Biochronological and palaeogeographical implications of a well-balanced late Middle Pleistocene fauna from Quisisana-Certosa (Capri, Southern Italy)

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*ABSTRACT – The rich fauna found in the red clays at the base of the Quisisana-Certosa deposit (Capri) was collected at the beginning of the present century during the construction and enlargement of the Quisisana Hotel. Several faunal lists have been published by different authors but the vertebrate assemblage of Quisisana-Certosa has never been studied in detail.*

*The present morphometric study of the bone remains has provided new information, the modification of some previous identifications and the demonstration of the presence of species not previously recorded from Capri. The following species have been identified:* Testudo hermanni *Gmelin,* Emys orbicularis *(Linnaeus),* Ursus spelaeus spelaeus *Rosenmüller-Heinroth,* Crocuta *cf.* C. crocuta spelaea *(Goldfuss).* Canis *cf.* C. mosbachensis *Soergel,* Panthera pardus *(Linnaeus),* Oryctolagus cuniculus *ssp.,* Elephas (Palaeoloxodon) antiquus *Falconer & Cautley,* Mammuthus (M.) chosaricus *Dubrovo,* Stephanorhinus hemitoechus *(Falconer),* Equus *aff.* suessenbornensis *Wüst,* Hippopotamus *sp.,* Sus scrofa *ssp.,* Cervus elaphus *ssp.,* Dama *sp.,* Bos primigenius *Bojanus.*

*The mammal assemblage is comprised of both herbivorous and carnivourous forms, with the additional presence of a lagomorph. Each of the assemblages are represented by several species having very different habitat and feeding adaptations (e.g. elephants, rhinoceros, hippopotamuses, deer, bears, hyenas). The faunal association is, therefore, well balanced, of continental type, suggesting that, in the Middle Pleistocene, Capri was not yet an insland but merely an extension of the present Penisola Sorrentina.*

*From a biochronological perspective, the presence of* Mammuthus chosaricus, Equus *aff.* suessenbornensis, Canis *cf.* C. mosbachensis *and* Ursus spelaeus spelaeus *leads us to refer the Quisisana-Certosa deposit to the late Middle Pleistocene. This age is supported also by the presence of Acheulean artefacts which were collected in the upper portion of the red clays, comparable to those found in the Italian peninsula in the sequence of Torre del Pagliaccetto (lower levels) (Torre in Pietra, Rome).*

*RIASSUNTO* – [Implicazioni biocronologiche e paleogeografiche di una fauna ben bilanciata del Pleistocene Medio superiore di Quisisana-Certosa (Capri, Italia meridionale)] – *La ricca fauna raccolta a Capri nelle argille rosse affioranti alla base della successione di Quisisana-Certosa furono scavate agli inizi di questo secolo in occasione dei lavori per l'ampliamento dell'Hotel Quisisana. Nonostante siano state pubblicate diverse liste faunistiche da diversi autori, l'associazione faunistica di Quisisana-Certosa non è mai stata studiata in dettaglio. Il presente studio morfometrico del materiale osseo raccolto a Capri fornisce nuove informazioni sulla composizione della fauna, modificando alcune determinazioni ed inserendo nella lista faunistica alcune specie mai segnalate a Capri prima d'ora. Le specie determinate sono le seguenti:* Testudo hermanni *Gmelin,* Emys orbicularis *(Linnaeus),* Ursus spelaeus spelaeus *Rosenmüller-Heinroth,* Crocuta *cf.* C. crocuta spelaea *(Goldfuss),* Canis *cf.* C. mosbachensis *Soergel,* Panthera pardus *(Linnaeus),* Oryctolagus cuniculus *ssp.,* Elephas (Palaeoloxodon) antiquus *Falconer & Cautley,* Mammuthus (M.) chosaricus *Dubrovo,* Stephanorhinus hemitoechus *(Falconer),* Equus *aff.* suessenbornensis *Wüst,* Hippopotamus *sp.,* Sus scrofa *ssp.,* Cervus elaphus *ssp.,* Dama *sp.,* Bos primigenius *Bojanus.*

*L'associazione faunistica elencata permette di trarre alcune conclusioni di natura sia paleogeografica che biostratigrafica. Tra i mammiferi sono presenti sia erbivori che carnivori (con l'aggiunta di un lagomorfo) ed entrambi i raggruppamenti sono costituiti da un discreto numero di specie caratterizzate da abitudini alimentari, ecologiche ed etologiche differenti (per esempio elefanti, rinoceronti, ippopotami, cervi, orsi, lupi, iene, ecc.). Si tratta, evidentemente, di una fauna ben bilanciata di tipo continentale e ciò suggerisce che all'epoca di questo popolamento Capri non fosse ancora un distretto insulare, ma solamente una estensione della Penisola Sorrentina.*

*Dal punto di vista biostratigrafico, la presenza di alcune forme come* Mammuthus chosaricus, Equus *aff.* suessenbornensis, Canis *cf.* C. mosbachensis *e* Ursus spelaeus spelaeus *inducono ad attribuire la fauna di Quisisana-Certosa alla parte superiore del Pleistocene Medio. Questa età è confermata anche dal ritrovamento, nella parte alta delle argille rosse della successione di Quisisana, di manufatti riferibili all'industria acheuleana, comparabili come grado di lavorazione a quelli rinvenuti nella classica serie di Torre del Pagliaccetto (livelli inferiori) (Torre in Pietra, Roma).*

## INTRODUCTION

The fossil vertebrate remains from the Pleistocene deposits of Quisisana-Certosa (island of Capri) were collected at different times in the early years of this century, during the construction of the Via Krupp and the enlargement of the Hotel Quisisana.

Bellini, Cerio and Dall'Osso were the first scientists who studied these sections, proposed stratigraphic interpretations and listed the fauna.

More recently, Blanc and Cardini studied the

lithic artefacts which were found in the same deposits, possibly in association with the fauna. But a systematic study of the vertebrate remains was never undertaken. However, the fossil material was preserved, with the original labels, in the Museum of the Sezione Caprense «Ignazio Cerio» of the Istituto Italiano di Paleontologia Umana, in the Museo di Paleontologia of the University of Naples «Federico II» and in the storerooms of the Istituto Italiano di Paleontologia Umana of Rome.

Thanks to the courtesy of the President of the «Sezione Cerio», Mrs. L. Cerio, of the Director of the Museo di Paleontologia of Naples, Prof. F. Barattolo, and of the President of the Istituto Italiano di Paleontologia Umana, Prof. A. Bietti, it was possible for us to collect together all the paleontological material and begin its detailed description and revision.

## HISTORICAL REVIEW OF THE QUISISANA-CERTOSA DEPOSIT: STRATIGRAPHY AND FAUNA

The sections of Quisisana and Certosa are located on a terrace sloping south from about 150 m to 100 m a. s. l.. Both were excavated in the first years of this century. In particular, the Certosa section was exposed in 1901 during the excavations for the construction of the Via Krupp. It is located at the beginning of this road, slightly before the Certosa, near Colle di Castiglione. The first observations were made by Bellini (1902; Bellini *in* Pigorini, 1906) who described the following stratigraphy (from the bottom to the top)[1].

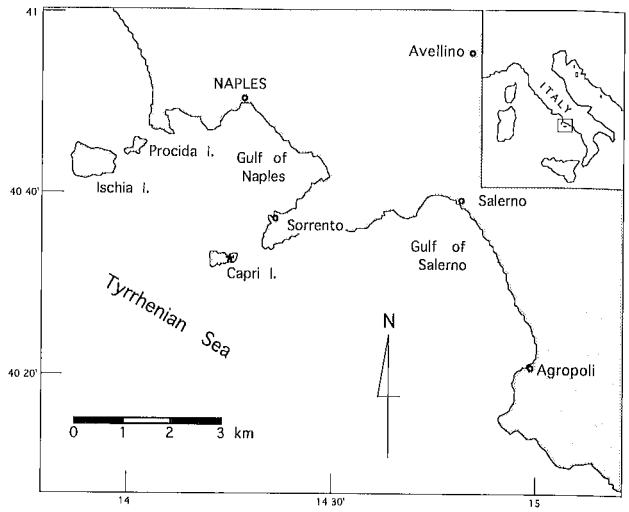
a) lacustrine oxidised clays, with vertebrate bones and chert artefacts;

b) tuff with altered pumices, and abundant crystals of sanidine (interpreted by the author as the base of the Flegrean trachytes);

c) lacustrine oxidised clays, with vertebrate bones and chert artefacts (*sic.*).

The thickness of each level is reported as 50 cm or more.

1) «Al di sopra del solito calcare compatto si adagiano per una considerevole estensione tre strati alti circa mezzo metro e più ognuno; l'inferiore ed il superiore sono d'argilla di origine lacustre e ferrifera, di color ruggine, contenente ossa di mammiferi; il medio è invece di tufo vulcanico con pomici in decomposizione, con vari cristalli di sanidino, base delle trachiti flegree. Lo strato inferiore segue le ondulazioni della roccia su cui si adagia, e tutto il complesso è coperto da grandi blocchi calcarei, caduti dalle pareti circostanti, in modo da mascherare, prima dell'apertura della via, la formazione inferiore. Intimamente contenuti in un punto dello strato più basso ho rinvenuto frammenti di selce piromaca scheggiata che non esiste nell'isola; vi fu quindi portata quando lo strato inferiore era in formazione e di conseguenza in questo tempo l'uomo abitava già la località». (*Bellini, 1902, p. 13*).




Text-fig. 1 - Location map of the island of Capri. The asterisk indicates the Quisisana-Certosa deposit.

The Quisisana section was exposed later, in 1904, during the excavations of the foundations for the enlargement of the Quisisana Hotel, 7 m below the level of the Via Tragara. This section was first described by Cerio in a letter to Pigorini (Cerio *in* Pigorini, 1906). The stratigraphy described by Cerio is as follows (from the bottom to the top)[2]:

a) basal limestone;

b) red clays dipping W, (thickness: 2.0-5.0 m) without volcanic minerals and with vertebrate bones. The upper portion of this level bears lithic artifacts;

c) alternating beds of pozzolana with small pumices and volcanic ashes (thickness: 2.8 m);

d) present day soil (thickness: 1.7 m).

The study of the artefacts and of the vertebrate bones was carried out both by Cerio and Dall'Osso

2) «Esaminando le sezioni di questi scavi, dove la serie de' depositi è completa, riscontrai che il suolo di detta valle è formato da terreno coltivabile spesso m 1,70, il quale ricopre strati alternatisi di pozzolane con piccole pomici e ceneri vulcaniche, del complessivo spessore di m 2,80, attraversati qua e là da piccoli banchi di detriti calcarei cementati da argilla giallo rossastra. Al di sotto di queste materie giace l'argilla rossa, la cui superficie è inclinata dall'est all'ovest ed in immediato contatto con esse, senza interposizione di altre sostanze e senza traccia di rimaneggiamento. Il suo spessore varia da 2 a 5 m secondo le prominenze o depressioni del calcare fondamentale su cui poggia, colmandone tutti i vuoti e tutte le sinuosità. (...) Accuratamente esaminata in tutta la sua massa non vi si trovano elementi di natura vulcanica, ma soltanto ossa di vertebrati poco meno che disfatte dall'umidità. (...). Gli avanzi della industria umana rinvenuti alla sua superficie, le ossa di giganteschi vertebrati riscontrate nella sua massa, sottostanti a tutti i materiali vulcanici dimostrano che qui a Capri, come in altre località d'Italia, l'uomo primitivo assisté a que' grandiosi fenomeni tellurici che mutarono così radicalmente l'aspetto delle nostre contrade ne' primordi dell'epoca quaternaria» (*Cerio* in *Pigorini, 1906, pp. 6-7*).

and between them arose the well-known controversy concerning the contemporary occurrence in Capri of man and large mammals. This controversy was debated during the Riunione della Società Italiana per il Progresso delle Scienze held in Firenze (1908) and at the meeting held in Padova (1909). Before the meeting in Napoli (1910), Pigorini suggested that a new excavation near the Quisisana Hotel should be undertaken to settle the controversy. That excavation, directed by Bassani and Galdieri (1911), showed a lithological sequence similar in composition (but different in the thicknesses) to that described by Cerio. The authors came to the conclusion that the contemporaneity of the large-mammal fauna and the Palaeolithic man was not well demonstrated and that the fauna was probably more ancient.

De Blasio (1906), Giuffrida-Ruggieri (1908) and Bellini (1916) reported the same stratigraphy described by Cerio *in* Pigorini (1906).

Within a short time, the classic section of Quisisana was covered again by the terraces of the hotel. In 1939 Blanc proposed to carry out a new excavation in the vicinity of the original section to make some more accurate investigations, (including palaeobotanical and mineralogical studies) to clarify the stratigraphy (Blanc, 1939). In 1964 Cardini and Segre, of the Istituto Italiano di Paleontologia Umana, had the opportunity to see a new section, exposed because of new building works; the description of that section is reported by Piperno & Segre, 1984. From the bottom to the top the stratigraphy is the following[3]:

a) basal Cretaceous limestone (Albian);

b) marine calcarenite with *Litophaga* holes (Sicilian *s.l.*);

c) red clays (= «Lehm» *Auct.*) with an Acheulean lithic industry in the upper part, overlying Middle Pleistocene vertebrate remains;

d) gray sanidinic stratified cinerite, with pumices and crystals of sanidine (interpreted as a local facies of the «Tufo Grigio Campano» *Auct.*), containing bones of *Dama* sp. (Late Pleistocene);

e) «terra rossa» with bones of *Cervus tyrrhenicus* Azzaroli (Late Pleistocene);

f) stratified «pozzolana» (Holocene);

g) soil and reworked pyroclastic material with Bronze Age pottery and Middle Neolithic lithic artefacts.

The red clays of Piperno & Segre (1984) clearly correspond to the «basal clays» described by Bellini (1902) in the Certosa section, to the «Lehm» of the authors, to the «level 5» of Bassani & Galdieri (1911) and to the «terra rossa» facies tentatively referred to the Mindel-Riss interglacial by Segre (1950) in the geological map of Capri. The red clays are overlain by the cineritic facies of the «Ignimbrite grigia Campana», probably corresponding to the level 3 of Bassani & Galdieri (1911) and to the «Tufo pipernoide campano» mentioned in the geological map of Capri (Segre, 1950). The gray cinerite, dated by $C^{14}$, gave a radiometric age of 35.000 years B.P. (Piperno & Segre, 1984). Inside that level Piperno & Segre mention the occurrence of *Dama* sp.. In our recent investigations no trace of these remains was found either at the Museo Cerio of Capri (where the great majority of the fossils of Quisisana-Certosa excavations is preserved) or at the other two museums where relevant material is stored. Perhaps the remains of *Dama* sp. were collected by Cardini and Segre themselves during their survey in 1964 or they may be the remains preserved in the Museo Cerio but labeled «*Cervus* sp. a 6.0 m nelle pozzolane della Certosa - Capri 1906». If the last hypothesis is the right one, the specific determination of the remains of this cervid should be modified into «*Cervus tyrrhenicus* Azzaroli». Above the «Ignimbrite grigia Campana», except for a small interposition of «terra rossa» bearing remains of *Cervus tyrrhenicus*, the sequence is covered by stratified pozzolana which may correspond to the level 2 of Bassani & Galdieri (1911) and to the brown pozzolana of the geological map of Capri (Segre, 1950).

From the basal red clays (= «Lehm» *Auct.*) bone remains referable to different species of reptiles and mammals were collected.

Cerio *in* Pigorini (1906) and Bellini (1916) mentioned the presence of *Elephas antiquus, Hippopotamus, Rhinoceros tichorhinus, Ursus spelaeus, Cervus* sp., *Sus scrofa, Canis* sp., *Felis tigris*?.

This list was integrated and partially modified by Rovereto (1908) who added the species *Felis pardus, Hystrix cristata* (?) and *Lepus cuniculus*, redefined the rhinoceros as *Rhinoceros mercki* and referred the cervid bones to *Cervus elaphus*.

This last list, without *H. cristata*, was published by Rellini (1910).

3) «La stratigrafia del giacimento si compone di una parte superiore con due livelli (Olocene): uno di suoli e piroclastico rimaneggiato con ceramica del Bronzo e Neolitico medio (1); uno sottostante di «pozzolana» stratificata (2); di una parte intermedia (Pleistocene finale) con una intercalazione di «*terra rossa*» contenente *Cervus tyrrhenicus* Azz. (3); cinerite grigia sanidinica stratificata con pomici, facies locale del «*tufo grigio campano*» *Auct.* (4) contenente *Dama* sp.; di una parte inferiore (Pleistocene medio) con argilla rossa (= «Lehm» *Auct.*) uniforme, priva di stratificazione, di spessore variabile con industria litica acheuleana nella parte alta e sottostanti resti di grandi mammiferi (5); riempimento di una morfologia paleocarsica molto più antica rielaborata da una trasgressione marina (Siciliano *sensu lato*) con residui di spiaggia cementata (6) e perforazioni di litodomi. Calcare cretaceo (Albiano) di base (7)» (*Piperno & Segre*, 1984).

Piperno & Segre (1984), re-examining the stratigraphy of the Quisisana-Certosa deposits, gave an updated faunistic list and, in particular, they mentioned for the first time a mammoth (*E. primigenius* or *E. trogontherii*), a pond tortoise *Emys* sp. and redefined the rhinoceros as *Dicerorhinus* cf. *hemitoechus* and the wild boar as *Sus scrofa ferus*.

Two years later, Caloi *et al.* (1986) referred more precisely the mammutine form to *Mammuthus (M.) chosaricus*.

In the present paper these faunal lists have been integrated and updated. We are now able to demonstrate that the following taxa are present in the deposits of the Quisisana-Certosa succession: *Testudo hermanni* Gmelin, *Emys orbicularis* (Linnaeus), *Ursus spelaeus spelaeus* Rosenmüller-Heinroth, *Crocuta* cf. *C. crocuta spelaea* (Goldfuss), *Canis* cf. *C. mosbachensis* Soergel, *Panthera pardus* (Linnaeus), *Oryctolagus cuniculus* ssp., *Elephas (Palaeoloxodon) antiquus* Falconer & Cautley, *Mammuthus (M.) chosaricus* Dubrovo, *Stephanorhinus hemitoechus* (Falconer), *Equus* aff. *suessenbornensis* Wüst, *Hippopotamus* sp., *Sus scrofa* ssp., *Cervus elaphus* ssp., *Dama* sp., *Bos primigenius* Bojanus. The bone fragment quoted as a rib fragment of *Hystrix cristata* (?) (Rovereto, 1908) is demonstrably not referable to that species, and is probably *O. cuniculus* ssp..

## SYSTEMATIC REVISION OF THE FAUNA

Ordo Perissodactyla
Family RHINOCEROTIDAE Owen, 1875
Gen. STEPHANORHINUS Kretzoi, 1942

STEPHANORHINUS HEMITOECHUS (Falconer, 1868)
Pl. 4, figs. 1-9

Material: fragment of a right mandible with traces of roots of $P_3$ (posterior lobe) and $P_4$ (anterior lobe) (inv. 12; h of the mandible between $P_3$ and $P_4$: 80 mm); left $P_2$ (inv. 11F; w: 20.2 mm); right $P_3$ (inv. 11E; L: 36.0 mm); right $M_2$ (inv. 11A; w: 31.6 mm); 2 left $M_3$ (inv. 11B and 11C); right $M_3$ (inv. 11D; Lxw: 46.0x27.6-30.0 mm); 35 fragments of molars (inv. 11); distal fragment of diaphysis of a very damaged left tibia (inv. 28; DDAP: 56 mm).

The remains of rhinoceros found in Quisisana consist of some loose lower teeth, not very diagnostic from a systematic point of view, and mostly severely damaged, and one extremely fragmentary portion of mandible; nevertheless, several characters of these remains contribute to their attribution to *Stephanorhinus hemitoechus* and not to *S. kirchbergensis* (Jäger, 1835) as was mentioned by Rovereto, 1908 (in De Lorenzo & D'Erasmo, 1927) or to the more ancient form *S. hundsheimensis* (Toula, 1902).

Among the most meaningful characters that justify this attribution, the following can be mentioned: horizontal ramus of the mandible relatively low and thin; presence of a labial rather developed but discontinuous cingulum on $M_2$; presence of a anterior and posterior wide «V»-shaped valleys, rather feeble lingual cingulum which rises up the paraconid and a moderate difference of height between the anterior and the posterior lobe on $M_3$. In general, the dimensions of the teeth are closer to the values of *S. hemitoechus* than to those of *S. kirchbergensis* (cf. Guerin, 1980).

According to Fortelius *et al.*, 1993, *Stephanorhinus hemitoechus* is probably present in Western Europe from Mosbach-2 stage (early Middle Pleistocene, post 0.7 Ma) associated with the other two forms *S. hundsheimensis* and *S. kirchbergensis*, but it becomes more frequent in younger deposits referable to the late Middle Pleistocene and the Late Pleistocene. In Italy, apart from the fragment of mandible of uncertain stratigraphic position, collected at Croce dei Cappuccini (Montevarchi) and referred to the Villafranchian (Fortelius *et al.*, 1993), the first sure presence of *S. hemitoechus* occurs at Visogliano (early Middle Pleistocene) (Bartolomei *et al.*, 1977). It disappeared with the beginning of the Last Glacial.

EXPLANATION OF PLATE 3

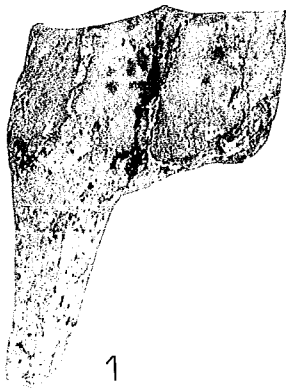
Figs. 1-4 - *Mammuthus (M.) chosarichus*, 1-2) second left upper molar in occlusal and labial views; 3-4) third right upper molar in occlusal view.

Fig. 5 - *Elephas (P.) antiquus*, second (?) lower molar in occlusal view.

All figures are 2/7 natural size.

EXPLANATION OF PLATE 4

Figs. 1-9 - *Stephanorhinus hemitoechus*, 1-2) right $M_2$ in labial and lingual views; 3-5) left $M_3$ in labial, lingual and occlusal views; 6-8) right $M_3$ in labial, lingual and occlusal views; 9) fragment of right mandible in outer view, with mental foramen and fragmentary roots of $P_3$ and $P_4$.
All figures are 4/5 natural size.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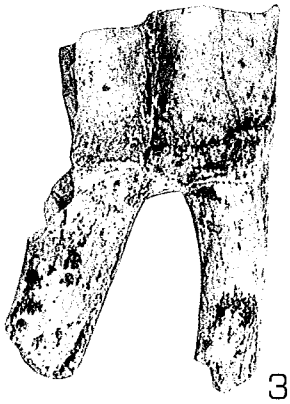
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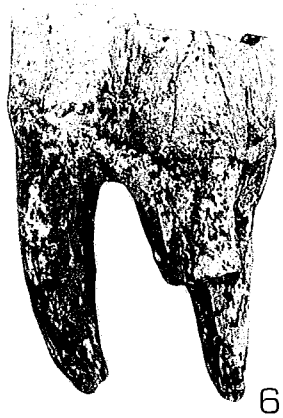
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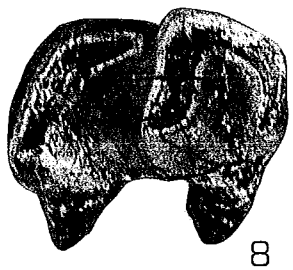
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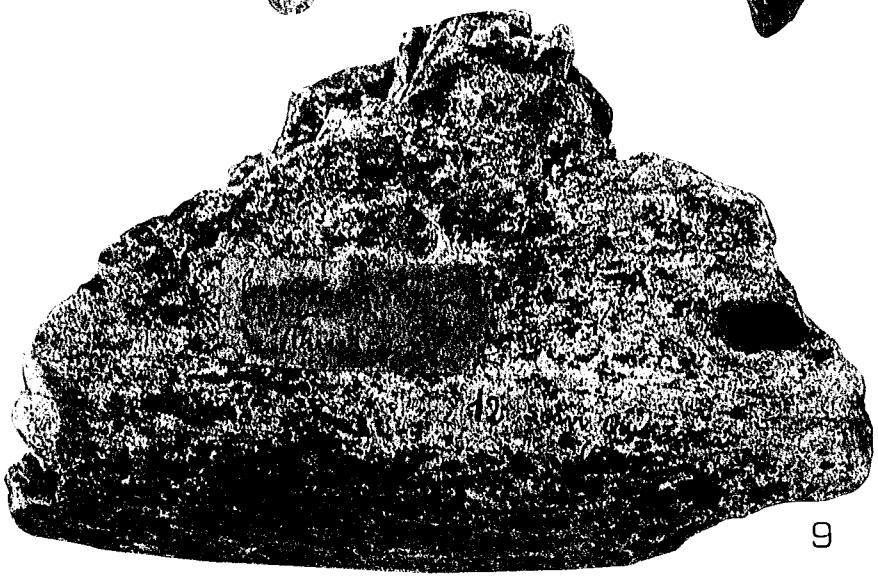
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