

## New benthic foraminifers (Miliolacea and Soritacea) from the Cenomanian and Upper Turonian of the Monte Cairo (Southern Latium, Central Italy)

*Nuovi Foraminiferi bentonici (Miliolacea e Soritacea) nel Cenomaniano e Turoniano superiore del Monte Cairo (Lazio meridionale, Italia centrale)*

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ABSTRACT - *Spiroloculina cenomana* n. sp., *Palaeosigmoilopsis apenninica* n. gen., n. sp., *Sigmomassilina ottadunensis* n. gen., n. sp., *Peneroplis cairensis* n. sp. from the Cenomanian and *Spirosigmoilina rajkae* n.sp. from the Upper Turonian of Monte Cairo (Southern Latium) are here described; new subfamily Palaeosigmoilopsinae is also proposed.

The carbonate sediments cropping out in the mentioned area were referred to platform back-reef depositional paleoenvironment (CHIOCCHINI *et alii*, 2005); while *Sigmomassilina ottadunensis* n. gen., n. sp. and *Spirosigmoilina rajkae* n. sp. are typical of this paleoenvironment.

*Spiroloculina cenomana* n. sp., *Palaeosigmoilopsis apenninica* n. gen., n. sp. and *Peneroplis cairensis* n. sp. occur also in carbonate sediments of the Aurunci, Ausoni and Lepini Mountains referred to the inner shelf paleoenvironment (CHIOCCHINI *et alii*, 1994).

KEY WORDS: Systematic, foraminifers (Miliolacea, Soritacea), Cenomanian, Upper Turonian, Southern Latium, Central Italy.

RIASSUNTO - Durante le ricerche microbiostratigrafiche condotte per diversi anni sui sedimenti carbonatici del Cretacico affioranti nell'area del Monte Cairo nel Lazio meridionale (CHIOCCHINI *et alii*, 2004), sono stati individuati numerosi nuovi taxa di foraminiferi bentonici. In questa nota vengono descritti *Spiroloculina cenomana* n. sp., *Palaeosigmoilopsis apenninica* n. gen., n. p., *Sigmomassilina ottadunensis* n. gen., n. sp., *Peneroplis cairensis* n. sp. tipiche del Cenomaniano e *Spirosigmoilina rajkae* n. sp. limitata al Turoniano superiore.

Le specie suddette risultano facilmente riconoscibili in base ad alcune particolarità tassonomiche: *Spiroloculina cenomana* n. sp. è caratterizzata da un profilo carenato e dalla tendenza delle logge dello stadio finale a cambiare il piano di avvolgimento e ad assumere una disposizione sigmoidale;

*Palaeosigmoilopsis apenninica* n. gen., n. sp. ha logge disposte in due serie spirali serrate, ad andamento sigmoidale, come in *Sigmoilopsis* FINLAY, 1947 ma con superficie esterna del guscio priva di materiale agglutinato; *Sigmomassilina ottadunensis* n. gen., n. sp. è caratterizzata dalle logge iniziali con disposizione quinqueloculina e quelle finali che si aggiungono alternativamente sui lati del guscio cambiando via via il piano di avvolgimento ed originando due serie ad andamento sigmoidale; *Spirosigmoilina rajkae* n. sp. mostra uno stadio iniziale leggermente rigonfio o sporgente su un lato del guscio, costituito da due serie spirali di logge ad andamento sigmoidale, mentre quelle finali tendono ad assumere una disposizione planispirale; *Peneroplis cairensis* n. sp. ha un guscio di notevoli dimensioni, con porzione iniziale planispirale ben sviluppata, camere finali dello stadio adulto più basse delle precedenti e larghi pori aperturali.

Per la loro limitata estensione stratigrafica le nuove specie vanno ad aggiungersi ai numerosi taxa bentonici già noti che caratterizzano i sedimenti carbonatici del Cenomaniano e del Turoniano, come illustrato nella allegata tabella 2.

Inoltre i taxa descritti rivestono una notevole importanza anche dal punto di vista paleoambientale: in particolare *Spirosigmoilina rajkae* n. sp. sembra limitata alle facies di retromargine della piattaforma carbonatica laziale - abruzzese ampiamente affioranti nell'area del Monte Cairo; *Spiroloculina cenomana* n. sp., *Palaeosigmoilopsis apenninica* n. gen., n. sp. e *Peneroplis cairensis* n. sp. risultano maggiormente diffusi, essendo stati osservati sempre nel Lazio meridionale, anche nei sedimenti di piattaforma carbonatica interna dei Monti Lepini, Ausoni e Aurunci, mentre *Sigmomassilina ottadunensis* n. gen., n. sp. è presente anche nel Cenomaniano inferiore in facies retromarginale di Val d'Agri in Lucania.

PAROLE CHIAVE: Sistematica, foraminiferi (Miliolacea e Soritacea), Cenomaniano, Turoniano superiore, Lazio meridionale, Italia centrale.

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## 1. - INTRODUCTION

A detailed micropaleontological and stratigraphical research carried out on cenomanian and turonian carbonatic sediments widely cropping out in Monte Cairo area, Southern Latium (fig. 1 A), allowed some new porcellanaceous benthic foraminifers genera and species to be identified. The designed type-localities for the new taxa are Colle Santa Lucia stratigraphic section as regards *Spiroloculina cenomana* n. sp. and *Peneroplis cairensis* n. sp., l'Ottaduna stratigraphic section for *Sigmomassilina ottadunensis* n. gen., n. sp. and *Spirosigmoilina rajkae* n. sp., la Cicogna stratigraphic section for *Palaeosigmoilopsis apenninica* n. gen., n. sp.; all the mentioned successions (fig. 1) crop out in the south-eastern sector of Monte Cairo (CHIOCCHINI *et alii*, 2005) (fig. 1 B).

As well as the sistematic description based on the classification by LOEBLICH & TAPPAN (1988), also accurate stratigraphical range of each species is given, according to the biostratigraphic scheme proposed by CHIOCCHINI *et alii* (1994) and recently reviewed by CHIOCCHINI *et alii*, 2008 for the Mesozoic carbonate successions of Central Apennine (Latium and Abruzzi).

Besides, the biostratigraphic study carried out in the Monte Cairo area has allowed the range of the most significant benthic foraminifers and calcareous algae, characterizing the cenomanian and turonian chronostratigraphic intervals of the analyzed successions, to be specified; the depositional environment where the carbonate sediments settled to be defined. The recording of *Spirolocu-*

*lina cenomana* n. sp., *Palaeosigmoilopsis apenninica* n. gen., n. sp., *Peneroplis cairensis* n. sp. also in other localities of the Southern Latium (Aurunci, Ausoni, Lepini Mountains), while *Sigmomassilina ottadunensis* n. gen., n. sp. has been observed also in the Lower Cenomanian of Val d'Agri (Lucania).

## 2. - SYSTEMATIC DESCRIPTION

ORDER Foraminiferida EICHWALD, 1830  
SUBORDER Miliolina DELAGE & HEROUARD, 1896  
SUPERFAMILY Miliolacea EHRENBERG, 1839  
FAMILY Spiroloculinidae WIESNER, 1920  
GENUS *Spiroloculina* D'ORBIGNY, 1826  
TYPE-SPECIES *Spiroloculina depressa*, D'ORBIGNY, 1826

### *Spiroloculina cenomana* n. sp.

Plate I, figures 1-5; plate II, figures 1-13; plate III, figures 1-14

1984 *Spiroloculina cretacea* REUSS - CHIOCCHINI, MANCINELLI & ROMANO, plate 4, figures 8, 12.

1984 *Spiroloculina?* sp. - PEYBERNES, plate 2, figures 16-18.

1994 *Spiroloculina* n. sp. - CHIOCCHINI, FARINACCI, MANCINELLI, MOLINARI & POTETTI, plate 15, figures 6-8.

1995 *Spiroloculina* sp. (cf. *S. cretacea* REUSS) - CARRAS, plate 56, figure 11.

1999/2000 *Spiroloculina* n. sp. - COCCIA, plate 2, figure 1; plate 5, figures 8, 9.

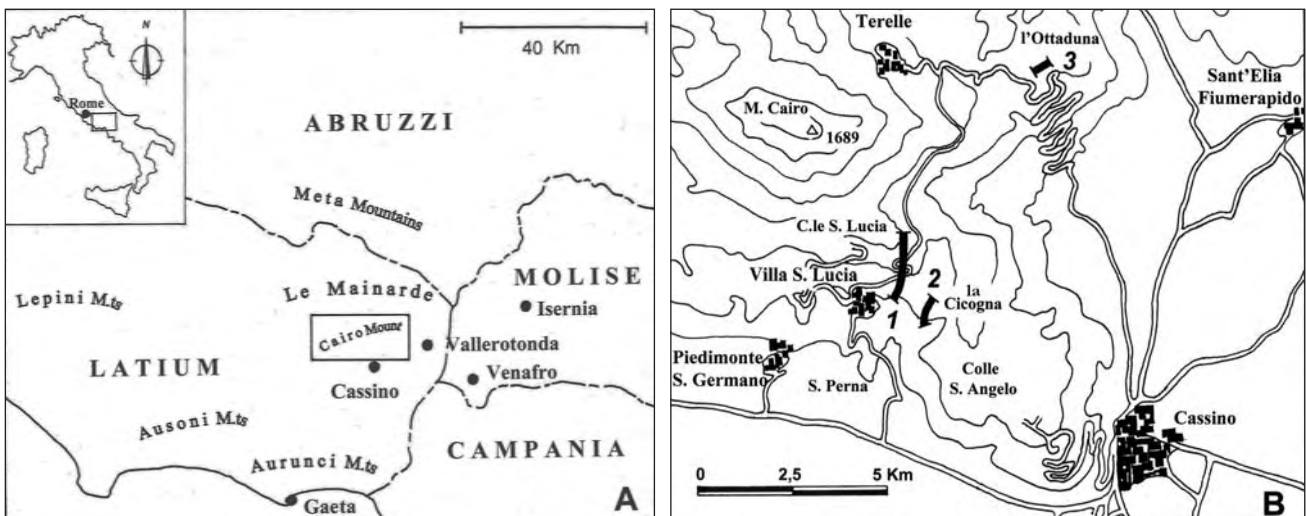


Fig. 1 - Map showing Monte Cairo area and other mountain chains mentioned in the text. A: Topographic detail of the southern sector of Monte Cairo with the investigated successions B: 1 - Colle S. Lucia; 2 - La Cicogna; 3 - L'Ottaduna.

- Localizzazione dell'area del Monte Cairo e delle alte catene montuose citate nel testo. A: Dettaglio topografico del settore meridionale del Monte Cairo con le sezioni stratigrafiche studiate. B: 1 - Colle S. Lucia; 2 - La Cicogna; 3 - L'Ottaduna.

2002 *Spiroloculina* sp. - MANCINELLI & COCCIA, plate 7, figures 11, 13, 14.

ORIGIN OF THE NAME: from Cenomanum, latin name of Mans (France), type-locality of the Cenomanian.

HOLOTYPE: equatorial section of a probably microspheric form, illustrated in plate II, figure 1, (sample A. 1293) deposited in the micropaleontological collection of the Department of Earth Sciences, University of Camerino, Italy.

PARATYPES: sections with different orientation illustrated in plate II, figures 2, 4, 8, 9, 10, 12, 13; Plate III, figures 2, 3, 6, 12, 13, 14, deposited in the micropaleontological collection (samples A. 249, A. 1386) of the above-mentioned Department of Earth Sciences.

TYPE-LOCALITY: southern side of Colle Santa Lucia, Monte Cairo, Southern Latium, Central Italy.

TYPE-LEVEL: Upper Cenomanian mud-supported limestone with acteonids and other gastropods.

MATERIAL: approximately 60 sections with different orientation, from type-level and several sections, variously oriented, from the above mentioned localities.

SPECIFIC DIAGNOSIS: *Spiroloculina* characterized by a periphery inflated with strongly carinate extremities, with last chambers changing plane of coiling and showing a sigmoid arrangement.

DESCRIPTION: test elliptical in outline, laterally biconcave with inflated periphery and strongly carinate extremities. The microspheric forms show a subspherical proloculus of small dimensions followed by a planispiral second chamber of one whorl in length. The adult stage consists of 4 to 5 pairs of chambers, quadrangular to plano-convex lens in shape, convex towards the exterior of the test. The first chambers are regularly added on alternate side in a single plane of coiling; last chambers, more growing in height, change the plane of coiling as are added and tend to arrange in sigmoid pattern.

Very rare specimen, probably belonging to megalospheric generation, are characterized by very large proloculus followed by 2 to 3 pairs of chambers with carinate extremities alternating in a single plane of coiling.

Wall calcareous, imperforate, porcelanaceous, consisting of a single layer thickening in the inner part of the test, due to the superimposition of one

chambers floor on the roof of the previous one. Aperture single at the end of the chamber produced on a short neck with a probably simple tooth.

REMARKS: the new species has been referred to the genus *Spiroloculina* because the sigmoid disposition of the last chambers, observed only in the microspheric forms, is considered a specific peculiarity rather than a generic character.

BIOMETRICAL PARAMETERS:

Microspheric specimen

proloculus diameter 0.030 - 0.035 mm

equatorial diameter 0.60 - 0.85 mm

axial diameter 0.42 - 0.46 mm

number of chambers 8 - 10

Megalospheric specimen

proloculus diameter 0.051 - 0.056 mm

equatorial diameter 0.32 - 0.35 mm

axial diameter ?

number of chambers 3 - 4

SIMILARITIES AND DIFFERENCES: according to CUSHMAN & TODD, 1944, *Spiroloculina limbata* CHAPMAN, 1982, *Spiroloculina perforata* REUSS, 1845/46 and *Spiroloculina simplex* ALBRITTON & PHLEGER, 1937 are regarded as synonymous of *Spiroloculina cretacea* REUSS, 1845; the latter, together with *Spiroloculina truncata* SLITER, 1968, has been certainly observed in the sediments of the Upper Cretaceous. *Spiroloculina cretacea* REUSS differs from *Spiroloculina cenomana* n. sp. for the general smaller dimensions of the test (*vide* CUSHMAN & TODD, 1944), but also for the test more compressed axially and a truncate periphery, often concave and lightly keeled, and generally for a lower number of chambers.

*Spiroloculina truncata* SLITER differs from *Spiroloculina cenomana* n. sp. for its axially compressed test, for the chambers rapidly increasing in size, with subtruncate but not carinate extremities and for the terminal aperture without a visible tooth. *Spiroloculina* sp., described by ARNAUD VANNEAU, 1980 in the Upper Barremian-Lower Aptian of Le Grands Goulets (Western Alps, France), differs from the new species for its smaller general dimensions, for a test more compressed in axial direction and for the clearly trapezoidal shape of the chambers. Finally *Spiroloculina cenomana* n. sp. differs from all the above mentioned species for the peculiar sigmoid arrangement of the last chambers in axial section and in the transverse sections close to the major diameter.

PALEONTOLOGICAL ASSOCIATION IN THE TYPE-LEVEL: *Spiroloculina cenomana* n. sp. occurs together

with *Pseudorhapydionina dubia* (DE CASTRO), *Nezzazata simplex* OMARA, *Biconcava bentori* HAMAOUI & SAINT-MARC, *Palaeosigmoilopsis apenninica* n. gen., n. sp., *Cuneolina pavonia* D'ORBIGNY, Miliolidae, Ostracoda, acteonids and other small gastropods.

STRATIGRAPHICAL EXTENSION:

Lower Cenomanian (upper portion of the Ostracoda and Miliolidae biozone) and Upper Cenomanian (*Pseudorhapydionina dubia* and *Pseudorhapydionina laurinensis* biozone and lowermost part of *Chrysalidina gradata* and *Pseudolituonella reicheli* biozone) in the type-locality and also in the other localities of Southern Latium (Aurunci, Ausoni and Lepini Mountains) and Lucania (Val d'Agri).

DEPOSITIONAL ENVIRONMENT:

back-reef and inner carbonate platform.

PALEOGEOGRAPHIC DISTRIBUTION:

the new species is so far known in Italy (Southern Latium and Lucania) and in Spanish Pyrenees (PEYBERNES, 1984).

FAMILY Hauerinidae SCHWAGER, 1876

SUBFAMILY Hauerininae SCHWAGER, 1876

GENUS *Sigmomassilina* n. gen.

TYPE-SPECIES *Sigmomassilina ottadunensis* n. sp.

ORIGIN OF THE NAME: shows the likeness of this genus with *Massilina* SCHLUMBERGER, 1893.

DIAGNOSIS: test subspheric to ovate in outline; subspherical proloculus followed by early chambers in quinqueloculine arrangement, later added in changing plane traced a sigmoid path with floor. Wall calcareous, imperforate, porcelanaceous. Single aperture at the end of the chamber with a simple tooth. Cenomanian; Central Italy.

REMARKS: ARNAUD VANNEAU, 1980 has described *Massilina* sp. (pl. 10, figs. 27, 28; pl. 18, figs. 58-60) and *Massilina* ? sp. (pl. 8, figs. 16, 17): these two taxa can be probably included in the *Sigmomassilina* n. gen. because of the sigmoid arrangement of the last chambers in the axial and subaxial sections.

SIMILARITIES AND DIFFERENCES: the new genus mainly differs from *Massilina* SCHLUMBERGER, 1893 because the chambers following the early quinqueloculine stage appear in axial and subaxial sections to form a sigmoid series. *Pseudomassilina* LACROIX, 1938 resembles to

*Sigmomassilina* n. gen. but differs from the latest for its final stage showing more than two chambers per whorl and for the slit-like aperture, bordered by lip and without a tooth.

*Sigmomassilina ottadunensis* n. sp.

Plate I, figures 10-13; plate IV, figures 1-18; plate V, figures 1-15

1994/95 aff. *Massilina* - COCCIA, plate 11, figures 4, 5, 7, 11, 12.

ORIGIN OF THE NAME: from l'Ottaduna locality, Monte Cairo, Southern Latium (Central Italy) where this species was observed for the first time.

HOLOTYPE: axial section of a specimen illustrated in plate IV, figure 1 (sample A. 1460), deposited in the micropaleontological collection of the Department of Earth Sciences, University of Camerino, Italy.

PARATYPES: sections with different orientation illustrated in plate IV, figures 2, 3, 4, 9, 10, 18; plate V, figures 1, 4, 12 (samples A. 1461, A. 1470, A. 1472, A. 1475), deposited in the micropaleontological collection of the above-mentioned Department of Earth Sciences.

TYPE-LOCALITY: l'Ottaduna stratigraphic section, south-eastern side of the Monte Cairo, Southern Latium, Central Italy.

TYPE-LEVEL: Lower-Upper Cenomanian boundary mud-supported limestone with alveolinids and orbitolinids.

MATERIAL: approximately 40 sections with different orientation from the type-level and several variously oriented sections from other mentioned localities.

SPECIFIC DIAGNOSIS: *Sigmomassilina* with well developed early quinqueloculine stage and a final stage as *Massilina*, but with chambers adding in a sigmoid path.

DESCRIPTION: test subcircular to elliptical in outline, laterally biconcave, with periphery plane or lightly bombè and weakly carinate extremities. The subspherical proloculus is followed by early well developed quinqueloculine stage, with 2 whorls of spira slightly eccentric on the equatorial plane. Later stage is composed by 3-6 alternate chambers adding on opposite side of the test as *Massilina*, but frequently changing the plane of coiling so that their arrangement shows a sigmoid



path, as seen in the axial sections. The chambers increase regularly in dimensions as added; they are separated by plane or slightly depressed sutures. In the above mentioned axial and in subaxial sections the chambers show oval to quadrangular outline: the upper part of the wall is plane or slightly convex. Their thick and pointed extremities originate two short carinae.

Wall calcareous, imperforate, porcelanaceous, consisting of a single layer thickening in the inner part of the test, due to the superposition of one chamber floor on the roof of the previous chamber. Aperture single at the end of the chamber with a large simple tooth.

BIOMETRICAL PARAMETERS:

proloculus diameter 0.025 - 0.033 mm

equatorial diameter 0.54 - 0.63 mm

axial diameter 0.28 - 0.55 mm

number of chambers in the quinqueloculine stage 10

number of chambers in the sigmoid stage 3 - 6

PALEONTOLOGICAL ASSOCIATION OF THE TYPE-LEVEL: *Sigmomassilina ottadunensis* n. gen., n. sp. is associated with *Nezzazata simplex* OMARA, *Biconcava bentori* HAMAOUÏ & SAINT-MARC, *Vidalina radoicicae* CHERCHI & SCHROEDER, *Cuneolina pavonia* D'ORBIGNY, *Praealveolina* aff. *tenuis* REICHEL, *Orbitolina* (*Conicorbitolina*) *conica* D'ARCHIAC, *Cisalveolina lehneri* REICHEL, *Heteroporella lepina* PRATURLON, Miliolidae, Ostracoda and rudists fragments.

STRATIGRAPHICAL EXTENSION: in the type locality and in other localities of the Southern Latium the new species range is Lower Cenomanian (uppermost portion of the Ostracoda and Miliolidae biozone) - Upper Cenomanian (initial portion of the *Pseudorhapydionina dubia* and *Pseudorhapydionina laurinensis* biozone). In Val d'Agri area *Sigmomassilina ottadunensis* n. gen., n. sp. was identified in the lowermost Cenomanian (middle portion of the Ostracoda and Miliolidae biozone), associated with *Ovalveolina crassa* DE CASTRO, *Peneroplis parvus* DE CASTRO, *Neoiraqia insolita* (DECROUEZ & MOULLADE), and *Vandanchella dercourti* DECROUEZ & MOULLADE.

DEPOSITIONAL ENVIRONMENT: back-reef and inner carbonate platform.

SUBFAMILY Sigmoidinitinae ŻUCZKOWSKA,  
1974

GENUS *Spirosigmoilina* PARR, 1942

TYPE-SPECIES *Spirosigmoilina tateana*  
HOWCHIN, 1889

*Spirosigmoilina rajkae* n. sp.

Plate I, figures 14-17; plate VI, figures 1-22

1980 *Spirosigmoilina* sp. 1 – RADOIČIĆ, plate 1, figure 1; plate 2, figures 1-10.

ORIGIN OF THE NAME: in honor of Rajka Radoičić who for the first time (1980) illustrated and briefly described this form.

HOLOTYPE: subequatorial section of a specimen illustrated in plate VI, figure 5 (sample A. 1462), deposited in the micropaleontological collection of the Department of Earth Sciences, University of Camerino, Italy.

PARATYPES: sections with different orientation illustrated in plate VI, figures 1, 6, 11, 12, 13, 14, 15, 20, 21 (sample A. 1463, A. 1464, A.1465), deposited in the micropaleontological collection of the above-mentioned Department of Earth Sciences.

TYPE-LOCALITY: upper part of l'Ottaduna stratigraphic section, south-eastern side of Monte Cairo, Southern Latium, Central Italy.

TYPE-LEVEL: Upper Turonian mud-supported limestone with rare rudists fragments

MATERIAL: approximately 80 sections with different orientation from the type-locality.

SPECIFIC DIAGNOSIS: *Spirosigmoilina* characterized by a tiny flat test, with early sigmoid portion slightly thicker and later chambers arranged as *Spiroloculina*, as height as large with a little pointed distal extremities.

DESCRIPTION: test elliptical to subcircular in outline, with a little pointed periphery, tiny flat and with slightly thicker central part. The subspherical proloculus is followed by numerous chambers one half coil in length, slowly increasing in dimension as added. In the early inflated stage, jutting out on one side of the test, the chambers are located in two spirals and close series with 3-4 chambers per each series and showing a sigmoid path as seen in the axial sections. The later stage is composed by 6-7 chambers: they are alternatively added on two sides of the test and tend to arrange themselves in a planispiral pattern. In axial section the long and narrow chambers show subcircular shape concerning the initial sigmoid stage. The chambers of the later planispiral stage are plano-convex to lightly pointed on the outer side of the test.

Wall calcareous, imperforate porcelanaceous, consisting of a single layer thickening in the inner

part of the test due to the superimposition of one chamber floor on the roof of the previous one, well shown in the chambers of the planispiral stage. Aperture single at the end of the chamber, with simple and very short tooth.

REMARKS: HOFKER (1971) has described in the Upper Albian of France an orthogenetic evolution of a "gens" from *Quinqueloculina* to *Spirosigmoilina* through a *Sigmoilina* stage. The presence of *Spirosigmoilina rajkae* n. sp. in the cretaceous limestones of Monte Cairo shows the continuity of *Sigmoilina* – *Spirosigmoilina* evolutionary trends during the Turonian age.

BIOMETRICAL PARAMETERS:

proloculus diameter 0.015 - 0.026 mm  
 equatorial diameter 0.36 - 0.55 mm  
 axial diameter 0.32 - 0.43 mm  
 total number of the chambers 11 - 13  
 number of chambers of the two spiral series 7 - 8  
 number of chambers of the planispiral stage 4 - 5

PALEONTOLOGICAL ASSOCIATION OF THE TYPE-LEVEL: *Spirosigmoilina rajkae* n. sp. occurs together *Spiroplectammina multicamerata* SAID & KENAWY, *Discorbis* cf. *turonicus* SAID & KENAWY, *Moncharmontia apenninica* (DE CASTRO), Lituolidae sp. 2, *Aeolisaccus barattoloi* DE CASTRO, Miliolidae, Ostracoda and rare rudists fragments.

STRATIGRAPHICAL EXTENSION: RADOIČIĆ (1980), has for the first time identified this taxon as *Spirosigmoilina* sp. 1 in the turonian limestones of the Stira Valley (Gucevo region, Western Serbia). In the type-locality *Spirosigmoilina rajkae* n. sp. is present only in the Upper Turonian (Nezzazatinella cf. aegyptiaca and Nummoloculina cf. irregularis biozone).

DEPOSITIONAL ENVIRONMENT: back-reef of the carbonate platform.

SUBFAMILY Palaeosigmoilopsinae n. subfam.

DESCRIPTION: chambers one half coil in length, added in changing plane so that in the axial section they trace a sigmoid path in the most part of the test; the last chambers may add in a single plane; wall calcareous, imperforate, porcelanaceous, without agglutinate material. Cenomanian.

REMARKS: the description of the new subfamily Palaeosigmoilopsinae is necessary because porcelanaceous wall of *Palaeosigmoilopsis* n. gen. is not

characterized by agglutinated coating on the outside and can not be assigned to the subfamily Sigmoilopsinae VELLA, 1957 or to whatever known subfamily.

GENUS **Palaeosigmoilopsis** n. gen.

TYPE-SPECIES *Palaeosigmoilopsis apenninica* n. sp.

ORIGIN OF THE NAME: shows the likeness between the cretaceous new genus and *Sigmoilopsis* FINLAY, 1947 of the Neogene-Holocene.

DIAGNOSIS: test ovate in outline, chambers one-half coil in length, changing plane of arrangement resulting in two close spirally series, looking sigmoids in axial section; the final chambers may become planispiral; chambers with floor. Wall thick, calcareous, imperforate, porcelanaceous; single aperture, at the end of the chamber, with a simple, large tooth.

SIMILARITIES AND DIFFERENCES: *Palaeosigmoilopsis* n. gen. differs from *Sigmoilopsis* FINLAY, 1947 for its porcellanaceous wall not coated of agglutinated particles but also for the two particular close spiral series of the chambers in the later portion of the test and for the large apertural tooth.

**Palaeosigmoilopsis apenninica** n. sp.

Plate I, figures 6-9; plate VII, figures 1-15; plate VIII, figures 1-16

ORIGIN OF THE NAME: referring to the provenance of the new taxon from Central Apennines, Italy.

HOLOTYPE: equatorial section illustrated in plate VII, figure 2 (sample A. 1286) deposited in the micropaleontological collection of the Department of Earth Sciences, University of Camerino, Italy.

PARATYPES: sections with different orientation illustrated in plate VII, figures 1, 5, 6, 7, 12, 14, 15; Pl. VIII, figures 1, 2, 3, 5, 8, 9, 12, 13 deposited in the micropaleontological collection (samples A. 1275, A. 1280, A. 1283, A. 1284) of the above-mentioned Department of Earth Sciences.

TYPE-LOCALITY: southern side of la Cicogna, Monte Cairo, Southern Latium, Central Italy.

TYPE-LEVEL: Lower Cenomanian fossiliferous grain-supported limestone, rich in *Sellialveolina viallii* COLALONGO.

MATERIAL: more than 100 sections with different

orientation from the type-level and several variously oriented section of other stratigraphic sections of Monte Cairo area, Lepini and Ausoni Mountains.

**SPECIFIC DIAGNOSIS:** *Palaeosigmoilopsis* characterized by two rather close spiral series of the elongated tubular chambers: in the axial section these chambers are convex towards the outside and plane or lightly convex towards the inside of the test.

**DESCRIPTION:** test elliptical in outline, laterally biconvex with rounded periphery. The subspherical proloculus, of small dimensions is followed by numerous long and low chambers, one half coil in length, very regularly increasing in dimension during the growth; these chambers change the plane of coiling as they are added. The chambers are arranged in two spiral series and show a sigmoid path in axial section. Each spiral series is composed by 8 - 11 tubular chambers; in the axial and subaxial sections, these chambers are convex towards the outside and plane or lightly convex towards the inside of the test. In the last stage of the growth, the final chambers tend to arrange in a planispiral pattern.

Wall calcareous, imperforate, porcelanaceous, consisting of a single layer thickening in the inner part of the test, due to the superimposition of one chamber floor on the roof of the previous one.

Aperture single at the end of the tubular chamber, with a simple, large tooth.

**BIOMETRICAL PARAMETERS:**

proloculus diameter 0.027 - 0.032 mm

equatorial diameter 0.73 - 0.86 mm

axial diameter 0.39 - 0.47 mm

total number of the chambers 16 - 22

**PALEONTOLOGICAL ASSOCIATION OF THE TYPE-LEVEL:** *Palaeosigmoilopsis apenninica* n. gen., n. sp. occurs together with *Sellialveolina viallii* COLALONGO, *Biconcava bentori* HAMAOUÏ & SAINT-MARC, *Nezzazata simplex* OMARA, *Spiroloculina cenomana* n. sp., *Cuneolina* sp., Miliolidae and Ostracoda.

**STRATIGRAPHICAL EXTENSION:** Lower Cenomanian (upper part of the Ostracoda and Miliolidae biozone) and Upper Cenomanian (*Pseudorhapydionina dubia* and *Pseudorhapydionina lauriniensis* biozone) in the type-locality and also in other localities in Southern Latium (Aurunci, Ausoni and Lepini Mountains) and Lucania (Val d'Agri).

**DEPOSITIONAL ENVIRONMENT:** back-reef and inner carbonate platform.

**SUPERFAMILY** Soritidacea EHRENBERG, 1839

**FAMILY** Peneroplidae SCHULTZ, 1954

**GENUS** *Peneroplis* DE MONTFORT, 1808

**TYPE-SPECIES** *Nautilus planatus* FICHTEL & MOLL, 1798

***Peneroplis cairensis* n. sp.**

Figures 2, 3; plate IX, figures 1-16

**ORIGIN OF THE NAME:** it indicates the provenance of new species from Monte Cairo area, (Southern Latium, Central Italy).

**HOLOTYPE:** incomplete equatorial section of a specimen illustrated in plate IX, figure 1 (sample A. 1695) deposited in the micropaleontological collection of the Department of Earth Sciences, University of Camerino, Italy.

**PARATYPES:** sections with different orientation illustrated in plate IX, figures 2, 3, 7, 8, 9, 10, 12, 13, 14, deposited in the micropaleontological collection (sample A. 1696, A. 1697, A. 1699) of the above-mentioned Department of Earth Sciences.

**TYPE-LOCALITY:** southern side of Colle Santa Lucia, Monte Cairo, Southern Latium, Central Italy.

**TYPE-LEVEL:** lowermost Cenomanian fenestral mud-supported limestone, immediately above the levels rich in *Orbitolina (Conicorbitolina) conica* (D'ARCHIAC), nerineids with *Plesioptygmatis nobilis* (MUNSTER) and other gastropods.

**MATERIAL:** approximately 50 sections with different orientation from the type-level and some sections, variously oriented from Serra del Pruno stratigraphic section, Ausoni Mountains, Southern Latium.

**SPECIFIC DIAGNOSIS:** *Peneroplis* characterized by large dimensions, rather developed early stage, the last chambers of the uncoiled stage lower than the formers and large apertural pores.

**DESCRIPTION:** test flabelliform, bilaterally compressed (peneropline) with lobulate periphery. The subspherical proloculus is followed by planispiral to weakly trochospiral early stage of considerable dimensions and laterally in position as regards the elongation axis; this stage is composed by 9 - 10 scythe-like chambers increasing very regularly in dimension during the ontogenesis and arranged in 1,5 - 2 tour of the spira. The very developed later uncoiled stage, rapidly increasing in breadth, is composed by 6 - 10 larger than high arched chambers with simple and



undivided interior. The chambers, jutting out towards the outer side of the test, are divided by slightly depressed sutures. The first 4 - 6 chambers increasing very slightly in height as are added, while the last 2 - 3 chambers are clearly lower than the formers. In the transversal section the chambers show a floor from plane to concave and a convex roof (fig. 2).

Wall calcareous, imperforate, porcelanaceous, made up by a single layer; external surface ornamented by radial striae. In the uncoiled stage the aperture consists of a row of large pores opening in the whole roof of the chambers.

REMARKS: the presence of fine radial striae on the external surface of the uncoiled portion of the test (fig. 3) allows to assign the new species to the genus *Peneroplis* DE MONTFORT, 1908.

BIOMETRICAL PARAMETERS:

proloculus outer diameter (dp) 0.045 - 0.060 mm  
 diameter of the coiled early stage (d) 0.35 - 0.38 mm  
 number of whorls of the coiled stage 1.5 - 2  
 number of chambers in the coiled stage 9 - 10  
 largest height of the test (H) 1.20 - 1.25 mm

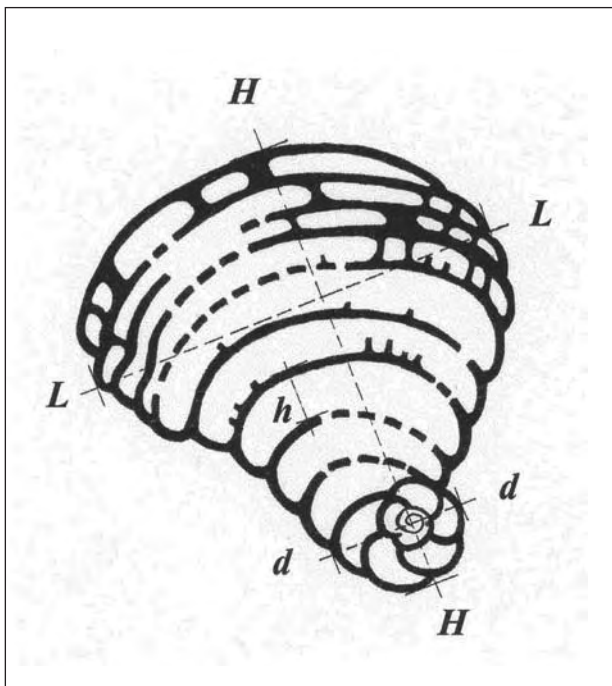


Fig. 2 - Reconstruction of a complete equatorial section of the *Peneroplis cairensis* n. sp. ( $\times 50$ ), obtained superimposing figure 10 upon figure 1, shown in the plate IX. H-H: largest length of the test; L-L: largest breadth of the test; d-d: largest breadth of the initial coiled portion of the test.

- Ricostruzione di una sezione equatoriale completa di *Peneroplis cairensis* n. sp. ( $\times 50$ ), ottenuta sovrapponendo la figura 10 alla figura 1 di tavola IX. H-H: lunghezza massima del guscio; L-L: larghezza massima del guscio; d-d: larghezza massima della porzione avvolta del guscio.

largest breadth of the test (L) 1.10 - 1.12 mm  
 number of chambers in the uncoiled stage 6 - 9  
 initial 0.10 - 0.12 mm  
 height uncoiled chambers (h)  
 last 0.07 - 0.08 mm

SIMILARITIES AND DIFFERENCES: *Peneroplis cairensis* n. sp. differs from *Peneroplis parvus* DE CASTRO, 1965 of the Lower Cenomanian of Campania basically by its larger general dimensions but also by a generally greater number of chambers in the uncoiled stage and by a large diameter of the apertural pores. The new species differs from *Peneroplis turonicus* SAID & KENAWY, 1957 of the

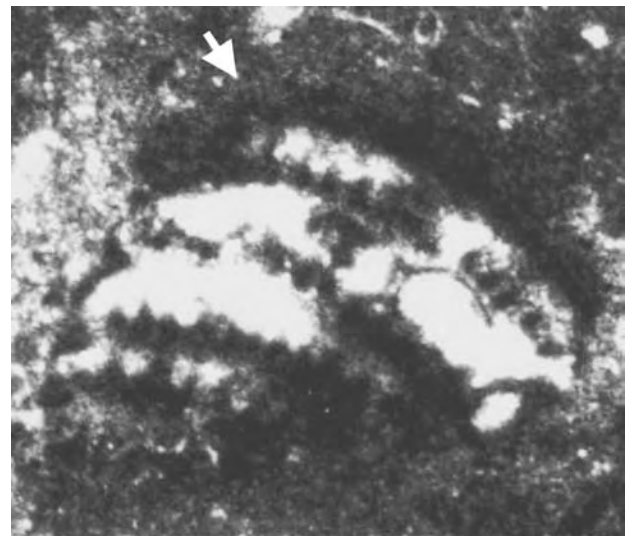


Fig. 3 - Partial subequatorial-oblique section of *Peneroplis cairensis* n. sp. ( $\times 100$ ), showing the fine radial striae ornamentation (indicated by the arrow).

- Sezione parziale subequatoriale-obliqua di *Peneroplis cairensis* n. sp. ( $\times 100$ ), che mostra l'ornamentazione a fini striae radiali (indicate dalla freccia).

Turonian of the Egypt, because the latter shows a smaller general dimensions, a smaller maximum number of the chambers in the uncoiled stage, very regularly increasing during the growth and by its outside surface lacking of radial striae. For this last character *Peneroplis turonicus* SAID & KENAWY can be assigned to genus *Laevipeneroplis* SULC, 1936, according to foraminiferal generic classification by LOEBLICH & TAPPAN, 1988. *Peneroplis* cf. *turonicus* SAID & KENAWY, described by SAINT-MARC (1974) in the Cenomanian of Lebanon (plate VIII, figs. 5-9), differs from the new species by the wall of the test showing two strata (by recrystallization?), but also by the generally smaller number of the chambers in the uncoiled stage and its thinner apertural pores (tab. 1).



PALEONTOLOGICAL ASSOCIATION IN THE TYPE-LEVEL: *Peneroplis cairensis* n. sp. occurs together with *Broeckina alaouitensis* (SAINT-MARC), *Nezzazata simplex* OMARA, *Cuneolina* cf. *pavonia* D'ORBIGNY, *Vidalina radoicicae* CHERCHI & SCHROEDER, *Pyrgo globulosa* TRONCHETTI, *Pseudorbapydionina dubia* (DE CASTRO), *Pseudorbapydionina anglonensis* CHERCHI & SCHROEDER, *Nezzazatinella* sp., *Bolivinopsis* sp., Miliolidae, Ostracoda, rudists fragments and rare corals remains.

STRATIGRAPHICAL EXTENSION: in the type-locality the range of the new species is restricted to the initial part of the Upper Cenomanian (lowermost part of the *Pseudorbapydionina dubia* and *Pseudorbapydionina laurinensis* biozone). In the Ausoni Mountains (Serra del Pruno stratigraphic section) the new species occurs, in the same stratigraphic interval, together with *Cisalveolina lehneri* REICHEL.

DEPOSITIONAL ENVIRONMENT: back-reef and inner carbonate platform.

### 3. - CONCLUSIONS

The new genera and/or species referred to superfamilies Miliolacea and Soritacea show a

restricted stratigraphic extension both in the type-localities of Monte Cairo and in other localities of the Central-Southern Apennines; these new forms can be added to the numerous typical species of benthic foraminifera and calcareous algae well-known in the cenomanian and turonian carbonate sediments of the Tethys (tab. 2).

The above-mentioned new forms show also an important paleoenvironment meaning: in the Monte Cairo area *Sigmomassilina ottadunensis* n. gen., n. sp. and *Spirosigmoilina rajkae* n. sp. are in fact typical of the plate-form back reef environment, characterized by a prevalence of fossiliferous grainstones and rudstones with frequent remains of acteonids, nerineids, rudists and rare corals (CHIOCCHINI *et alii*, 2005). *Spiroloculina cenomana* n. sp., *Palaeosigmoilopsis apenninica* n. gen., n. sp. and *Peneroplis cairensis* n. sp. occur also in the fossiliferous wackestones and floatstones of the Lepini, Ausoni and Aurunci Mountains, Southern Latium, referred to an inner shelf environment (CHIOCCHINI *et alii*, 1974).

### Acknowledgments

The author would like to thank Eng. Franco Chiocchini for drawing of "plate I" and Mrs. Gabriella Pesci of ISPRA - Servizio Geologico d'Italia for the review of the English manuscript.

A especially thank to Professor Johannes Pignatti of Earth Sciences-University "La Sapienza" of Rome, for constructive and careful review of the manuscript.

Tab. 1 - Comparison between the biometrical parameters of *Peneroplis cairensis* n. sp. and other cretaceous species referred to genus *Peneroplis* by some authors.

- Confronto tra i parametri biometrici di *Peneroplis cairensis* n. sp. e quelli relativi ad alcune specie affini del Cretacico, riferite allo stesso genere da vari autori.

Biometrical parameters (mm)	<i>Peneroplis turonicus</i> from SAID & KENAWY, 1957 Egypt lowermost Turonian	<i>Peneroplis planatus parvus</i> from DE CASTRO, 1965 Campania - Italy Middle Cenomanian	<i>Peneroplis</i> cf. <i>tunicus</i> from SAINT-MARC, 1974 Libano Middle Cenomanian - - Upper Turonian	<i>Peneroplis parvus</i> from DE CASTRO, 1985 Campania - Italy Middle Cenomanian	<i>Peneroplis cairensis</i> n. sp. M. Cairo - Latium, Italy Upper Cenomanian
outer diameter of the proloculus (dp)		0.042 - 0.052	0.085	0.040 - 0.065	0.045 - 0.060
diameter of the coiled early stage (d)					0.35 - 0.38
number of rows of the coiled stage		1.5 - 2		max 2	1.5 - 2
number of the coiled chambers	7 - 8	8 - 14	6 - 10	8 - 10	9 - 10
largest height of the test (H)	0.4		0.3 - 0.8	max 0.820	1.20 - 1.26
largest breadth of the test (L)	0.4	max 0.433	0.35 - 0.65	0.42 - 0.75	1.10 - 1.12
number of the chambers in the uncoiled stage		11.5 - 17.5 x mm	0 - 7	13 - 15 x mm	6 - 9
height of uncoiled chambers (h)		0.053- 0.087			0.10 - 0.12 initial chambers 0.07 - 0.08 last chambers
ornamentation on the surface of the test	no present	fine radial striae	no present	fine radial striae	fine radial striae

Tab. 2 - Range-chart of the most significant benthic foraminifers and calcareous algae in the cenomanian and turonian limestones of Southern Latium. The new taxa are in bold.

- Carta di distribuzione delle specie più significative di foraminiferi bentonici ed alghe calcaree presenti nei calcari cenomaniani e turoniani del Lazio meridionale. In grassetto i nuovi taxa descritti nel presente lavoro.

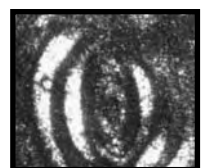
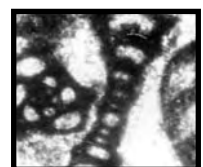
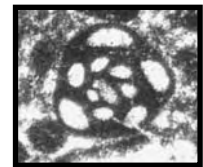
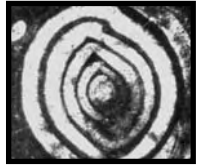
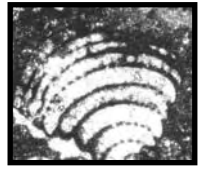
AGE	CENOMANIAN		TURONIAN	
	Early	Late	Early	Late
BIOZONES (from CHIOCCHINI <i>et alii</i> , 2004)	Ostracoda and Miliolidae	<i>P. dubia</i> and <i>P. laurinensis</i>	<i>C. gradata</i> and <i>P. reicheli</i>	<i>N. cf. aegyptiaca</i> and <i>N. cf. irregularis</i>
? <i>Fischerina carinata</i>	▲			
<i>Vandanchella decourti</i>	▲			
<i>Ovalveolina crassa</i>	▲			
<i>Neoragia insolita</i>	▲			
<i>Peneroplis parvus</i>	▲	—		
<b><i>Sigmomassilina ottadumensis</i></b>	—	—		
<i>Nezzazata simplex</i>	—	—		
<i>Sellialveolina viallii</i>	—			
<b><i>Palaeosigmoilopsis apenninica</i></b>	—	—		
<b><i>Spiroloculina cenomana</i></b>	—	—		
<i>Vidalina radoicicae</i>	—	—		
<i>Biconcava bentori</i>	—	—		
<i>O. (Conicorbitolina) conica</i>		—		
<i>Trochospira avnimelechi</i>		—		
<i>Broeckina alaouitensis</i>		—		
<i>Merlingina cretatica</i>		—		
<i>Praealveolina aff. tennis</i>		—		
<i>Cisalveolina lehneri</i>		—		
<i>Trocholina cf. arabica</i>		—		
<i>Marssonella turris</i>		—		
<i>Murgeina apula</i>		—		
<i>Nezzazata gyra</i>		—		
<i>Heteroporella lepina</i>		—		
<i>Nezzazata conica</i>		—		
<i>Rotalia mesogeensis</i>		—		
<i>Pyrgo globulosa</i>		—		
<i>Pseudorbapydionina laurinensis</i>		—		
<i>Pseudorbapydionina dubia</i>		—		
<b><i>Peneroplis cairensis</i></b>		—		
? <i>Pseudorbapydionina anglonensis</i>		—		
<i>Peneroplis cf. turonicus</i>		—		
<i>Discorbis cf. minutus</i>		—		
<i>Pseudolituonella reicheli</i>		—		
<i>Chrysalidina gradata</i>		—		
<i>Nezzazatinella cf. aegyptiaca</i>		—	—	→
<i>Cisalveolina fraasi</i>		—	—	→
<i>Discorbis cf. turonicus</i>		—	—	→
<i>Pseudorbipydionina murgiana</i>		—	—	→
<i>Coxites zubairensis</i>		—	—	→
<i>Permocalculus irenae</i>		—	—	→
<i>Nummoloculina cf. irregularis</i>		—	—	→
Lituolidae sp.2		—	—	→
<i>Aeolisaccus barattoloi</i>		—	—	→
<i>Spiroplectammia multicamerata</i>		—	—	→
<b><i>Spirosigmoilina rajkae</i></b>		—	—	→
<i>Monchamontia apenninica</i>		—	—	→
<i>Pseudocyclammia sphaeroidea</i>		—	—	→

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**PLATE I** - Hypothetical reconstruction of the tests and oriented sections of the new taxa of Miliolacea.**Figs. 1-5** - *Spiroloculina cenomana* n. sp. x 85

- fig. 1 - side view;  
 fig. 2 - edge view;  
 fig. 3 - apertural view;  
 fig. 4 - transverse section;  
 fig. 5 - axial section.

**Figs. 6-9** - *Palaeosigmoilopsis apenninica* n. gen., n. sp. x 70

- fig. 6 - side view;  
 fig. 7 - edge view;  
 fig. 8 - apertural view;  
 fig. 9 - transverse section showing the arrangement of the chambers.

**Figs. 10-13** - *Sigmomassilina ottadunensis* n. gen., n. sp. x 90

- fig. 10 - side view;  
 fig. 11 - edge view;  
 fig. 12 - apertural view;  
 fig. 13 - transversal section showing the arrangement of the chambers.

**Figs. 14-17** - *Spirosigmoilina rajkae* n. sp. x 135

- fig. 14 - side view;  
 fig. 15 - edge view;  
 fig. 16 - apertural view;  
 fig. 17 - transversal section showing the arrangement of the chambers.

**TAVOLA I** - Ricostruzione ipotetica dei gusci e sezioni relative ai nuovi taxa di Miliolacea.**Figg. 1-5** - *Spiroloculina cenomana* n. sp. x 85

- fig. 1 - norma laterale;  
 fig. 2 - norma di profilo;  
 fig. 3 - norma aperturale;  
 fig. 4 - sezione trasversale;  
 fig. 5 - sezione assiale.

**Figg. 6-9** - *Palaeosigmoilopsis apenninica* n. gen., n. sp. x 70

- fig. 6 - norma laterale;  
 fig. 7 - norma di profilo;  
 fig. 8 - norma aperturale;  
 fig. 9 - sezione trasversale mostrante la disposizione delle camere.

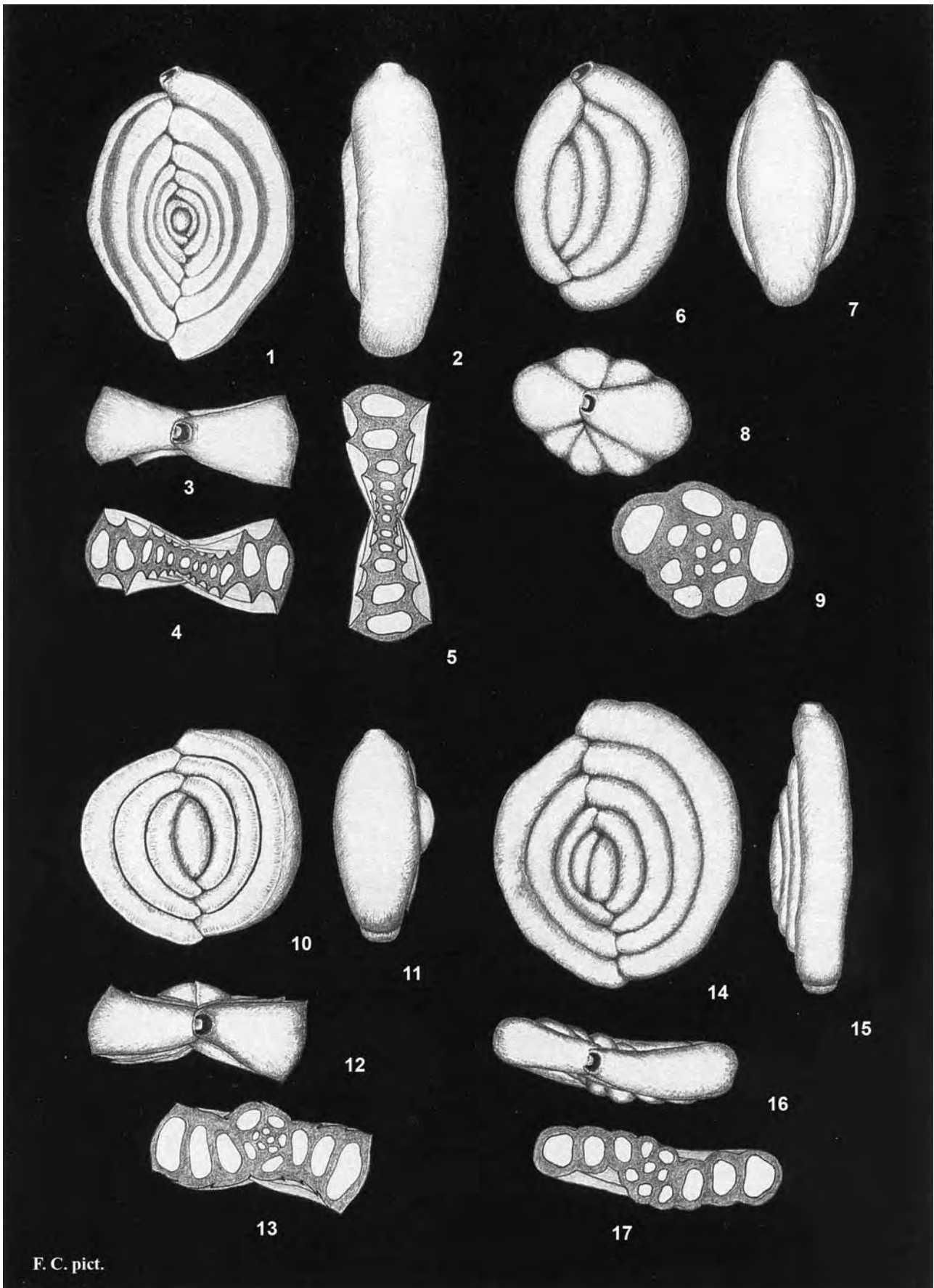
**Figg. 10-13** - *Sigmomassilina ottadunensis* n. gen., n. sp. x 90

- fig. 10 - norma laterale;  
 fig. 11 - norma di profilo;  
 fig. 12 - norma aperturale;  
 fig. 13 - sezione trasversale mostrante la disposizione delle camere.

**Figg. 14-17** - *Spirosigmoilina rajkae* n. sp. x 135

- fig. 14 - norma laterale;  
 fig. 15 - norma di profilo;  
 fig. 16 - norma aperturale;  
 fig. 17 - sezione trasversale mostrante la disposizione delle camere.

Plate I



F. C. pict.



**PLATE II** - *Spiroloculina cenomana* n. sp. x 100

- Fig. 1 - equatorial section, holotype;  
 figs. 2, 4, 10 - subaxial oblique sections, paratypes;  
 fig. 3 - transverse section;  
 fig. 5 - incomplete equatorial section;  
 fig. 6 - transverse oblique section;  
 fig. 7 - oblique section;  
 fig. 8 - axial section, paratype;  
 fig. 9 - transverse section of probably megalospheric form, paratype;  
 fig. 11 - transverse oblique sections;  
 fig. 12 - transverse section, paratype;  
 fig. 13 - equatorial oblique section, paratype.

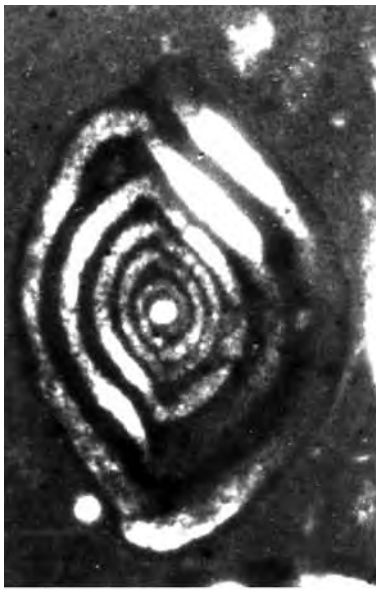
All the figures from type-locality, Colle Santa Lucia stratigraphic section (Monte Cairo, Southern Latium), Upper Cenomanian.

**TAVOLA II** - *Spiroloculina cenomana* n. sp. x 100

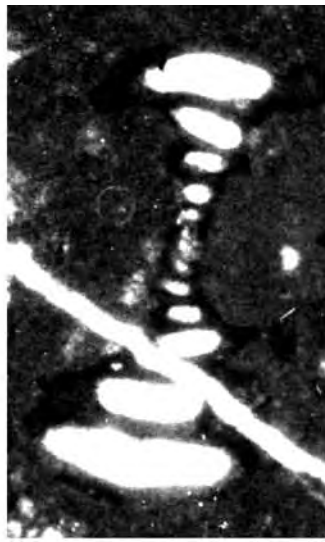
- Fig. 1 - sezione equatoriale, olotipo;  
 figs. 2, 4, 10 - sezioni subassiali oblique, paratipi;  
 fig. 3 - sezione trasversale;  
 fig. 5 - sezione equatoriale incompleta;  
 fig. 6 - sezione trasversale obliqua;  
 fig. 7 - sezione obliqua;  
 fig. 8 - sezione assiale, paratipo;  
 fig. 9 - sezione trasversale di un probabile individuo megalosferico, paratipo;  
 fig. 11 - sezione trasversale obliqua;  
 fig. 12 - sezione trasversale, paratipo;  
 fig. 13 - sezione equatoriale obliqua, paratipo.

Tutti gli esemplari dalla località-tipo, sezione stratigrafica Colle Santa Lucia (Monte Cairo, Lazio meridionale), Cenomaniano superiore.

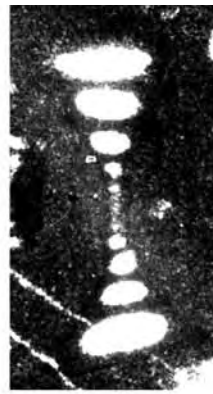
Plate II



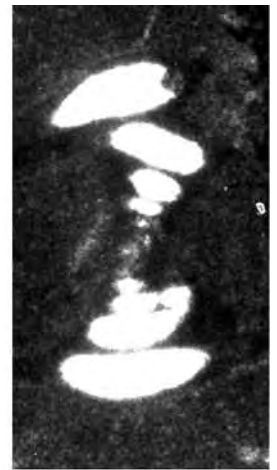
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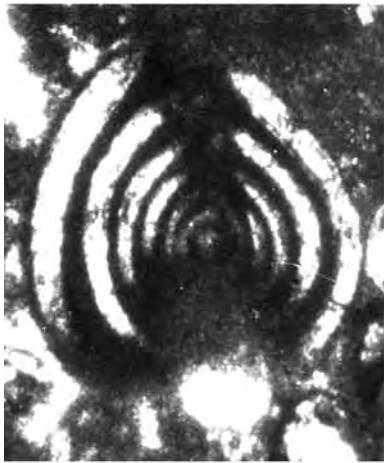
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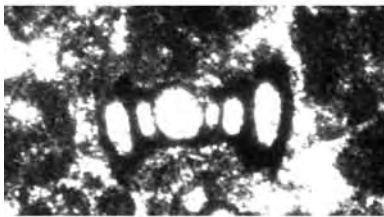
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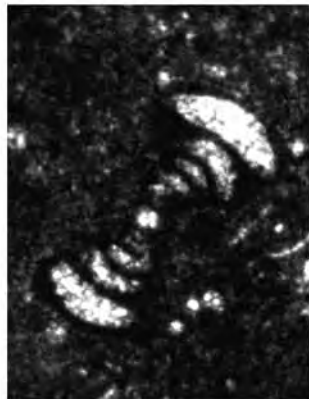
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**PLATE III** - *Spiroloculina cenomana* n. sp. x 100

**Fig. 1** - incomplete equatorial section;  
**fig. 2** - equatorial section, paratype;  
**figg. 3, 13** - axial sections, paratypes;  
**fig. 4** - subaxial oblique section;  
**figg. 5, 7, 8, 9, 11** - subaxial sections;  
**fig. 6** - transverse section, paratype;  
**fig. 10** - transverse oblique section;  
**figg. 12, 14** - subaxial sections, paratypes.

All specimens from type-locality, Colle Santa Lucia stratigraphic section (Monte Cairo, Southern Latium), Upper Cenomanian; except figures 1, 7, 11 from la Cicogna stratigraphic sections (Monte Cairo, Southern Latium), Lower Cenomanian.

**TAVOLA III** - *Spiroloculina cenomana* n. sp. x 100

**Fig. 1** - sezione equatoriale incompleta;  
**fig. 2** - sezione equatoriale, paratipo;  
**figs. 3, 13** - sezioni assiali, paratipi;  
**fig. 4** - sezione assiale obliqua;  
**figs. 5, 7, 8, 9, 11** - sezioni subassiali;  
**fig. 6** - sezione trasversale, paratipo;  
**fig. 10** - sezione trasversale obliqua;  
**figs. 12, 14** - sezioni subassiali, paratipi.

Tutti gli esemplari dalla località-tipo, sezione stratigrafica di Colle Santa Lucia (Monte Cairo, Lazio meridionale), Cenomaniano superiore; ad eccezione degli esemplari illustrati nelle figure 1, 7, 11 provenienti dalla sezione stratigrafica la Cicogna (Monte Cairo Lazio meridionale), Cenomaniano inferiore.



Plate III



1



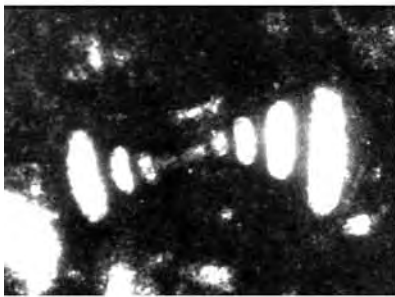
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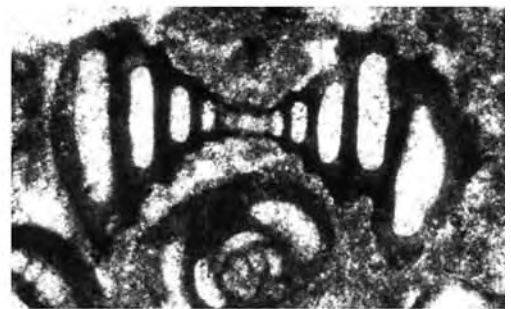
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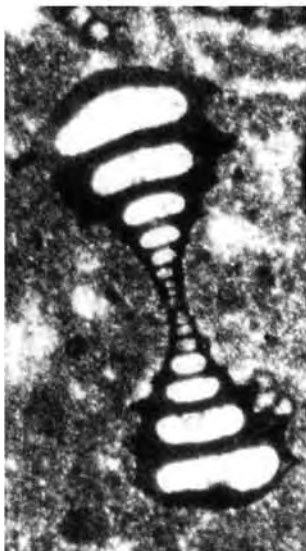
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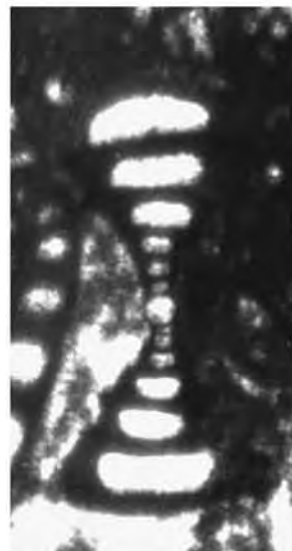
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**PLATE IV** - *Sigmomassilina ottadunensis* n. gen., n. sp. x 100

- Fig. 1** - transverse section, holotype;  
**figs. 2, 3, 4, 17** - transverse sections, paratypes;  
**figs. 5, 8, 11, 12, 15** - oblique sections;  
**fig. 6** - tangential section showing the large simple tooth;  
**fig. 7** - transverse section;  
**figs. 9, 10** - equatorial oblique sections, paratypes;  
**figs. 13, 14** - transverse sections;  
**fig. 16** - transverse oblique section;  
**fig. 18** - transverse oblique section showing the large simple tooth, paratype.

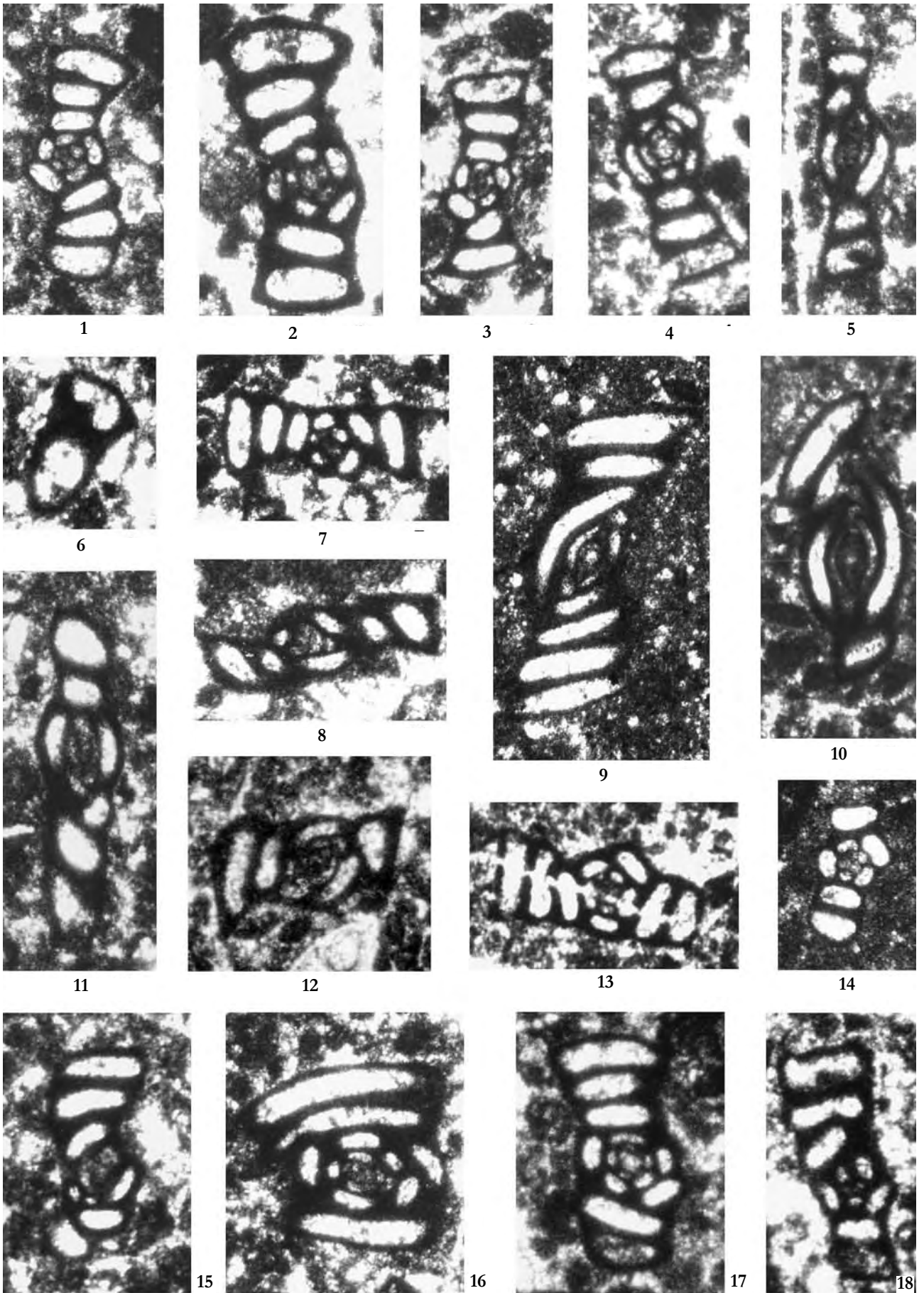
All specimens from type-locality, l'Ottaduna stratigraphic section (Monte Cairo, Southern Latium), Lower-Upper Cenomanian boundary; except the specimen of figure 8 from Val d'Agri (Lucania), lowermost Cenomanian.

**TAVOLA IV** - *Sigmomassilina ottadunensis* n. gen., n. sp. x 100

- Fig. 1** - sezione trasversale, olotipo;  
**figg. 2, 3, 4, 17** - sezioni trasversali, paratipi;  
**figg. 5, 8, 19, 12, 15** - sezioni oblique;  
**fig. 6** - sezione tangenziale che mostra il largo dente semplice;  
**fig. 7** - sezione trasversale;  
**figg. 9, 10** - sezioni equatoriali oblique, paratipi;  
**figg. 13, 14** - sezioni trasversali;  
**fig. 16** - sezione trasversale obliqua;  
**fig. 18** - sezione obliqua che mostra il largo dente semplice paratipo.

Tutti gli esemplari dalla località-tipo, sezione stratigrafica de l'Ottaduna (Monte Cairo, Lazio meridionale), limite Cenomaniano inferiore- superiore; fa eccezione l'esemplare di figura 8 proveniente da Val d'Agri (Lucania), Cenomaniano basale.

Plate IV



**PLATE V** - *Sigmomassilina ottadunensis* n. gen., n. sp. x 100

**Figs. 1, 4** - subequatorial oblique sections, paratypes;  
**figs. 2, 6, 11** - transverse oblique sections;  
**figs. 3, 5, 10, 12, 13, 14, 15** - transverse sections;  
**figs. 6, 7, 8, 9** - oblique sections.

All specimens from type-locality, l'Ottaduna stratigraphic section (Monte Cairo, Southern Latium), Lower-Upper Cenomanian boundary; except specimens figures 7, 8, 10 from Val d'Agri (Lucania), lowermost Cenomanian.

**TAVOLA V** - *Sigmomassilina ottadunensis* n. gen., n. sp. x 100

**Figg. 1, 4** - sezioni subequatoriali oblique, paratipi;  
**figg. 2, 6, 11** - sezioni trasversali oblique;  
**figg. 3, 5, 10, 12, 13, 14, 15** - sezioni trasversali;  
**figg. 6, 7, 8, 9** - sezioni oblique.

Tutti gli esemplari dalla località-tipo, sezione stratigrafica de l'Ottaduna (Monte Cairo, Lazio meridionale, limite Cenomaniano inferiore – superiore; fanno eccezione le figure 7, 8, 10 provenienti da Val d'Agri (Lucania), Cenomaniano basale.

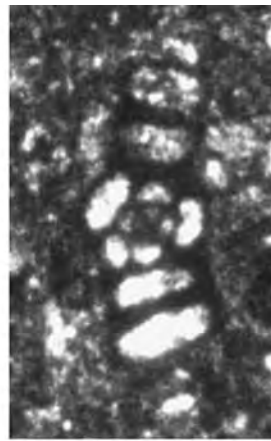
Plate V



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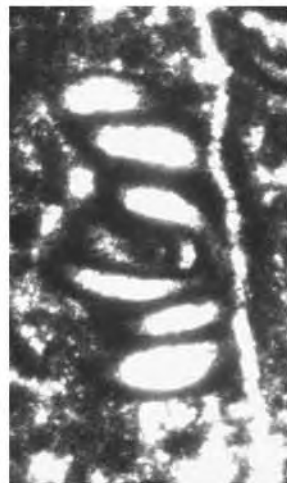
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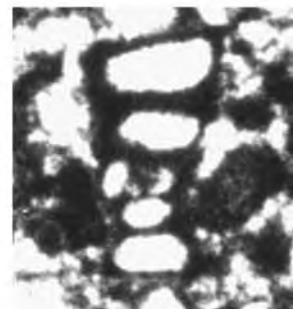
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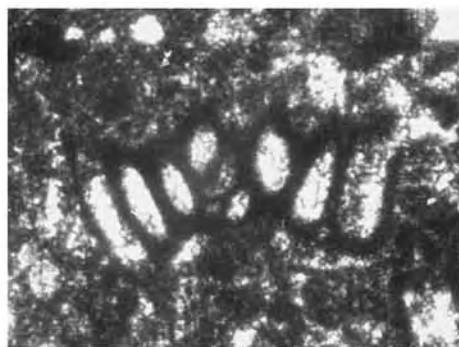
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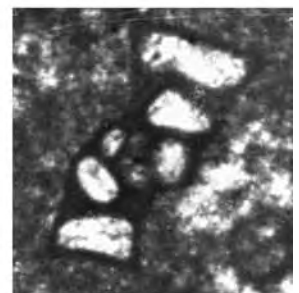
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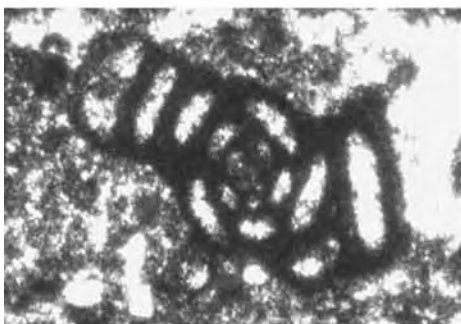
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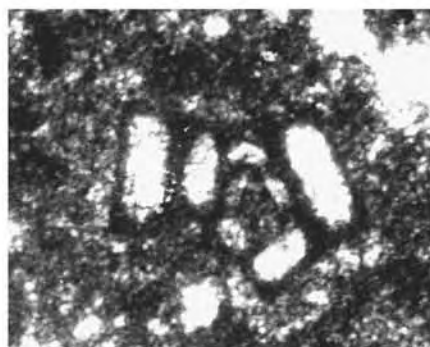
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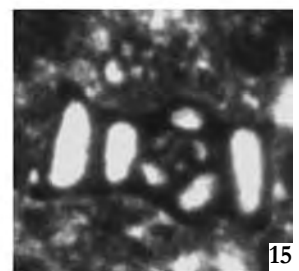
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**PLATE VI** - *Spirosigmoilina rajkae* n. sp. x 100

- Fig. 1** - subequatorial section, paratype;  
**fig. 2** - incomplete equatorial section;  
**fig. 3** - subequatorial section;  
**figs. 4, 10, 22** - oblique sections;  
**fig. 5** - equatorial section, holotype;  
**figs. 6, 14, 15** - transverse oblique sections, paratypes;  
**figs. 7, 8, 9, 16, 17, 18, 19** - transverse sections;  
**figs. 12, 13, 20, 21** - transverse sections, paratypes.

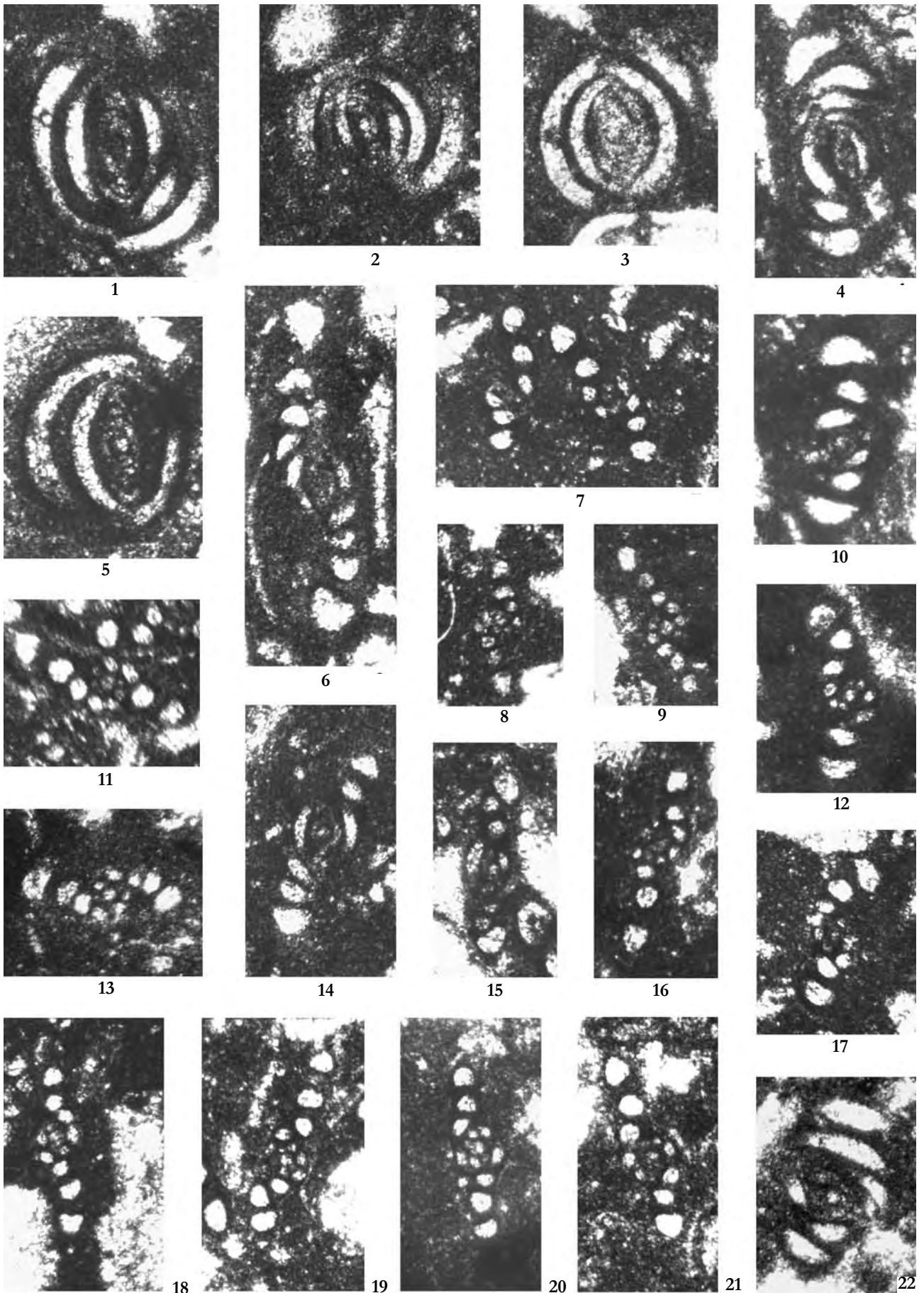
All the figures from type-locality, l'Ottaduna stratigraphic section (Monte Cairo, Southern Latium), Upper Turonian.

**TAVOLA VI** - *Spirosigmoilina rajkae* n. sp. x 100

- Fig. 1** - sezione subequatoriale, paratipo;  
**fig. 2** - sezione equatoriale incompleta;  
**fig. 3** - sezione subequatoriale;  
**figg. 4, 10, 22** - sezioni oblique;  
**fig. 5** - sezione equatoriale, olotipo;  
**figg. 6, 14, 15** - sezioni trasversali oblique, paratipi;  
**figg. 7, 8, 9, 16, 17, 18, 19** - sezioni trasversali;  
**figg. 12, 13, 20, 21** - sezioni trasversali, paratipi.

Tutte le figure dalla località-tipo, sezione stratigrafica de l'Ottaduna (Monte Cairo, Lazio meridionale), Turoniano superiore.

Plate VI



**PLATE VII** - *Palaeosigmoilopsis apenninica* n. gen., n. sp. x 100

**Figs. 1, 5, 12, 15** - variously oriented longitudinal sections, paratypes;  
**fig. 2** - longitudinal section, holotype;  
**fig. 3** - transverse oblique section;  
**figs. 4, 9, 10, 13** - variously oriented longitudinal sections;  
**figs. 6, 7, 14** - transverse sections, paratypes;  
**fig. 8** - longitudinal oblique section showing the large simple tooth;  
**fig. 11** - transverse section of the specimen showing the planispiral arrangement of the latest chamber.

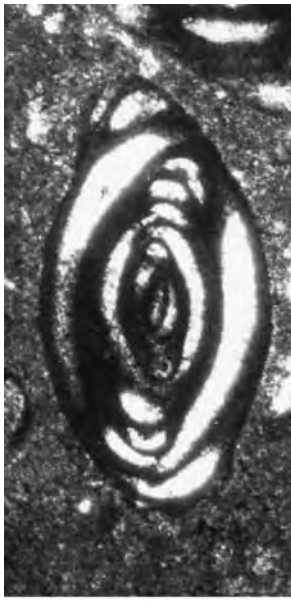
All the figures from type-locality, La Cicogna stratigraphic section (Monte Cairo, Southern Latium), Lower Cenomanian; except figures 8, 11 from Punta dei Briganti stratigraphic section (Lepini Mountains, Southern Latium), Upper Cenomanian.

**TAVOLA VII** - *Palaeosigmoilopsis apenninica* n. gen., n. sp. x 100

**Figg. 1, 5, 12, 15** - sezioni longitudinali variamente orientate, paratipi;  
**fig. 2** - sezione longitudinale, olotipo;  
**fig. 3** - sezione trasversale obliqua;  
**figg. 4, 9, 10, 13** - sezioni longitudinali variamente orientate;  
**figg. 6, 7, 14** - sezioni trasversali, paratipi;  
**fig. 8** - sezione longitudinale obliqua mostrante il largo dente semplice;  
**fig. 11** - sezione trasversale di un individuo con disposizione planispirale dell'ultima camera.

Tutte le figure dalla località-tipo, sezione stratigrafica de La Cicogna (Monte Cairo, Lazio meridionale), Cenomaniano inferiore; fanno eccezione le figure 8, 11 provenienti dalla sezione stratigrafica di Punta dei Briganti (Monti Lepini, Lazio meridionale), Cenomaniano superiore.

Plate VII



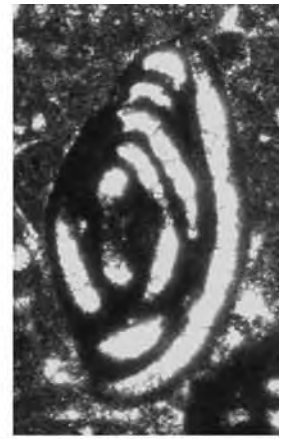
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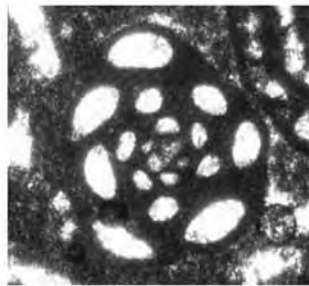
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**PLATE VIII** - *Palaeosigmoilopsis apenninica* n. gen., n. sp. x 100

**Figs. 1, 2, 8, 12, 13** - variously oriented longitudinal sections, paratypes;  
**figs. 3, 5, 9** - transverse sections, paratypes;  
**figs. 4, 14** - variously oriented longitudinal sections;  
**figs. 6, 10, 15, 16** - transverse oblique sections;  
**figs. 7, 11** - transverse sections.

All the figures from type-locality, la Cicogna stratigraphic section (Monte Cairo, Southern Latium), Lower Cenomanian; except figures 7, 11, 14 from Punta dei Briganti stratigraphic section (Lepini Mountains, Southern Latium), Upper Cenomanian.

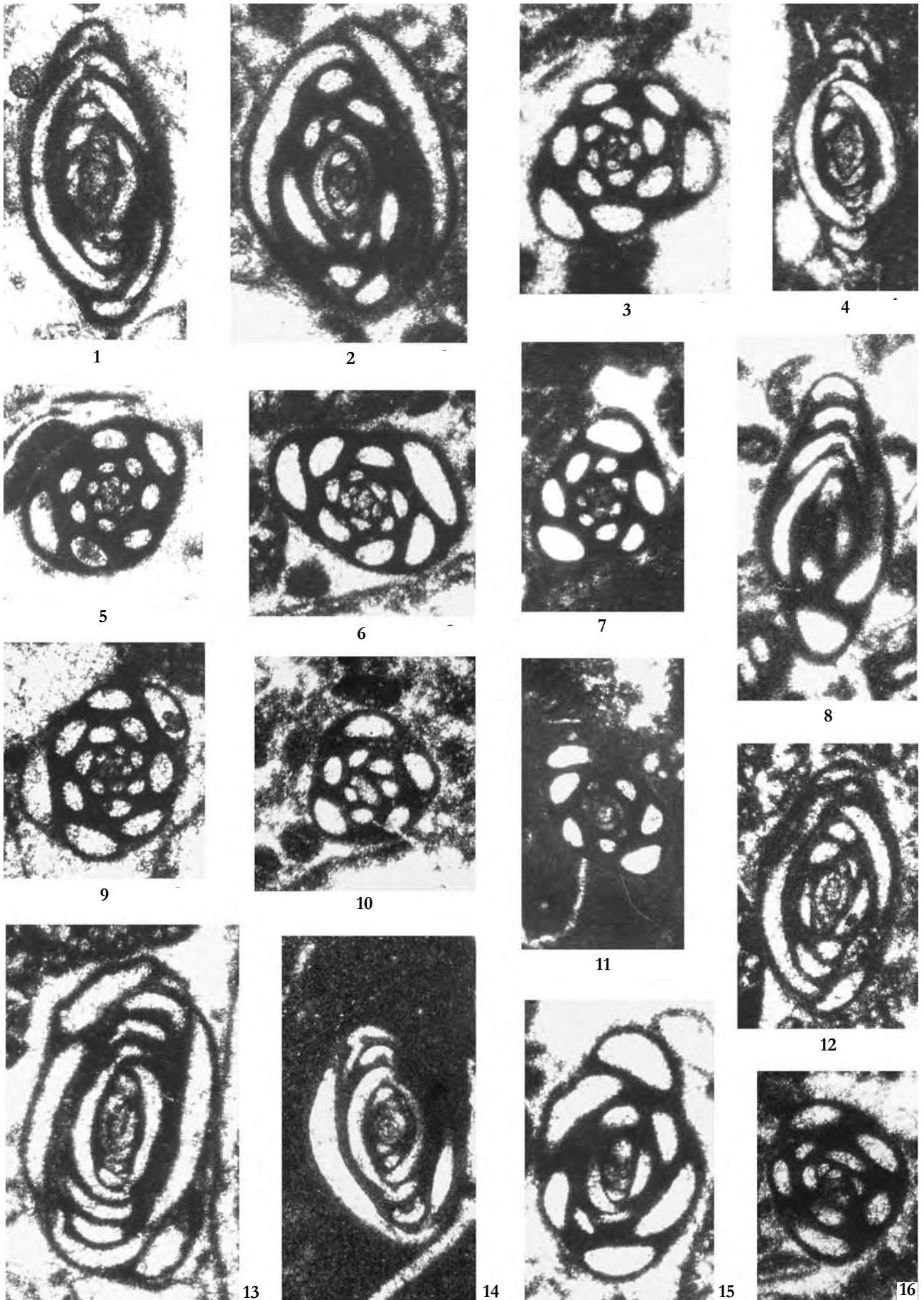
**TAVOLA VIII** - *Palaeosigmoilopsis apenninica* n. gen., n. sp. x 100

**Figg. 1, 2, 8, 12, 13** - sezioni longitudinali variamente orientate, paratipi;  
**figg. 3, 5, 9** - sezioni trasversali, paratipi;  
**figg. 4, 14** - sezioni longitudinali variamente orientate;  
**figg. 6, 10, 15, 16** - sezioni trasversali oblique;  
**figg. 7, 11** - sezioni trasversali.

Tutte le figure dalla località-tipo, sezione stratigrafica la Cicogna (Monte Cairo, Lazio meridionale), Cenomaniano inferiore; fanno eccezione le figure 7, 11, 14 provenienti dalla sezione stratigrafica Punta dei Briganti (Monti Lepini, Lazio meridionale), Cenomaniano superiore.



Plate VIII



**PLATE IX** - *Peneroplis cairensis* n. sp. x 50

- Fig. 1** - incomplete equatorial section, holotype;  
**figs. 2, 3** - longitudinal oblique sections, paratype;  
**figs. 4, 5** - longitudinal oblique sections;  
**fig. 6** - incomplete equatorial section;  
**fig. 7** - tangential section of the apertural face, paratype;  
**fig. 8** - longitudinal oblique section, paratype;  
**figs. 9, 12, 14** - longitudinal sections, paratype;  
**figs. 10, 13** - equatorial sections of the planispiral early stage, paratypes;  
**figs. 11, 15** - partial oblique sections;  
**fig. 16** - equatorial oblique section.

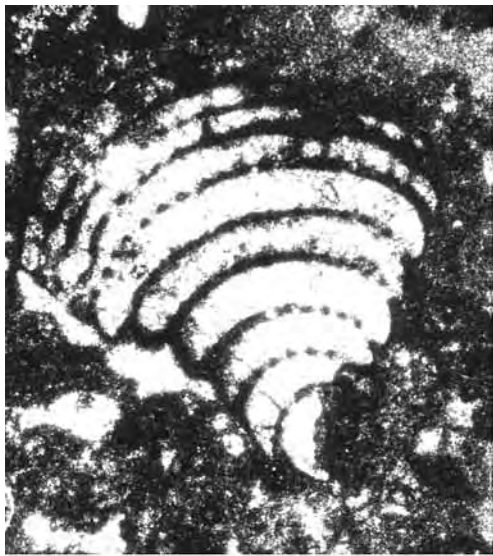
All the figures from type-locality, Colle Santa Lucia stratigraphic section (Monte Cairo, Southern Latium), Upper Cenomanian; except figures 5, 16 from Serra del Pruno stratigraphic section (Ausoni Mountains, Southern Latium), Upper Cenomanian.

**TAVOLA IX** - *Peneroplis cairensis* n. sp. x 50

- Fig. 1** - sezione equatoriale incompleta, olotipo;  
**figg. 2, 3** - sezioni longitudinali oblique, paratipi;  
**figg. 4, 5** - sezioni longitudinali oblique;  
**fig. 6** - sezione equatoriale incompleta;  
**fig. 7** - sezione tangenziale della faccia aperturale, paratipo;  
**fig. 8** - sezione longitudinale obliqua, paratipo;  
**figg. 9, 12, 14** - sezioni longitudinali, paratipi;  
**figg. 10, 13** - sezioni equatoriali dello stadio iniziale planispirale, paratipi;  
**figg. 11, 15** - sezioni parziali oblique;  
**fig. 16** - sezione equatoriale obliqua.

Tutte le figure dalla località-tipo, sezione stratigrafica Colle Santa Lucia (Monte Cairo, Lazio meridionale), Cenomaniano superiore; fanno eccezione le figure 5 e 16, provenienti dalla sezione stratigrafica Serra del Pruno (Monti Ausoni, Lazio meridionale), Cenomaniano superiore.

Plate IX



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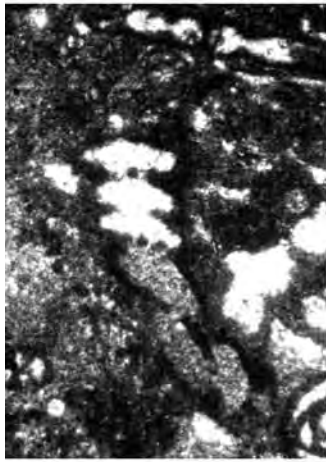
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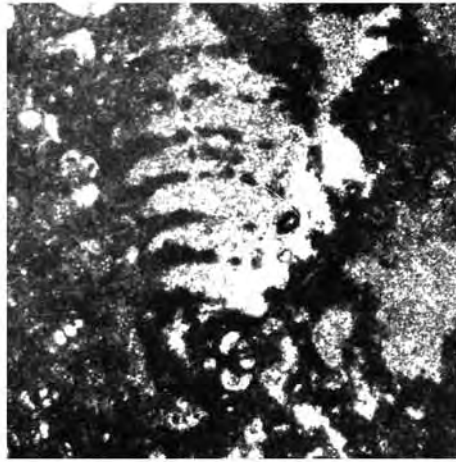
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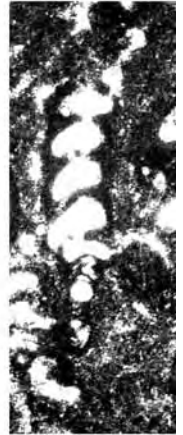
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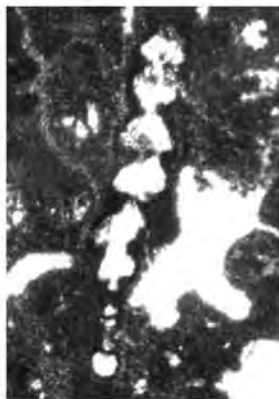
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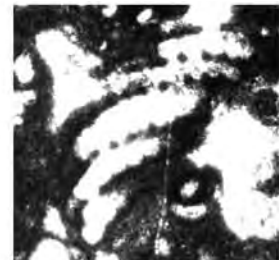
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16