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AMMONITES AND CALCAREOUS NANNOPLANKTON OF THE TOARCIAN « ROSSO AMMONITICO » IN THE EXPOSURES OF M. LA PELOSA (TERNI, CENTRAL APENNINES, ITALY)

A correlated study is presented concerning the distribution of Ammonites and of calcareous Nannoplankton in a series of exposures of Toarcian « Rosso Ammonitico » of the Umbro-Marchigiano-Sabina facies. The study of Ammonites associations has made it possible to subdivide the main section into four zones: « unnamed zone », « *Hildoceras bifrons* zone », « *Phymatoceras erbaense* zone », « *Dumortieria meneghinii* zone », on the other hand, we may have to reconsider these terms in view of the new data we collected.

We have illustrated the stratigraphic distribution of the Nannofossils on the basis of the Ammonites zones, as we did not deem it right to establish a zonation on such a limited area.

We also give strictly systematic data on the Ammonites as well as on the Nannoplankton. Two new species of Ammonites are described: *Harpoceras* (*Harpoceratoides*) *domaticus* PALLINI and *Rarenodia venturii* PALLINI. The nature of some « *incertae sedis* » organisms, attributed to *Schizosphaerella punctulata* DEFLANDRE & DANGEARD is discussed.

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Introduction

We studied the Ammonites fauna and the calcareous Nannoflora of the « Rosso Ammonitico » (Toarcian) of M. La Pelosa exposures (Polino, Terni).

In this zone we found numerous exposures of Toarcian « Rosso Ammonitico » which were in favorable conditions for the sampling of Ammonites faunas and calcareous Nannofloras.

We examined the exposures situated along the road connetting the village of Polino to the summit of M. La Pelosa (q. 1635 m) about 4 km after Polino (Foglio 138 Terni I NE Polino) (fig. 1).

In this locality the road cuts the Lower and Middle Jurassic formations of the Umbro-Marchigiano-Sabina facies with numerous hairpin bends. A section of « Rosso Ammonitico » corresponds to just about every curve, and we examined all these exposures to collect the Ammonite fauna.

The fifth and sixth exposures are clearly connected and form a single section which has an ample exposed area. On this we based the Ammonites zonation and collected the Nannoplankton

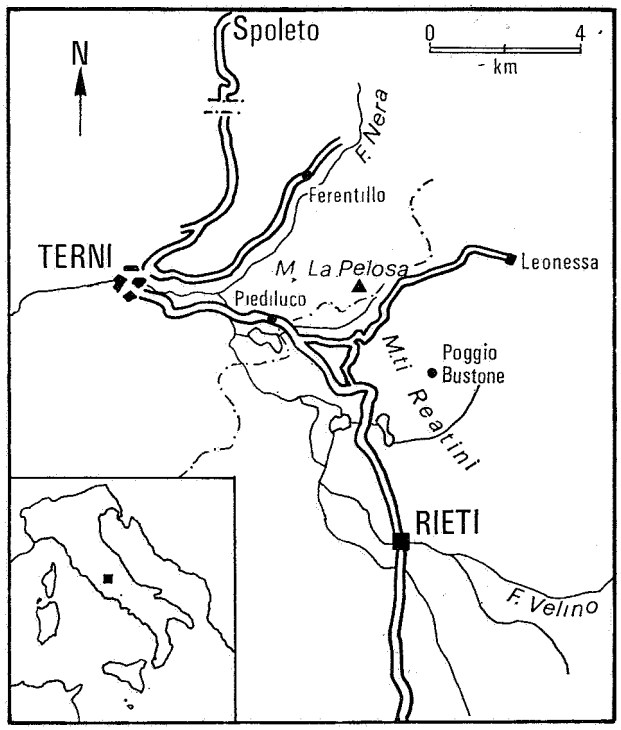

FIG. 1 — Localization of the exposures.

— Localizzazione dell'area studiata.

samples for the study. Of this we made a detailed description of lithological succession. Here the « Rosso Ammonitico » has a thickness of about 18 m and it is consistent with the rest of the series, in a N - NE direction. It leans West regularly and it lays on grey limestone of the « Corniola » which can be attributed to the Domerian as it shows some rare *Arieticeras* spp. On the upper part of the section, after a gradual increase of the calcareous fraction, already pointed out by VENTURI (1972), we noticed the start of the « Calcari Diasprigni ». This passage is made very evident by the different fauna and lithology.

Method of sampling

To obtain the right kind of sampling for our purpose, we have adopted several ways, in order to have a standard basis for future studies.

The section was previously subdivided in meters, and we took as basis (0 meters) the limit between the grey micritic levels, which contain some specimens of *Arieticeras* spp., and the liver colored marles which represent the first lithology attributable to the « Rosso Ammonitico ». Unfortunately these last ones are just about barren, with the exception of a big fragment of *Protogrammoceras* comparable to forms of *P.* gr. *meneghinii* (BONARELLI).

We then roughly identified the limits between the Ammonites zones, or, at least, the last layers which we can safely attribute to a zone and the first layers which we can refer to the successive.

We collected *in situ* all the Ammonites used for stratigraphic purpose or used to calculate the frequency in the distribution of the various species.

We used the ones found in the rich detritus and in the minor exposures only to observe the variability of the forms or to prove the presence of those very rare forms that are only found in fragments *in situ*.

The whole section was then carefully studied, as far as the lithology is concerned, in the eventuality that the Nannoplankton distribution was related more to changes of some environmental factors, than to chronological variations.

This hypothesis can be confirmed or denied only by comparing the section to other sections where the various lithological types have a different chronological distribution compared to ours.

We took samples for Nannoplankton study following two different methods.

First we collected samples in layers with clear variations of Ammonites fauna and we quickly determined them at least according to the type of associations, on the spot. When the absence of an Ammonite species marker prevented the exact marking of the limits of the various zones and subzones, the sampling was made keeping a costant distance among the samples, compatibily with the elimination of those which showed the smallest signs of contamination. In view of this, we must emphasize that this danger is allways present in the nannoflora sampling and especially so in cases of unconsolidated or semiconsolidated sediments, as is partly, the « Rosso Ammonitico ».

We should also expect some argillaceous infiltrations into microfractures of calcareous layers, in as much as the unconsolidated sediment is present pratically in all of the interlayers. This is made even more probable by the strong action of tectonics which shows in every exposure of this formation. For these reasons we often had to discard some samples and had to collect others after a great deal of digging.

In extreme cases we had to resort to cutting Ammonites and then grind down their inner part.

In conclusion we would like to add that, in order to obtain a correlated stratigraphy between Ammonites and Nannoplankton, we believe it is necessary to examine various sections.

Along this line of thinking we have already sampled and are now studying other outcrops, such as: the classic Val d'Urbia outcrop, already used by type section for the Italian Toarcian stratigraphy by DONOVAN (1958) and by GALLITELLI WENDT (1970), and the M. Motette outcrop.

At the present, various other sections are in the process of being sampled. At times they may be incomplete because of gaps or faultings, still they help us cover the area in this tentative work of correlation.

Up to now we have localized and partly sampled sections of M. Arcaro (San Polo de' Cavalieri, Roma), of Cantiano (S.S. nº 3 Flaminia, km 230 ca), of M. Martano Sud and M. Martano NW (Acquasparta), of Scoppio (Spoleto), of Battiferro (Terni), of Furlo (Fano), M. Tezio (Perugia) and many others which will enrich the sampling network. As we intend to continue the correlated study between Ammonites and Nannoplankton of the Umbro-Marchigiano-Sabino Toarcian we thought it useful to conclude the introductory part with this list and with the explanation of the sampling procedures, so that in the future we will be able to use it as a reference without having to go back on the subject.

The Toarcian series

The abundance of fauna, the good state of preservation and the possibility to extract Ammonites directly from the layers, allowed us to easely identify the boundaries between zones, thus making it easier for us to correlate the Ammonites and the Nannoplankton associations.

The main section is approximately 18 m thick and includes:

— m 0 - 2 Liver colored marles in very thin laminae, practically barren except for a large fragment of *Protogrammoceras* gr. *meneghinii* (BONARELLI), a few fragments of Dactylioceratides and a small Ammonite of the hildoceratitic type.

— m 2 - 2.40 Nodular limestone with fauna poor in species and specimens, and mostly in fragments; we identified *Dactylioceras* (*Orthodactylites*) cfr. *semicoelatum* (SIMPSON), *D.* (*O.*) *anguinum* (REINECKE), *Hildaites* sp. and at the top of this thickness *Catacoeloceras crassum* (YOUNG & BYRD).

Inside this thickness we recognize the « *D. semicoelatum* zone » (= « *D. tenuicostatum* zone »), whose lower boundary is identified by the presence of *Protogrammoceras*, mostly present in the Upper Domerian but it can sometimes be found, even if only as a genus, also in the Earliest Toarcian.

— m 2.40 - 3.10 The nodular limestone continues with more abundant and varied fauna. It includes *Harpoceras falcifer* (SOWERBY) in the type form as well as in the variety *H. falcifer* (SOW.) *mediterraneum* PINNA, *Polyplectus pluricostatus* (HAAS), *Lytoceras* spp. *Hildaites* sp., *Phylloceras heterophyllum* (SOWERBY), *Ph. doderleinianum* (CATULLO), *Calliphylloceras capitanioi* (CATULLO) e *C. nilssoni* (HEBERT); in its uppermost part, we find frequently large fragments of *Hildoceras sublevisoni* FUCINI still in association with the above mentioned *Harpoceras*.

This thickness should therefore be related to the « *H. falcifer* zone » because this zone coincides with the rather brief duration of its species marker in the exposure we examined.

The 0 - 3.10 m interval shows some forms marker in the lower zone of the Toarcian but does not permit an exact subdivision because of the rarity of the forms and their vertical spacing. That is, we have about one meter which shows the passage between the two lower zones of the Toarcian but we are not able to define the exact level, unless we take as a boundary the appearance of markers of the higher zone (*Harpoceras falcifer* (SOWERBY)) as we have discovered only three specimens of these extremely rare forms. For this reason we call this interval « unnamed zone » (DONOVAN 1958) and we do not subdivided it into the proven classical zones (« *D. semicoelatum* zone » and « *H. falcifer* zone »).

— m 3.10 - 4.10 Red nodular limestone with light green interbedded clays. These layers are extremely fossiliferous. On it we discovered an association of hundreds of Ammonites (mostly Phylloceratids and Hildoceratids). Many specimens were in a very good state of fossilization according to the typical preservation of the « Rosso Ammonitico » where all Ammonites are preserved only as inner mold. We identified: *Hildoceras bifrons* (BRUGUIERE), *Hildoceras graecum* (RENZ), *Hildoceras sublevisoni* FUCINI (of much smaller dimensions than those of specimens originating from lower levels), *Lytoceras sepositum* MENEGHINI, *Lytoceras francisci* (OPPEL), *Alocolytoceras dorcadis* (MENEGHINI), *Audaxlytoceras spirorbe* (MENEGHINI), *Hildoceras caterinii* MERLA, *Mercaticeras umbilicatum* BUCKMAN, *Mercaticeras hellenicum* (RENZ), *Mercaticeras mercati* (HAUER), *Polyplectus pluricostatus* (HAAS) and many Dactylioceratids.

This association can be compared to the traditional established association in the lower subzone of the « *H. bifrons* zone » (= *M. mercati* zone). In this paper such a subzone will be indicated as « *Hildoceras graecum* subzone » because the subzonal marker more commonly used, *Hildoceras sublevisoni* FUCINI, appears already in the lower zone of the section in association to *Harpoceras falcifer* (SOWERBY).

— m 4.10 - 5.10 Limestone with infrequent nodules; intercalations with more calcareous component begin with these layers.

— m 5.10 - 5.90 Bold nodular limestone.

— m 5.90 - 7 Typical red limestone with nodules appearing in various quantity and with light green prominent argillaceous intercalations in the upper part. The last part of these layers especially showed abundance of fossils. Throughout this interval the fauna is homogeneous while the lithologies are extremely variable. In effect in this thickness we identified: *Polyplectus pluricostatus* (HAAS), *Hildoceras bifrons* (BRUGUIERE), *Hildoceras graecum* (RENZ), *Mercaticeras mercati* (HAUER), *Mercaticeras umbilicatum* BUCKMAN, *Mercaticeras hellenicum* (RENZ), *Mercaticeras thyrrenicum* (FUCINI), *Mercaticeras dilatum* (MENEGHI-

NI), *Alocolytoceras dorcadis* (MENEGHINI), *Audaxlytoceras spirorbe* (MENEGHINI), *Rarenodia venturii* PALLINI, *Peronoceras aculeatum* (PARISH & VIALE), *Hildoceras semipolitum* BUCKMAN, *Telodactylites desplacei* (D'ORBIGNY). This association, however similar to that one of the « *H. graecum* subzone », shows generally higher forms as *Hildoceras semipolitum* BUCKMAN, *Telodactylites desplacei* (D'ORBIGNY), *Mercaticeras thyrrenicum* (FUCINI) and *Mercaticeras dilatum* (MENEGHINI).

The abundance and well defined distribution of *Hildoceras semipolitum* BUCKMAN prompted us to use this species as subzonal marker also for our exposures.

— m 7 - 15 Mass of layers almost entirely calcareous. In the last 60 cm the layers show a marlaceous layer mixed with pink calcareous fragments of 3-4 cm in diameter.
There are three layers affected by a slumping between the 12th - 13th meter from the base of the section.
This phenomenum doesn't seem to have caused a mixture of the forms. We deduce this by osserving the succession of faunas in the layers which precede and follow the slumping. Moreover the layers affected by this phenomenum are sterile of Ammonite.

Between the 7th - 15th meter with the exception of the slumped section, we discovered Ammonites especially on two levels.

On the basis of the forms we discovered, this bulk of layers is attributed to the lower zone of the Upper Toarcian, that is, the « *Phymatoceras erbaense* zone ». This zone shows two different types of associations originating from the above mentioned two levels, in which we found abundant fossils. We divided this zone in two subzones: the lower one, indicated in this paper as the « *Pseudomercaticeras rotaries* subzone » correlated to the « *Collina gemma* subzone » of GALLITELLI WENDT (1970) or to the « *Pseudomercaticeras latum* subzone » of PELOSIO (1968) and the upper subzone indicated as « *Paroniceras sternale* subzone » already used by GALLITELLI WENDT (1970) correlated to the « *Brodieia bayani* subzone » *Auctt.*

The forms found in the first association are: *Mercaticeras dilatum* (MENEGHINI), *Crassiceras latum* MERLA, *Pseudomercaticeras rotaries* MERLA, *Pseudomercaticeras frantzi* (REYNES), *Brodieia gradata* (MERLA), *Brodieia alticarinata* (MERLA), *Brodieia retrograda* (MERLA), *Phymatoceras armatum* (MERLA), *Phymatoceras robustum* HYATT, *Phymatoceras erbaense* (HAUER), *Phymatoceras iserense* (OPPEL), *Harpoceras exaratum* (YOUNG & BYRD) *subexaratum* BONARELLI, *Harpoceras mulgravium* (YOUNG & BYRD), *Harpoceras* (*Harpoceratoides*) *domaticus* PALLINI, *Polyplectus pluricostatus* (HAAS).

The forms found in the upper part of the interval are: *Paroniceras sternale* (BUCH in D'ORBIGNY), *Paroniceras substernale* PELOSIO, *Oxyparoniceras buckmanni* (BONARELLI), *Chartronia chelussii* (PARISCH & VIALE), *Chartronia fabale* (SIMPSON), *Chartronia venustula* MERLA, *Brodieia bayani* (DUMORTIER), *Brodieia moltoni* PINNA, *Pseudogrammoceras subfallaciosum* BUCKMAN, *Pseudogrammoceras subregale* PINNA, *Hammatoceras planinsigne* VACEK, *Erycites rotundiformis* MERLA, *Collina gemma* BONARELLI *sensu* PINNA & LEVI-SETTI (1971).

In this subzone also we observed some rare specimens of *Phymatoceras erbaense* (HAUER) which therefore can be accepted as zonal marker. We are in agreement however with various Authors that it should be substituted because it presents problems of determination and its original description is still debatable.

— m 15 - 18 Very fine and compact limestone; pink colored and similar to the overlaying Dogger « Calcari Diasprigni » although the latter ones show siliceous nodules and levels. The fauna is poor but typical.

Dumortieria meneghinii (ZITTEL in HAUG), confirmed here as zonal marker, proves the presence of the Upper Toarcian in the section we examined. Associated to this species we also discovered *Hammatoceras planinsigne* VACEK, *Hammatoceras* sp., *Erycites costulosus* (MERLA), Phylloceratids and Lytoceratids which we had already found in the lower layers. The poor fauna did not permit the subzonal division.

Ammonite zones

« Unnamed zone »

We found it scarcely fossiliferous with most part of the Ammonites discovered on two levels.

The lower layer showed a poorly developed *Dactylioceras* fauna, of the orthodactylic type, generally attributed to the « *Dactylioceras semicoelatum* zone » (= « *D. tenuicostatum* zone »).

The upper level showed a more abundant fauna with *Harpoceras falcifer* (SOWERBY) and *Harpoceras falcifer* (SOWERBY) *mediterraneum* PINNA associated to large fragments of *Hildoceras sublevisoni* FUCINI.

Harpoceras falcifer (SOWERBY) could prove the presence of the homonymous zone and the poorly developed *Dactylioceras* could indicate the presence of the basal zone of the Toarcian. However, the absence of *Hildaites* and of other meaningful forms as well as the poorness of the fauna marker represented only by a dozen specimens, prevented us from defining the exact limit between the two zones and therefore make it advisable to maintain the term introduced by DONOVAN (1958).

At the base of the section we discovered a large fragment of *Protogrammoceras* gr. *meneghinii* (BONARELLI), which we found in association with small fragments of *Dactylioceras* and therefore attributable to the Toarcian (FERRETTI 1972; GUEX 1973).

This finding may be the first one of its kind in the Toarcian.

« *Hildoceras bifrons zone* »

It coincides with the duration of its species marker. For the abundance of its fauna, it was possible to subdivide it into two subzones, a lower « *Hildoceras graecum* subzone » and an upper « *Hildoceras semipolitum* subzone ».

The association of the lower subzone is the traditional one (DONOVAN 1958, KOTTEK 1966, GALLITELLI WENDT 1970, VENTURI 1972 - 1975).

We have chosen *H. graecum* (RENZ) as subzonal marker which is found preferably in the lower part but it is present in the whole zone.

In sections of the Greece this species was used as zonal marker by KOTTEK (1966), meaning a similar distribution as in our exposures.

The only difference are due to the fact that in the exposures we examined for this study, most part of specimens, over 80%, was found before the appearance of *Hildoceras semipolitum* BUCKMAN, that is in the lower part of the « *Hildoceras bifrons* zone ».

We have no remarks concerning the higher subzone, that is the « *Hildoceras semipolitum* subzone », except a few notes on the development of the *Mercaticeras* genus.

This genus seems to have a development concurrent to the *Hildoceras* and therefore *M. mercati* (HAUER) was chosen as zonal marker instead of *Hildoceras bifrons* (BRUGUIERE) (which we preferred in our study because of its abundance). Moreover we recognized a sequence, going from bottom to top, of *Mercaticeras umbilicatum* BUCKMAN, *M. hellenicum* (RENZ), *M. mercati* (HAUER), *M. thyrrenicum* (FUCINI), at least as percentage in the presence of these forms corresponding to the modification of the specific characters.

In this vertical sequence we saw a tendency to the involution and thinning down of the whorl in the *Mercaticeras* genus.

These characters are also important to distinguish *Mercaticeras* and *Pseudomercaticeras* genera.

Mercaticeras dilatum (MENEGHINI) which is found on the upper part of the « *Hildoceras semipolitum* subzone » could indicate an evolution attempt, continued in the « *Phymatoceras erbaense* zone » with *Crassiceras latum* MERLA, and rapidly terminated.

A similar tendency is developed in *Hildoceras* genus with the change from thick and relatively evolved forms, typical of *Hildoceras sublevisioni* FUCINI, to forms which are involved, flattened, typical of *Hildoceras semipolitum* BUCKMAN, through *Hildoceras bifrons* (BRUGUIERE) which shows intermediate characters.

At the basis of the « *Hildoceras semipolitum* subzone » we discovered a *Rarenodia venturii* PALLINI specimen.

« *Phymatoceras erbaense zone* »

We defined the start of the lower zone of the Upper Toarcian at the appearance of the species marker *Phymatoceras erbaense* (HAUER). The genus *Phymatoceras* appear in mass at the same time and in particular with those species characterized by a bold ornamentation as *Phymatoceras erbaense* (HAUER), *Phymatoceras iserense* (OPPEL), *Phymatoceras armatum* (MERLA), *Phymatoceras robustum* HYATT.

This zone shows two different types of association: the lower one related to the « *Pseudomercaticeras rotaries* subzone » and the upper one attributed to the « *Paroniceras sternale* subzone ».

We had to establish a new subzonal marker for the lower part of the « *Phymatoceras erbaense* zone » because those commonly used in the literature are absent or have an anomalous vertical distribution.

As a matter of fact, *Collina gemma* BONARELLI, subzonal marker established by GALLITELLI WENDT (1970) for the Val d'Urbia section and for other sections in the Marche region, was found to have a different distribution than that in the literature.

Pseudomercaticeras latum (MERLA), subzonal marker used by DONOVAN (1958) and by PELOSIO (1968) is extremely rare.

Therefore we preferred *Pseudomercaticeras rotaries* MERLA which extends vertically in the section we examined and coincides with the genus extension, because of the abundance of specimens and

their good state of preservation. This genus is represented also by *Pseudomercaticeras frantzi* (REYNES).

The association of this subzone includes also those *Phymatoceras* characterized by a bold ornamentation, the two above mentioned species of *Pseudomercaticeras* and *Brodieia* in the more evolved forms as *Brodieia gradata* (MERLA), *Brodieia alticarinata* (MERLA), *Brodieia retrograda* (MERLA).

Of particular interest is the presence of harpoceratoids with specimens typical of *Harpoceras* and *Harpoceratoides*, to which belongs a fragment of the new *Harpoceras* (*Harpoceratoides*) *domaticus* PALLINI. The same situation occurs in the Aveyron region and was described by MONESTIER (1931).

These forms reoccur at the basis of the « *Phymatoceras erbaense* zone », after showing with *Harpoceras falcifer sensu lato* at the top of the « unnamed zone ».

Beside the above mentioned new species, the recognized species are *Harpoceras exaratum* (YOUNG & BYRD) *subexaratum* BONARELLI and *Harpoceras mulgravium* (YOUNG & BYRD) traditionally related to the « *Harpoceras falcifer* zone » (PELOSIO 1968) but discovered also in levels stratigraphically coeval to ours (GALLITELLI WENDT 1970, KOTTEK 1966).

The subzonal marker and forms as *Brodieia bayani* (DUMORTIER) and *Brodieia moltoni* PINNA belong to the higher subzone indicated in this paper as « *Paroniceras sternale* subzone ». These forms are characterized by a greather involution in respect to the species of the same genus appearing in the lower subzone.

We also found the presence of phymatoceratids of the *Chartronia* genus, with *Chartronia chelussii* (PARISCH & VIALE), *Chartronia fabalis* (SIMPSON), *Chartronia venustula* (MERLA) species showing a not so bold ornamentation as the similar *Phymatoceras* genus found in the underlaying levels with most part of the forms.

We also discovered, particularly in the upper part of the subzone, *Pseudogrammoceras subfallaciosum* BUCKMAN, *Pseudogrammoceras subregale* PINNA, *Oxyparoniceras buckmanni* (BONARELLI) and *Paroniceras substernale* PELOSIO. Almost touching the successive zone we discovered *Collina gemma* BONARELLI *sensu* PINNA & LEVI SETTI 1971, this being the highest place they were ever found, *Hammatoceras planinsigne* VACEK and *Erycites rotundiformis* MERLA present also in the successive zone.

We think it is useful to point out two details. The first one concerns the impracticability of mantaining *Phymatoceras erbaense* (HAUER) as zonal marker for the difficult species determination and the scarcity of its specimens in the zone. The second remark concerns the presence of *Oxyparoniceras buckmanni* (BONARELLI), relatively rare in the Italian exposures.

« *Dumortieria meneghinii zone* »

The lower limit of the « *Dumortieria meneghinii* zone » coincides with the appearance of the species marker. We discovered, in association, some good specimens of *Erycites costulosus* (MERLA), *Erycites rotundiformis* MERLA and *Hammatoceras planinsigne* VACEK.

There is no indication of *Pleydellia* and *Leioceras* and *Tmetoceras* forms and this proves the absence of the Aalenian or of the Lower Dogger. Comparing the fauna of this zone to the corresponding one of GALLITELLI WENDT (1970) we could deduce that our « *Dumertieria meneghinii* zone » relates to that Author's lower subzone. In this case the studied section would be lacking of the Upper Toarcian.

At any rate, the scarcity of fauna does not permit a thorough examination of this correlation.

SYSTEMATICS

Superfamily HILDOCERATACEAE HYATT, 1867
Family HILDOCERATIDAE HYATT, 1867
Subfamily *ARIETICERATINAE* HOWARTH, 1955
Genus **Protogrammoceras** SPATH, 1913
Protogrammoceras cfr. **meneghinii** (BONARELLI), 1899

We have a partial specimen with few noticeable characters, embedded in a rock. Relatively developed whorl, rapidly increasing in height. Large and not very deep umbilic, flat sides, moderate thickness. Ornamentation consisting of thin falcate ribbing characterized by a straight and forward oriented pattern, at one third distance from the inner part. In the center of the side the ridges bend twice and end at one third distance from the outher part, again oriented forward. No signs of lobal line.

Dimensions (extrapolated) - D = 60 mm ca.; u = 23 mm ca.; h = 28 mm; t = ribbs 27 in 1/4 of the whorl; u/D = 0.35 ÷ 0.42; h/D = 0.43 ÷ 0.50.

Remarks - The specimen appears relatively similar to the BONARELLI form, but is more developed. Concerning the whorl increase, the form and the ridge pattern, the specimen is very similar to *P. meneghinii* (BONARELLI). For a better comparison

we report here the numerical data of the holotype and of an other specimen:

Holotype - D = 59 mm; u = 23 mm; h = 26 mm; u/D = 0.31; h/D = 0.56 ribbs 22 in 1/4 of the whorl.

Other specimen: D = 70 mm; u = 21 mm; h = 30 mm; u/D = 0.30; h/D = 0.43; ribbs 27 in 1/4 of the whorl.

The whorl increase, in 1/4 of the whorl is of the 18% in our specimen, and of the 16% in other two.

Stratigraphy - Deep red and thinly laminated marles of the basal Toarcian of main section of M. La Pelosa.

Subfamily *HARPOCERATINAE* NEUMAYR, 1875
Genus **Harpoceras** WAAGEN, 1869
Subgenus **Harpoceratoides** BUCKMAN, 1909
Harpoceras (Harpoceratoides) domaticus PALLINI n. sp.

Description - Flat discoid form with whorl rapidly increasing in height, especially in the inner whorls, umbilic is not large (approximately 1/3 of maximum diameter) or deep. Fastigate section of whorls with large but not prominent keel and with siphonal furrows faintly showing (fig. 3a). Whorls overlapping for 1/3 of height.

Flat sides, showing a characteristic bend at one third distance from outer part and then coming together at ventral area.

Sickle-shaped ribbing with large ribs separated by wide intervening furrows. Highest curvature point of the sickle starts in correspondence to bend on the side.

The ribs are thinner and closer in the inner whorls and tend to widen in the proximity of and over the body chamber (fig. 3b).

Sutures are characterized by the relative simplicity of many elements in the area of the harpoceratitic sutures (seven saddles and six lobes with 90 mm of the diameter) (fig. 3c).

Outer saddle bifid with slightly diverging lobes and are 1/3 of the median lobe deep. This median lobe is narrow, very deep, symmetrical and ending with bifid lacinia. Umbilical lobes decreasing in size from center of side to the umbilic.

Body chamber preserved only for half a whorl, on the basis of traces left on penultimate whorl, it probably extended to 3/4 of the whorl.

Dimension of holotype - D = 117 mm; u = 37 mm; h = 44 mm; t = 22 mm; u/D = 0.31; t/h = 0.50; ribbs = ca. 50; increase in height is 7 mm in half whorl; increase in thickness is 5 mm in half whorl (calculations determined on last whorl).

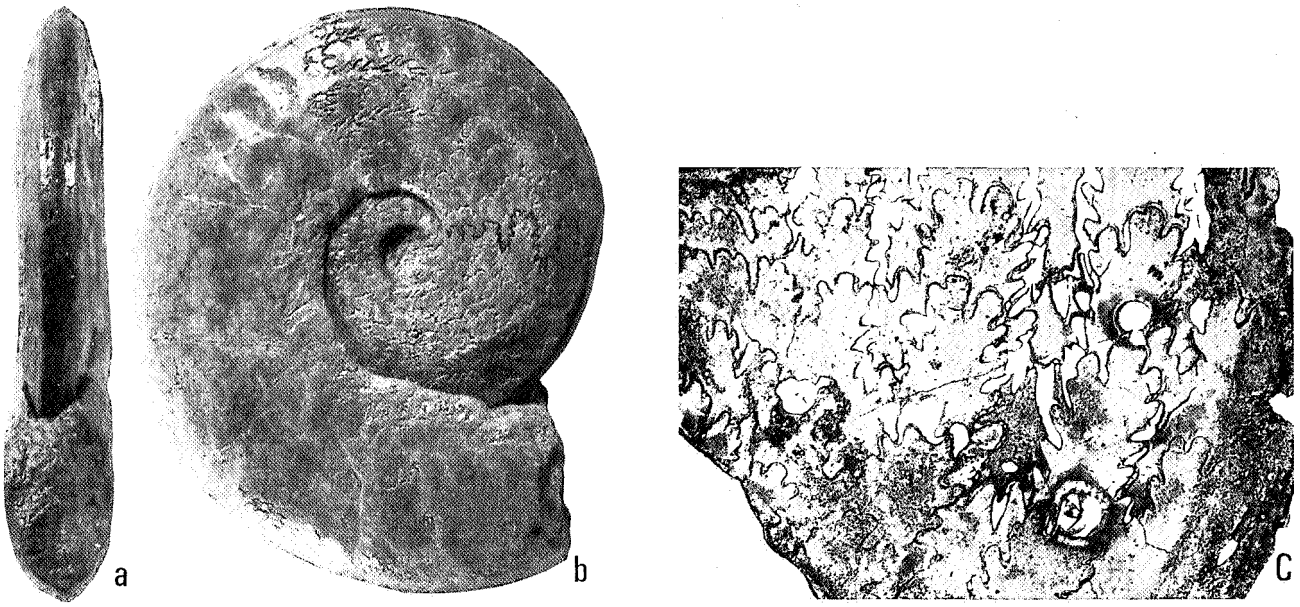

FIG. 3 — *Harpoceras* (*Harpoceratoides*) *domaticus* PALLINI n. sp. D = 117 mm; u = 37 mm; h = 44 mm; t = 22 mm; n = 50 ca. Holotype originating from the basis of the « *Pseudomercaticeras rotaries* subzone ». 3a) Lateral view; 3b) ventral view; 3c) suture line, peel x 4.

— *Harpoceras* (*Harpoceratoides*) *domaticus* PALLINI n. sp. D = 117 mm; o = 37 mm; a = 44 mm; s = 22 mm; n = 50 circa. Olotipo proveniente dalla base della zona a *Phymatoceras erbaense*, sottozona a *Pseudomercaticeras rotaries*. 3a) Vista laterale, 3b) vista ventrale, 3c) linea suturale, peel x 4.

Remarks - This new species, instituted on a large, well preserved specimen, as an inner mould, and on a fragment which clearly shows the specific characters, might be attributed to the *Harpoceratoides* subgenus for the similarity of the suture line.

In fact the suture line appears to be very similar to that of *Harpoceras* (*Harpoceratoides*) *alternatum* (SIMPSON) *convergens* KOTTEK (1966, pag. 104, Abb. 31b) and relatively close to that of *Harpoceratoides* aff. *serotinum* BETTONI in GALLITELLI WENDT (1970, pag. 21, fig. 1).

It differs from these two forms for the ornamentation and for the form of the section, which in this case is the type fastigate.

Type level - Upper Toarcian. Lower part of « *Pseudomercaticeras rotaries* subzone » of « *Phymatoceras erbaense* zone ».

Type locality - Balza di Soterio, Podere Capraricia, M. Nerone (Piobbico, Central Apennines).

Depository - Collection of Don Domenico Rinaldini - Parish church S. Maria in Val d'Abisso - Piobbico.

Derivatio nominis - *domaticus* = dome shaped; from the characteristic shape of the ventral area.

Discussion - The two forms examined, found in two different localities, originate from same zone. In fact, the holotype found in association with *Telodactylites eucosmus* (LIPPI BONCAMBI) of the « *Haugia variabilis* zone » (PINNA & LEVI - SETTI 1971, pag. 118). This zone may be correlate to the lower part of « *Phymatoceras erbaense* zone » (GUEUX 1972, p 622).

The other specimen, originating from the main section of Polino, is associated to the *Phymatoceras erbaense* (HAUER), *Pseudomercaticeras rotaries* MERLA etc. (fig. 2), and therefore belongs to the « *Phymatoceras erbaense* zone », « *Pseudomercaticeras rotaries* subzone ».

Family HAMMATOCERATIDAE BUCKMAN, 1887
Subfamily *HAMMATOCERATINAE* BUCKMAN, 1887
Genus **Rarenodia** VENTURI, 1975
Rarenodia venturii PALLINI n. sp.

1977 *Rarenodia* gr. *planulata* VENTURI - NICOSIA *et alii.*: 126, pl. 1, fig. 14, 15.

Description - Evolute form with lanceolate - oval section, with whorl slowly increasing in height. Whorls are overlapping for about 1/3 (fig. 4a).

Ornamentation consist of numerous straight ribs, with a radial pattern, slightly forward oriented in the proximity of ventral side. These ribs are of three types: a) ribs pairing off in periumbilical knots, b) alternating ribs never reaching the umbilical edge, c) simple ribs starting at the umbilical knot. Outer area characterized by a thin keel with faintly suggestet siphonal furrows (fig. 4b). Lobal line characterized by very complex elements: outer saddle with narrow nad deep adventitious lobe. Large lateral lobe indented and ending in three long laciniae; umbilical saddles separated by thin and deep adventitious lobes; narrow and deep umbilical lobes, indented and centrifugal. The form and the pattern of these umbilical lobes represent the hammatoceratitic characters of the form being studied (fig. 4c).

Dimensions of holotype - D = 80 mm; u = 40 mm; t = 20 mm; h = 24 mm; ribs = 30 in 1/2 of the last whorl; knots = 12 in 1/2 of the last whorl; u/D = 0.50; t/h = 0.83.

Remarks - The specimen described appears to have peculiar characteristics in the genus instituted by VENTURI (1975). It shows in fact different characteristic than those in the forms studied by VENTURI. It has some similarities with *Rarenodia* sp. ind. of fig. 1 in the text pag. 12 in VENTURI (1975) in regard to the lobal line, but differs for the form and the relative dimensions of the lobe and of the outer saddle. It presents some similarities with *Rarenodia planulata* VENTURI regarding the type of ornamentation, but the ribs of our specimen appear straighter. This species now instituted differs from *Rarenodia planulata* VENTURI for the greater winding ratio (0.50 instead of 0.44) and the greater flatness ratio (0.83 instead of 0.62 ÷ 0.76) as well as for the slightly higher number of ribs.

It differs from *Rarenodia latecostata* VENTURI for the flatness ratio (0.83 instead of 0.68) and for number and form of umbilical knots.

The difference between the suture lines is more conspicuous because all the elements forming the suture of *Ratenodia venturii* PALLINI appear more pronounced and indented.

Type level - Lower Toarcian. « *Hildoceras bifrons* zone ». Basis of the « *Hildoceras semipolitum* subzone ».

Type locality - Polino, M. La Pelosa, main section (Central Apennines, Terni).

Depository - Institute of Geology and Paleontology of the University of Rome. Holotype nº C 173.

Derivatio nominis - This species is dedicated to the Dr. Federico VENTURI, a renowned Italian paleontologist.

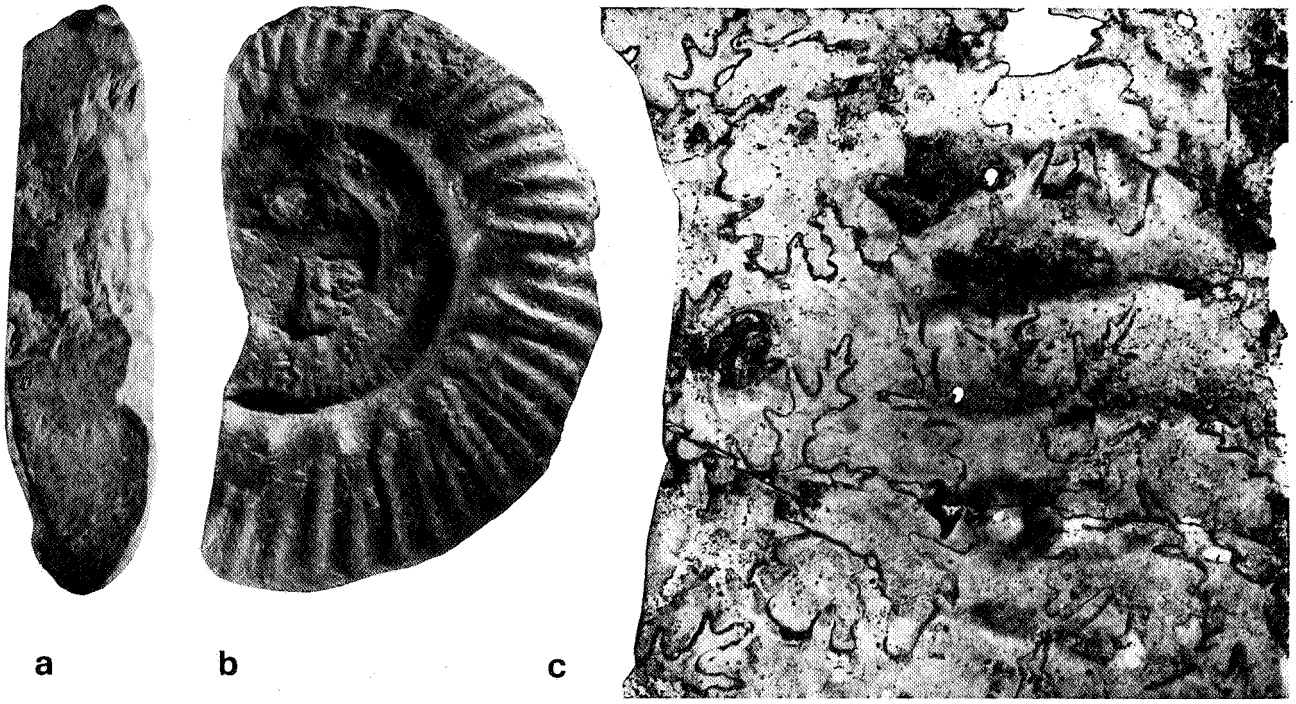

FIG. 4 — *Rarenodia venturii* PALLINI n. sp. x 1 ca. D = 80 mm; u = 40 mm; h = 24 mm; t = 20 mm; n = 30 in ½ of the last whorl. Holotype originating from the basis of the « *Hildoceras semipolitum* subzone ». 4a) Ventral view, 4b) lateral view, 4c) suture line, peel x 4.

— *Rarenodia venturii* PALLINI n. sp. x 1 circa. D = 80 mm; o = 40 mm; a = 24 mm; s = 20 mm; n = 30 in metà dell'ultimo giro. Olotipo proveniente dalla base della sottozona ad *Hildoceras semipolitum*. 4a) Vista laterale, 4b) vista ventrale, 4c) linea di sutura, peel x 4.

CALCAREOUS NANNOPLANKTON

Previous studies

Since this is the first time that detailed studies are made on the nannofloras of the Italian Toarcian, we think it is necessary to make a brief summary of the data acquired from previous studies.

Specific literature on Jurassic nannofossil association is generally poor, and more so Toarcian associations. In fact the literature on Toarcian association is totally lacking in regard to the Italian exposures.

NOËL (1972) and BARNARD & HAY (1974) give brief historic accounts on the subject and we refer to them also for the essential bibliography.

For our purpose it is enough to mention the works of STRADNER (1963), NOËL (1965, 1972), REINHARTH (1966), PRINS (1969), AMESIEUX (1972), ROOD, BARNARD & HAY (1973), GRUN, PRINS & ZWEILI (1974), THIERSTEIN (1976) who studied the nannofloras associations in Jurassic sediments or in exclusively Toarcian sediments in Europe. Some of these Authors began an attempt of Nannoplankton zonation. Others correlated Nannoplankton zonation to Ammonite zonations.

STRADNER confined himeself to the indication of Jurassic type associations and in particular he instituted the « *opacus* associations » for the Lias - middle Bajocian interval. These associations are characterized by the presence of *Schizosphaerella punctulata* DEFLANDRE & DANGEARD, *Parabdolithus liasicus* DEFLANDRE, *Discolithus crassus* DEFLANDRE e *Coccolithus opacus* STRADNER and terminate with the appearance of *Coccolithus britannicus* STRADNER, *Hexalithus lecali* GARDET, *Discolithus asper* STRADNER, *Rhabdolithus decorus* DEFLANDRE.

PRINS was the first to compare the Lias Ammonites zonations to the Nannoplankton zonation which he instituted. Unfortunately he examined in details the interval which terminates with the end of the middle Lias « *Dactylioceras tenuicostatum* zone » which he includes in the *Striatococcus* zone » in the « *Striatococcus opacus* subzone ».

AMEZIEUX's « *Crepidolithus* zone » correspons to the entire interval between the « *Uptonia jamesoni* zone » (Pliensbachian) and the « *Graphoceras concavum* zone » (Aalenian). The Author then subdivided it in « *Crepidolithus* subzone » which extends from the start of the Pliensbachian to the start of the Toarcian, and « *Crepidolithus crassus*, *Palaeopontosphaera* and *Cyclagelosphaera* subzone » which includes Toarcian and Aalenian.

More recently BARNARD & HAY gave a complete Nannoplankton zonation and the correlation between Ammonite zones and Nannoplankton zones of the entire Jurassic of sediments of western Europe. They recognized two zones in the Toarcian, one « *Podorhabdus* » and the other « *Discorhabdus* ». Unfortunately the terrains where the Authors took the samples have gaps from the « *Dactylioceras tenuicostatum* zone » to the base of the « *Dumortieria levesquei* zone » pratically a large part of the Toarcian. Their zonation in this interval is based only on a few forms which pass beyond the basal Toarcian and on other forms which appear in the Upper Toarcian.

All these Ammonite and Nannoplankton zonations are related to the boreal paleogeographic province. Therefore we propose with our study to fill a void in the stratigraphic literature by taking in consideration the faunas of the Mediterranean province which are only relatively similar to the former.

Nannoplankton assemblage

The forms in the association are very few, also rather primitive and in a bad state of preservation. From their general appearance we could adopt the term « liasicity » (STRADNER, 1963) because the forms are simple with justaposed crystals, and because of the presence of *S. punctulata*. By a quantitative analysis we noticed a variation in the total number of the specimens found at the start of the « *P. sternale* subzone » which is the high subzone of the « *Ph. erbaense* zone ».

This coincides with the increase in calcareous component in the section being sampled, as well as in nearly exposures and generally in the Umbro-Marchigiano « Rosso Ammonito » Toarcian (VENTURI, 1972).

In all the samples we find the presence of *Biscutum dubium*, *Schizospharella punctulata* and many discoid forms composed by two jointive crystal discs, probably related to *Discorhabdus* bases, as was already indicated by NOËL (1965) and by PRINS in BERNOULLI & RENZ (1970).

The great difference in the thickness of crystals of the two discs and the tight justaposition of the discs could also mean a relatio to the genus *Bidiscus*. On the other hand, we should be able to reject this supposition because of the greater showing of the *Discorhabdus* in the Jurassic, as PRINS pointed out in BERNOULLI & RENZ (1970).

The nannoflora is represented by the following forms: *Biscutum dubium* (NOËL), *Schizosphaerella punctulata* DEFLANDRE & DANGEARD, *Discorhabdus* sp., *Parhabdolithus* cfr. *robustus* NOËL, *Sollasites* sp., *Crepidolithus crassus* (DEFLANDRE), *Ellipsagelosphaera communis* (REINHARDT).

Two forms *S. punctulata* and *Ellipsagelosphaera communis* acquire locally lithogenetical value.

For each case the stratigraphic distribution of the forms coincides with the known distribution of the European Jurassic, with the exception of the *Ellipsagelosphaera*.

The exceptions are due mainly to the absence of some forms which are present in the associations studied in western and Central Europe and in North Africa. In particular the absence of *Discorhabdus tubus* NOËL, *Podorhabdus cylindratus* NOËL and *Vekshinella quadriarculla* (NOËL) are all the more surprising since the first two were chosen by BARNARD & HAY (1974) as zonal markers of the Domerian-Bajocian time interval and the third one is always present in the associations studied by the Authors just mentioned. According to BARNARD & HAY (1974) *D. tubus* is the zonal marker for the upper part of the Toarcian and for the Bajocian lower part (« *D. levesquei* », « *L. opalinum* », « *T. scissum* » zones) in Western Europe.

Above all we must remember that the Aalenian does not appear in the stratigraphic scale of the Authors and that the « *L. opalium* » and « *T. scissum* » zones, together with the « *L. murchisoni* zone», cover the entire Aalenian, according to the zonation of MOUTERDE *et alii* (1971). The absence of *D. tubus* from our layers can be explained by keeping in mind that probably in the section we studied the « *D. meneghini* zone » has not « *P. aalensis* subzone » (GALLITELLI, 1970) or, at least, there is no evidence of it. For what the Authors of the Jurassic Nannoplankton zonation in Eastern Europe said concerning the sampling of the Toarcian sediments, it is possible that they took samples in the upper part of the « *D. levesquei* zone ». In such case we can hypothesize that *D. tubus* starts only in the upper part of the « *D. levesquei* zone » and that this last one can be correlated to the « *P. aalensis* subzone » of the mediterranean region.

At present there are no explanation of stratigraphic nature for the absence of *P. cylindratus*, zonal marker for the time interval extending from the « *P. davoei* » to the « *G. thouarsense* » zones and of *V. quadriarculla*.

As mentioned before, the only noticeable exception concerning the distribution of the forms ap-

pearing in our exposure, is the presence of *Ellipsagelosphaera* in the lower part of the « *Ph. erbaense* zone » (m 8.5) and in the entire « *D. meneghini* zone ».

There is also the possibility that this form may be present starting halfway of the « *H. semipolitum* subzone » (m 5), but the specimens are rare and in a bad state of preservation, therefore the attribution is rather doubtful.

The *E. communis*, which until now, was pointed out only in the Aalenian « *T. scissum* zone » (Lower Bajocian according to BARNARD & HAY, 1974), must be considered present at least starting from Toarcian. Our belief is supported by the discovery of *Cyclagelosphaera* in the Toarcian (AMEZIEUX, 1972). As known, this genus shows the same characters of the *Ellipsagelosphaera* (NOËL, 1965) except for the general form which is round instead of elliptical and is attributable to the same subfamily.

While waiting that this form might be verified in other exposures, we think it is possible to subdivide the Toarcian, however informally, by using the appearance of *E. communis* as an indication of the end of the Lower Toarcian and the beggining of the Upper Toarcian.

The remaining forms in these exposures were discovered discontinuously and are not worth a detailed analysis from the stratigraphic point of view.

In conclusion the Toarcian nannoplankton association of M La Pelosa seems to be characterized by the constant presence of *B. dubium*, *S. punctulata* and, at times, of *C. crassus*.

Most recent Authors believe that *B. dubium* is synonymous of *C. opacus* (*Striatococcus opacus* according PRINS, 1969) and that *Crepidolithus crassus* is synonymous of *Discolithus crassus* (according STRADNER, 1963), therefore it would seem necessary to go back to STRADNER « *opacus* associations » or to PRINS « *S. opacus* zone », « *S. opacus* subzone » rather than to the zonation of BARNARD & HAY (1974).

The presence of *Ellipsagelosphaera communis* instead allows the subdivision of the association and pratically defines the faunas of the Mediterranean paleogeographic region from those of the boreal region where this subdivision seems impossible until now.

The general aspect of the association, with primitive sturdy forms, might even be related to phenomena of diagenetical and sedimentological nature but for the present we believe it best to wait for further information, in as much as the data obtained are equally useful from the stratigraphic point of view.

As we intend to continue the study of the Toarcian calcareous Nannoplankton, we will not discuss here problems of nomenclature, leaving this till the conclusion of our study of various series. For the moment we will confine ourselves to accept the most recent nomenclature without entering into the subject.

Considerations concerning *Schizosphaerella punctulata* DEFLANDRE & DANGEARD

We should emphasize the diversified presence of *S. punctulata* recognizable in its original and recrystallized structure.

The form is still recognizable, even if not well preserved and is very abundant in clay and in argillous marles of the low part of the formation. The form defined by PRINS in BERNOULLI & RENZ (1970) as « many layered *Schizosphaerella* » however is commonly found in the upper levels, the « *Ph. erbaense* » and « *D. meneghini* zone ».

The great difference between the species in its original form and the specimens of this second type are due in our opinion to recrystallization phenomena could have occurred in this sequence: from the original mesh structure formed by paired crystals (AUBRY & DEPECHE, 1974) we proceed to single crystal mesh resulting from the fusion of the two crystals, and then to the prismatic crystals which replace an entire mesh.

The inner cavity is then filled by a subspherical mould which, when the shell is removed, shows traces of the tips of the crystals proximal edges which constitute the shell at this stage.

The matrix recristallizes in pseudo-shells, which are concentric to the real shell, and shave a preferred recrystallization pattern probably caused by prismatic crystals of the above mentioned pseudo-shells. They can be recognized in extremely rare cases, also in Coccospheres as shown in fig. 5 in a whole specimen, originating from Middle Lias sediments. Examples of the last stage can be recognized in MONTANARI's illustrations (1972, pl. XIV, figs. 1-6; figs. 1-2) representing Domerian sediments in the Marche.

The forms termed « many layered » probably originate from these phenomena and from the type of section cut. If, for instance, a *Schizosphaerella* is cut at the point of insertion of the two valves after the recrystallization phenomena, we will have at least 5 concentrical layer, two of which are real



FIG. 5 — Coccosphaera showing a covering layer formed by subequal crystals. The remaining matrix maintains an isotropic texture. « Corniola » - Middle Lias - Fonte Cerro, Cottanello, Sabina. T.E.M. x 15.700.

— Coccosfera mostrante uno strato di rivestimento formato da cristalli subuguali. Il resto della matrice rimane a tessitura isotropa. « Corniola » - Lias medio - Fonte Cerro, Cottanello, Sabina. T.E.M. x 15.700.

shells and the other three are respectively a layer of recrystallized matrix, a filling layer contained between the two valves and an inner mould, going outside to the inside.

From a sistematic point of view *Schizosphaerella* remains in the « incertae sedis » forms, even according to recent investigations (AUBRY & DEPECHE, 1974) and other species of this genus are not known. If we accept the fact that these forms should be referred to this genus, we should accept also the unique species and designate the recrystallized forms as *Schizosphaerella punctulata*.

Acknowledgements

We are grateful to Rev. Domenico Raimondini, pastor of the Abbey of S. Maria in Val d'Abisso (Piobbico, on the slopes of M. Nerone, Apennines of the Marche region). The *Harpoceras* (*Harpoceratoides*) *domaticus* PALLINI holotype, kindly loaned for this study, is lodged with him. We are also grateful to Prof. Federico Venturi for the interesting discussions we had with him. Moreover we are pleased here to mention Mr. Luciano Spinozzi and Mr. Domenico Fiorentino for the good photographic work and Mr. M. Salvati for the drawings.

RIASSUNTO

È stato effettuato per la prima volta lo studio comparato della distribuzione delle Ammoniti e del Nannoplancton calcareo in una serie di affioramenti di « Rosso Ammonitico » del Toarciano della facies umbro-marchigiano-sabina. Lo studio delle associazioni ad Ammoniti ha permesso di suddividere la sezione principale, dallo spessore di 18 m circa, in quattro zone.

Dalla base della sezione, ove sono stati rinvenuti un grosso frammento di *Protogrammoceras* gr. *meneghinii* associato a dactylioceratidi di tipo ortodattilico, a metri 3.10 sono presenti le due zone più basse del Toarciano: « zona a *Dactylioceras semicoelatum* » e « zona ad *Harpoceras falcifer* ». Per la scarsità delle forme e per la difficoltà di tracciare un limite netto tra queste due zone, pur avendo riconosciuto alcuni indicatori zonali, abbiamo preferito mantenere il termine introdotto per la prima volta da DONOVAN (1958) di « unnamed zone ». Lo spessore di strati compreso tra metri 3.10 a metri 7 è attribuibile alla « zona ad *Hildoceras bifrons* ». La ricchezza della fauna ha permesso la sottozonazione ed abbiamo riferito alla « sottozona ad *Hildoceras graecum* » il primo metro dello spessore citato e alla « sottozona ad *Hildoceras semipolitum* » la parte rimanente. Il limite tra queste due sottozone è stato fatto coincidere con la comparsa della specie indice della sottozona superiore. L'intervallo tra metri 7 e metri 15 è stato attribuito alla « zona a *Phymatoceras erbaense* » che, presentando due associazioni diverse, è stata suddivisa in « sottozona a *Pseudomercaticeras rotaries* » in basso e « sottozona a *Paroniceras sternale* » in alto. Gli ultimi tre metri della sezione principale appartengono alla « zona a *Dumortieria meneghinii* ». L'assenza di forme come *Pleydellia aalensis* (ZIETEN) fa ritenere mancante la sottozona superiore di quest'ultima zona.

La distribuzione stratigrafica dei nannofossili è illustrata in base alle zone ad ammoniti poiché sullo studio di un'area così limitata non sembra opportuno stabilire una zonazione. L'associazione è caratterizzata dall'assenza di tutti i markers delle zone corrispondenti della regione paleogeografica boreale.

Viene segnalata, per la prima volta in terreni sicuramente pre aaleniani, *Ellipsagelosphaera communis* (REINHARDT). Tale presenza, se confermata in altri affioramenti, permetterà di suddividere in base al Nannoplancton il Toarciano in inferiore e superiore.

Sia per le Ammoniti che per il Nannoplancton sono forniti anche dati di carattere strettamente sistematico: vengono infatti istituite due nuove specie di Ammoniti: *Harpoceras* (*Harpoceratoides*) *domaticus* PALLINI e *Rarenodia venturii* PALLINI. Viene discussa la natura di alcuni organismi « *incertae sedis* » attribuiti a *Schizosphaerella punctulata* DE FLANDRE & DANGEARD.

Manoscritto presentato il giorno 11 novembre 1977

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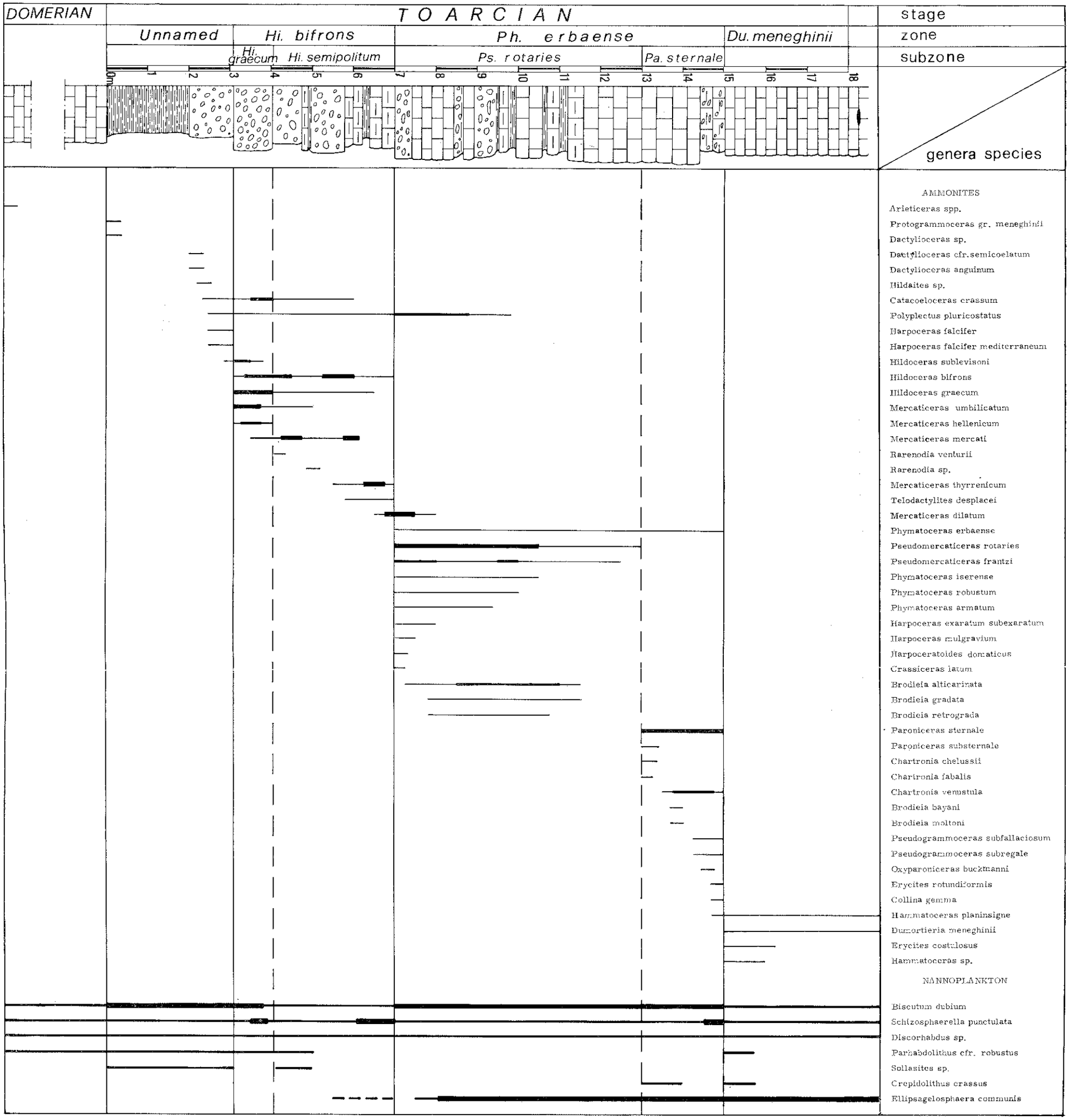

FIG. 2 — Outline showing the lithological succession of the main section. Also shown are the distribution and relative frequency on the Ammonite fauna and of the Nannoflora, with the exclusion of Phylloceratids, some Lytoceratids and some Dactyliocerati ds.

— Schema raffigurante la successione litologica della sezione principale. Sono anche riportate le distribuzioni e le frequenze relative della fauna ad ammoniti e del nannoplancton. Sono stati esclusi Phylloceratidi, alcuni Lytoceratidi e alcuni Dactyliocerati di.

PLATE I

Fig. 1 - *Paroniceras sternale* (BUCH in D'ORBIGNY).
D = 35 mm; u = 5 mm; t = 9 mm ca; h = 18 mm.
Specimen collected at the top of the « *Paroniceras sternale* subzone ». Main section of M. La Pelosa.

Fig. 2 - *Phymatoceras erbaense* (HAUER).
t = 15 mm; h = 15 mm. It was found at the basis of the « *Phymatoceras erbaense* zone ». Main section of M. La Pelosa.

Fig. 3 - *Pseudomercaticeras rotaries* MERLA.
D = 50 mm; u = 22 mm; t = 14 mm; h = 16 mm; n = 45.
Specimen originating from the basis of the « *Pseudomercaticeras rotaries* subzone ». Main section of M. La Pelosa.

Fig. 4 - *Hildoceras semipolitum* BUCKMAN.
D = 37 mm; u = 12 mm; t = 8 mm; h = 15 mm; n = 50 ca.
Specimen originating from the top of the « *Hildoceras semipolitum* subzone ». Main section of M. La Pelosa.

Fig. 5 - *Hildoceras graecum* (RENZ).
D = 50 mm; u = 21 mm; t = 11 mm ca; h = 17 mm; n = 43.
Specimen originating from the medium part of the « *Hildoceras graecum* » subzone. Main section of M. La Pelosa.

Fig. 6 - *Hildoceras bifrons* (BRUGUIERE).
D = 61 mm; u = 23 mm; t = 15 mm; h = 21 mm; n = 44.
Specimen originating from the base of the « *Hildoceras bifrons* zone », « *Hildoceras graecum* subzone ». Main section of M. La Pelosa.

Fig. 7 - *Harpoceras falcifer* (SOWERBY).
D = 48 mm; u = 13 mm; t = 13 mm ca.; h = 22 mm; n = 48 ca.
Specimen originating from the top of the « unnamed zone », section of M. La Pelosa.

Fig. 8 - *Dactylioceras* (*Orthodactylites*) cfr. *semicoelatum* (SIMPSON).
Specimen originating from layers situated at 2.30 m from the basis of the main section of M. La Pelosa. x 2 ca.

Fig. 9 - *Rarenodia* sp.
t = 9 mm ca.; h = 15 mm. Specimen originating from the basis of the « *Hildoceras semipolitum* subzone ». Main section of M. La Pelosa.

Fig. 10 - *Harpoceratoides domaticus* PALLINI n. sp.
t = 16 mm ca.; h = 35 mm. Specimen originating from the basis of the « *Pseudomercaticeras rotaries* subzone ». Main section of M. La Pelosa.

Fig. 11 - *Protogrammoceras* gr. *meneghinii* (BONARELLI).
Specimen originating from the basis of the main section of M. La Pelosa. x 1 ca.

Fig. 12 - *Dumortieria meneghinii* (ZITTEL in HAUG).
D = 99 mm; u = 57 mm; t = 15 mm; h = 24 mm; n = 28 (calculated in half whorl). Specimen originating from the top of the main section of M. La Pelosa.

Fig. 13 - *Mercaticeras mercati* (HAUER).
D = 42 mm; u = 18 mm; t = 15 mm; h = 14 mm; n = 35.
Specimen originating from the central part of « *Hildoceras bifrons* zone ». Main section of M. La Pelosa.

Fig. 14 - *Harpoceras mulgravium* (YOUNG & BYRD).
t = 16 mm ca.; h = 30 mm. Specimen originating from the basis of the « *Pseudomercaticeras rotaries* subzone ». Main section of M. La Pelosa.

Fig. 15 - *Oxyparoniceras buckmanni* (BONARELLI).
D = 51 mm; u = 14 mm; t = 16 mm; h = 21 mm.
Specimen originating from the top of « *Paroniceras sternale* subzone ». Main section of M. La Pelosa.
All the specimen are loged with the Institute of Geology and Paleontology of the University of Rome.

TAVOLA I

Fig. 1 - *Paroniceras sternale* (BUCH in D'ORBIGNY).
D = 35 mm; o = 5 mm; s = 9 mm circa; a = 18 mm.
Esemplare raccolto alla sommità della « s. zona a *Paroniceras sternale* ». Sezione principale di M. La Pelosa.

Fig. 2 - *Phymatoceras erbaense* (HAUER).
s = 15 mm; h = 15 mm.
È stato rinvenuto alla base della « zona a *Phymatoceras erbaense* ». Sezione principale di M. La Pelosa.

Fig. 3 - *Pseudomercaticeras rotaries* MERLA.
D = 50 mm; o = 22 mm; s = 14 mm; a = 16 mm; n = 45.
Esemplare proveniente dalla base della « s. zona a *Pseudomercaticeras rotaries* ». Sezione principale di M. La Pelosa.

Fig. 4 - *Hildoceras semipolitum* BUCKMAN.
D = 37 mm; o = 12 mm; s = 8 mm; a = 15 mm; n = 50 circa.
L'esemplare proviene dalla parte sommitale della « sottozona ad *Hildoceras semipolitum* ». Sezione principale di M. La Pelosa.

Fig. 5 - *Hildoceras graecum* (RENZ).
D = 50 mm; o = 21 mm; s = 11 mm circa; a = 17 mm; n = 43.
Esemplare proveniente dalla parte media della « s. zona ad *Hildoceras graecum* ». Sezione principale di M. La Pelosa.

Fig. 6 - *Hildoceras bifrons* (BRUGUIERE).
D = 61 mm; o = 23 mm; s = 15 mm; a = 21 mm; n = 44.
Esemplare proveniente dalla base della « zona ad *H. bifrons* », « sottozona ad *Hildoceras graecum* ». Sezione principale di M. La Pelosa.

Fig. 7 - *Harpoceras falcifer* (SOWERBY).
D = 48 mm; o = 13 mm; s = 13 mm circa; a = 22 mm; n = 48 circa.
Esemplare proveniente dalla sommità della « unnamed zone ». Sezione principale di M. La Pelosa. x 2 c.

Fig. 8 - *Dactylioceras* (*Orthodactylites*) cfr. *semicoelatum* (SIMPSON).
L'esemplare proviene dagli strati posti a 2,30 m dalla base della sezione principale di M. La Pelosa. x 2 c.

Fig. 9 - *Rarenodia* sp.
s = 9 mm circa; a = 15 mm. Esemplare proveniente dalla base della « s. zona ad *Hildoceras semipolitium* ». Sezione principale di M. La Pelosa.

Fig. 10 - *Harpoceratoides domaticus* PALLINI.
s = 16 mm circa; a = 35 mm circa. Esemplare proveniente dalla base della « zona a *Ph. erbaense* ». Sezione principale di M. La Pelosa.

Fig. 11 - *Protogrammoceras* cfr. *meneghini* (BONARELLI).
Esemplare proveniente dalla base della sezione principale di M. La Pelosa. x 1 c.

Fig. 12 - *Dumortieria meneghinii* (ZITTEL in HAUG).
D = 99 mm; o = 57 mm; s = 15 mm; a = 24 mm; n = 28 (contate in mezzo giro). Esemplare proveniente dalla sommità della sezione principale di M. La Pelosa.

Fig. 13 - *Mercaticeras mercati* (HAUER).
D = 42 mm; o = 18 mm; s = 15 mm; a = 14 mm; n = 35.
Esemplare proveniente dalla parte centrale della « zona ad *Hildoceras bifrons* ». Sezione principale di M. La Pelosa.

Fig. 14 - *Harpoceras mulgravium* (YOUNG & BIRD).
s = 16 mm circa; a = 30 mm circa. Esemplare proveniente dalla base della « zona a *Ph. erbaense* », « sottozona a *Pseudomercaticeras rotaries* ». Sezione principale di M. La Pelosa.

Fig. 15 - *Oxyparoniceras buckmanni* (BONARELLI).
D = 51 mm; o = 14 mm; s = 16 mm; a = 21 mm.
Esemplare proveniente dalla sommità della « zona a *Ph. erbaense* », « sottozona a *Paroniceras sternale* ». Sezione principale di M. La Pelosa.
Tutti gli esemplari sono conservati presso l'Istituto di Geologia e Paleontologia dell'Università di Roma.

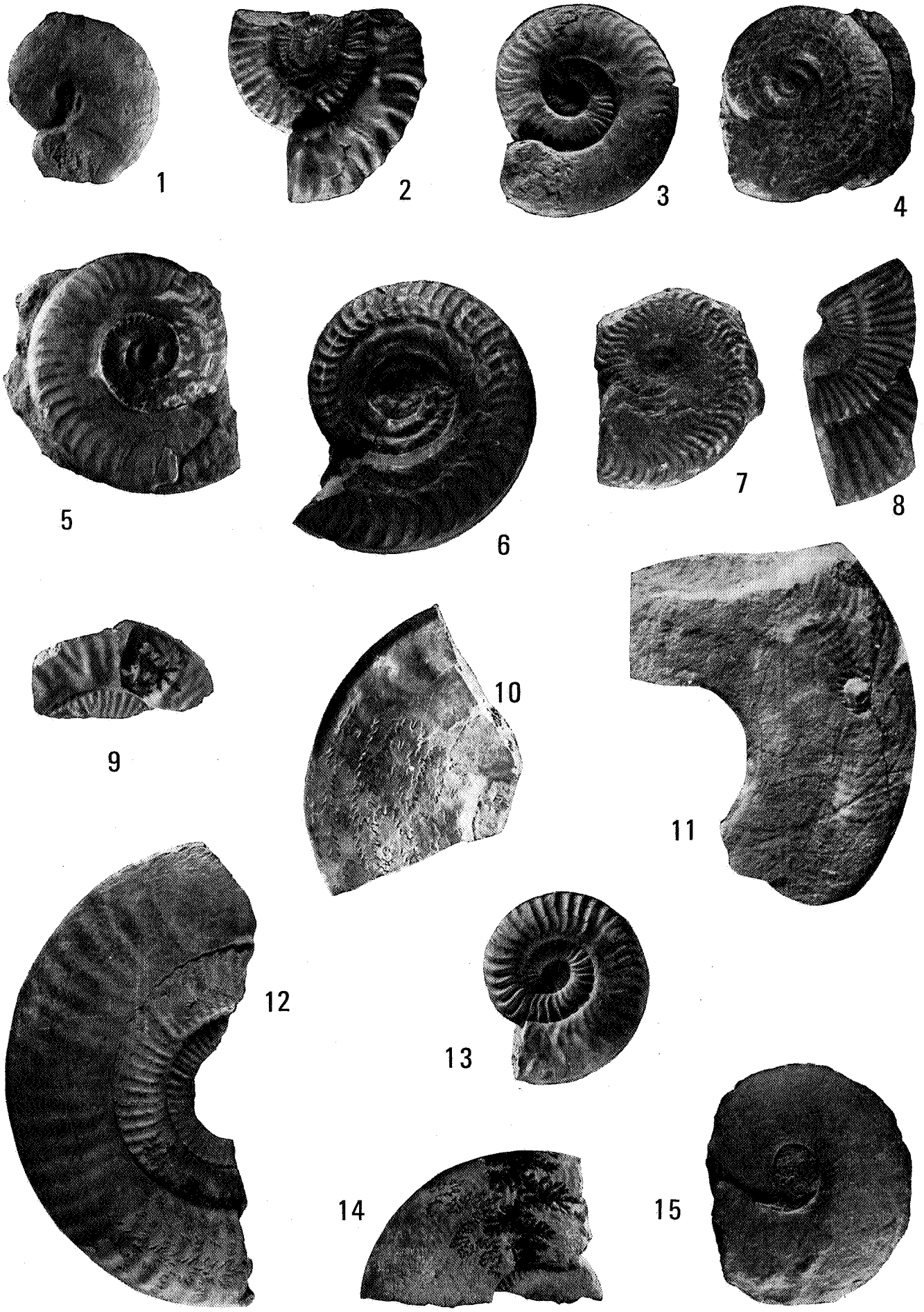
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PLATE II

Figs. 1-6 - Calcareous Nannoplankton -« Rosso Ammonitico » Formation. Toarcian. Main section of M. La Pelosa -Terni.

Fig. 1 - *Biscutum dubium* (NOËL) x 8,500 ca. S.E.M. « *Phymatoceras erbaense* zone ».

Fig. 2 - *Ellipsagelosphaera communis* (REINHARDT) S.E.M. x 10,000 ca. « *Dumortieria meneghinii* zone ».

Fig. 3 - *Discorhabdus* sp. S.E.M. x 9,000 ca. « *Dumortieria meneghinii* zone ».

Figs. 4-6 - *Schizosphaerella punctulata* DEFLANDRE & DANGEARD; 4 - inside view of shell, showing traces of the mesh structure. S.E.M. x 8,500 ca. «*Hildoceras bifrons* zone ». 5 - Inner mould with traces of tips of shell crystals. S.E.M. x 5,000 ca. « *Dumortieria meneghini* zone ». 6 - Recrystallized shell and inner mould. x 9,000 ca. « *Dumortieria meneghini* zone ».

TAVOLA II

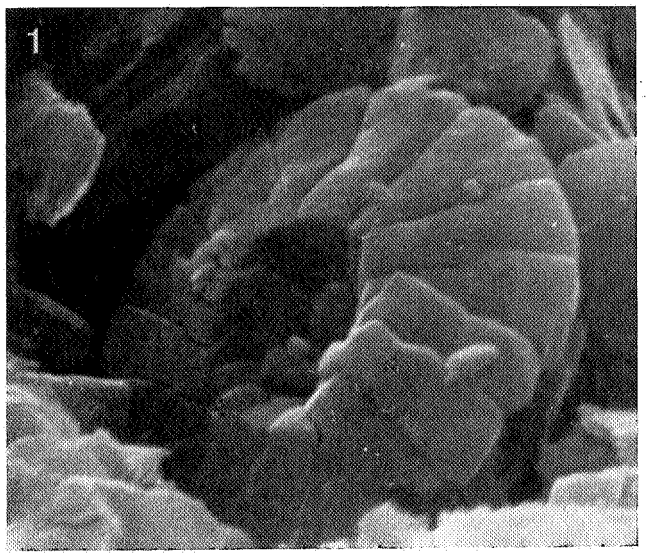
Fig. 1-6 - Nannoplancton calcareo Fm. del « Rosso Ammonitico » Toarciano, M. La Pelosa, Terni.

Fig. 1 - *Biscutum dubium* (NOËL) - « zona a *Ph. erbaense* » S.E.M. x 8.500 circa.

Fig. 2 - *Ellipsagelosphaera communis* (REINHARDT) - « zona a *Dumortieria meneghini* » S.E.M. x 10.000 circa.

Fig. 3 - *Discorhabdus* sp. - « zona a *D. meneghini* » S.E.M. x 9.000 circa.

Fig. 4-6 - *Schizosphaerella punctulata* DEFLANDRE & DANGEARD. 4 - Interno del guscio mostrante ancora le tracce della struttura a maglie - « zona a *H. bifrons* » S.E.M. x 8.500 circa. 5 - Modello interno con le tracce delle terminazioni dei cristalli del guscio - « zona a *D. meneghini* » S.E.M. x 5.000 circa. 6 - Guscio ricristallizzato e modello interno - « zona a *D. meneghini* » S.E.M. x 9.000 circa.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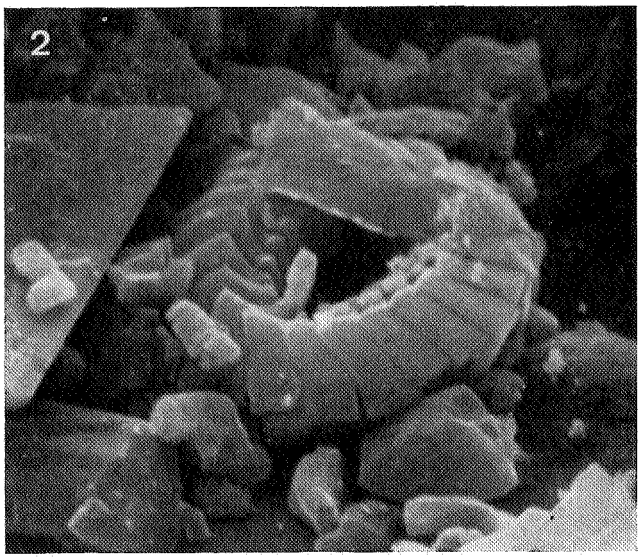
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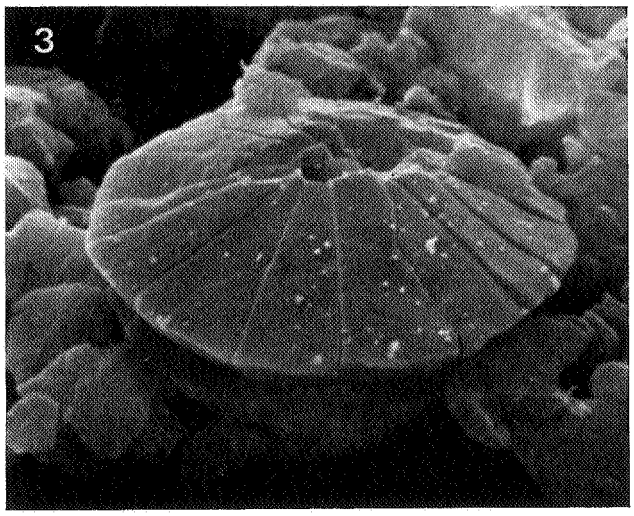
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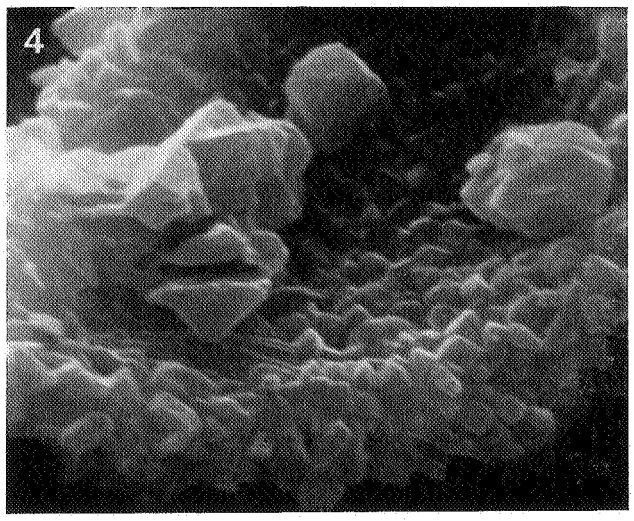
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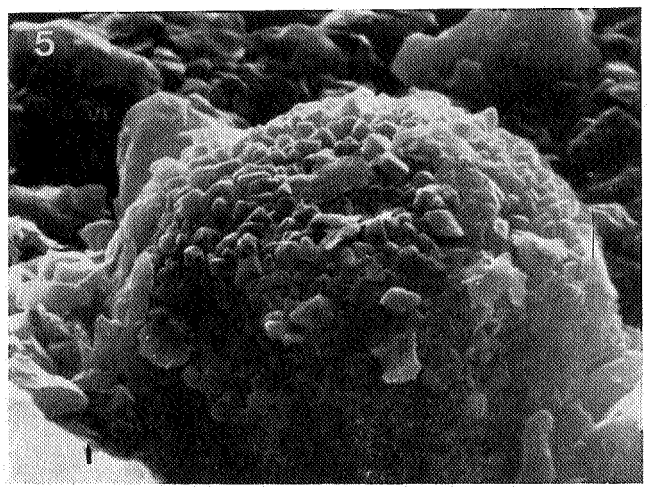
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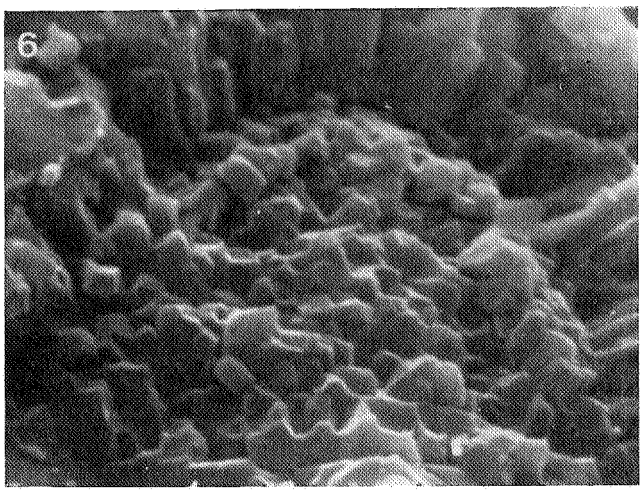
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