

Riv. It. Paleont. Strat.	v. 98	n. 4	pp. 453-466	tav. 32-34	Marzo 1993
--------------------------	-------	------	-------------	------------	------------

**THREE NEW SPECIES OF CORALLINE ALGAE
(GENERA *LITHOTHAMNION* AND *LITHOPHYLLUM*)
FROM THE TERTIARY PIEDMONT BASIN^o**

PATRIZIA FRAVEGA^{oo}, MICHELE PIAZZA^{oo} & GRAZIA VANNUCCI^{oo}

Key-words: Systematic palaeobotany, Corallinaceae, *Lithothamnion*, *Lithophyllum*, Burdigalian.

Riassunto. Vengono descritte tre nuove specie di Rhodophyceae calcaree della Formazione di Visone del Bacino Terziario del Piemonte, di età burdigaliana. Si tratta di due specie di *Lithothamnion* (*Lt. gammari-noi* e *Lt. cardinellense*) e di una specie di *Lithophyllum* (*Lp. tedeschi*), che sono risultate presenti, oltre che nelle località di rinvenimento degli olotipi, anche in altri settori del Bacino.

Abstract. Two new species of the genus *Lithothamnion* and one of *Lithophyllum* were discovered in the burdigalian section of Bric Cardinelle (Visone Formation, Tertiary Piedmont Basin). The holotypes are present in rhodoliths coming from oncolitic rudstone or calciruditic bodies. The new species are characterised by morphological features and dimensions of cells that are clearly different from those of the other recorded species of *Lithothamnion* and *Lithophyllum*.

Introduction.

The Ph. D. Thesis research work developed by one of the authors in the Tertiary Piedmont Basin supplied some algal remains with peculiar morphological and structural features; new data achieved by focused studies allow to identify three new species. The formalization of these new species is corroborated by their finding in other stratigraphic sections of the Tertiary Piedmont Basin: Lower Miocene of SW areas and Pliocene of Northern sector. The studies on these sections will be published later.

The holotypes come from three different levels ("livelli g, r, z", see in Piazza, 1989) of Bric Cardinelle Section (Visone Formation, SE of Ponzzone, Alessandria, S Piedmont, NW Italy). This section, 80 m thick, is formed by sequences of sandstone, sand, siltstone with the occurrence of resedimented bodies formed by sandstone, grainstone, conglomerate, and oncolitic rudstone.

The presence of *Miogypsina globulina* (Michelotti) in several levels of the Bric Cardinelle Section indicates a Lower Burdigalian age (Piazza, 1989).

^oWork supported by research funds from MURST 60%.

^{oo} Dipartimento di Scienze della Terra dell'Università di Genova, Corso Europa 26, 16132 Genova, Italy.

Systematic descriptions

Genus *Lithothamnion* Heydrich, 1897 nom. cons.

Lithothamnion giammarinoi sp. n.

Pl. 32, fig. a-d

1989 *Lithothamnium* sp. 1 Piazza, pp. 159-160.

Holotype. Coll. Bric Cardinelle, slide P18c.

Isotypes. Coll. Bric Cardinelle, slides P18b(1), P18c(1), P29a.

Derivatio nominis. The species was dedicated to Prof. Stani Giammarino in acknowledgement of his studies on red algal facies of the Tertiary Piedmont Basin.

Description.

Thallus forms an irregular crust, 540-620 μ in thickness and 2.5 cm long; at times small mammelons develop close to conceptacles.

Hypothallus. Hypothallus is poorly developed (80-100 μ), with slightly curved layers of cells. Cell dimensions (12) 15-20 (24) μ in length x (5) 8-10 μ in width (mean value 17 μ x 8.5 μ , number of measures 30).

Perithallus. Perithallus is thin (450-500 μ), commonly with regular, parallel growth zones, and is formed by layers (strong vertical and weak cross partitions) of squarish cells measuring (5) 8-12 (15) μ x 5-8 μ (mean value 10 μ x 7 μ , n= 50). In some areas vertical and cross partitions are equally developed.

Reproductive organs. Elliptical, large, multipored conceptacles (450) 600-710 μ in diameter and 180-250 μ high (mean value 640 μ x 220 μ , n= 10). The slight, subtriangular shaped pores are from 40 to 50 μ in height and 20-25 μ in basal width.

Comparisons.

As the morphological and structural features of our specimens resemble *Lithothamnium undulatum* Capeder 1900 (p. 178, pl. 6, fig. 6), *Lt. tectifons* Mastrorilli 1968 (p. 278, pl. 10, fig. 3), *Lt. nodai* Ishijima 1956 (p. 3, pl. 1, fig. 2; pl. 2, fig 3) and *Lt. ishigakiensis* Johnson 1964 (p. 6, pl. 3, fig 1, 2), it was compared with these forms.

The new species differs from the above ones by different dimensions of cells and conceptacles, and distinctive characters of hypothallus and perithallus.

Lithothamnium undulatum is close to our species in cell dimensions, but the perithallus shows different growth zones, arrangement of cells, and range in size of cells; moreover it has smaller conceptacles (230-500 μ x 171 μ).

Lithothamnium tectifons differs by smaller conceptacles (280-450 μ x 130-150 μ) and hypothallial cells (8-15 μ x 8-10 μ), and by the lack of growth zones in perithallus.

(1) More than one specimens assigned to this species are present in this thin section.

Lithothamnium nodai differs by smaller conceptacles ($165\text{-}250\ \mu \times 75\text{-}80\ \mu$), and by less pronounced growth zones in perithallus.

Lithothamnium ishigakiensis differs by the laminar-crustose growth habit, by the wider perithallial cells ($6\text{-}12\ \mu$), and by smaller minimum height of conceptacles ($88\ \mu$).

Remarks. The level ("livello z"; Fig. 1) which supplied the new species, consists of 30 cm of oncolithic (only rhodoliths) rudstone, with reversed graded bedding and grainstone matrix; this shows sparry calcite cement (rarely lime mud matrix in smaller areas) and very low porosity. Fine and approximately rounded grains of serpentinites, calcschist, and quartz form the scanty silicoclastic skeletal fraction. Echinoid spines and plates, bivalve and serpulid shell fragments, bryozoans, miliolids, textularids, globigerinids, and fine fragments of coralline algae are present as bioclastic skeletal fraction.

The rhodoliths are elliptical, with major axis ranged from 1 to 6 cm, commonly with bioclastic nucleus, and laminar to globular growth. Laminar to globular growth form (at times passing to columnar) mainly occurs in the inner zone of the coating sequence; the laminar in the outer zone and in smaller rhodoliths.



Fig. 1 - Bric Cardinelle Section: z level, in which the holotype of *Lithothamnium giammarinoides* is found, is the lower oncolithic rudstone bed.

Besides the new species, the algal assemblage of the level includes: "*Archaeolithothamnium*" *pseudokeenani* Mastrorilli 1973(1), *Lithothamnium andrusovi* Lemoine 1934, *Lt. exuberans* Mastrorilli 1968, *Lt. peleense* Lemoine 1918, *Lt. ponzonense* Conti 1943, *Lt. cf. ponzonense* Conti 1943, *Lt. cf. wallisium* Johnson & Tafur 1952, *Mesophyllum roveretoi* Conti 1943, *Mp. cf. kutense* Maslov 1962, *Mp. cf. izuensis* Ishijima 1968, *Mp. cf. yuyashimaensis* Ishijima 1954, *Lithophyllum ligusticum* Airoldi 1932, *Lp. pactum* Ishijima 1954, *Lp. perrandoi* Airoldi 1932, *Lp. cf. minae* Ishijima 1968.

Type locality. The holotype is present in a rhodolith coming from "livello z" of the Bric Cardinelle Section (Visone Formation) (Fig. 1). This level outcrops near the hill-top, on the south-eastern slope of Bric Cardinelle: elevation 640 m a.s.l., longitude E 3°59'01" and latitude N 44°34'32".

The rhodolith has elliptical shape with major axis 6 cm long and minor 4 cm long, bioclastic nucleus, and globular to laminar growth. The first colonisation is made by *Mp. roveretoi*. The holotype occurs in the outer zone of the coating sequence and overgrows thalla of *Lithothamnium ponzonense* and *Mesophyllum roveretoi*. Besides the new species, "*Archaeolithothamnium*" *pseudokeenani*, *Lithothamnium ponzonense*, *Lt. cf. ponzonense*, *Lt. cf. wallisium*, *Mesophyllum roveretoi*, and *Lithophyllum pactum*, form the rhodolith.

Age. Burdigalian.

***Lithothamnium cardinellense* sp. n.**

Pl. 33, fig. a-d

1989 *Lithothamnium* sp. 2 Piazza, p. 160.

Holotype. Coll. Bric Cardinelle, slide P20I.

Isotypes. Coll. Bric Cardinelle, slides P20I(2), P20Ia, P20Ib.

Derivatio nominis. The specific name derives from the name of the locality in which it was found.

Description.

Thallus (3.5 cm long) is a crust (430 μ in thickness) with large protuberances (3080 μ thick), sometimes with superimposed growth.

Hypothallus. Hypothallus is thin (80-120 μ) with gently curved layers of cells, which in some areas are arranged as a plumose structure. Cells measure 22-35 μ in height and (6) 10-12 μ in width (mean value 25 μ x 11 μ , n = 30).

(1) The name *Archaeolithothamnium* is written with quotation marks because its taxonomic status is uncertain (see in Woelkerling, 1988).

(2) More than one specimens assigned to this species are present in this thin section.

Perithallus. The thick perithallus (crustose zones 360μ thick, and protuberances 3000μ thick) usually shows strong vertical partitions and weak cross partitions, but in some areas both are equally and strongly developed. Perithallus is not very homogeneous and shows irregular, lenticular, and well evident growth zones. Cells measure $12-15 \mu \times 6-10 (12) \mu$ (mean value $13 \mu \times 9 \mu$, $n = 50$).

Reproductive organs. Multipored conceptacles range from 260 to 462μ in diameter and $115-187 \mu$ in height (mean value $430 \mu \times 140 \mu$, $n = 20$). The chambers are scattered in the perithallus and show approximately convex base, and rough wavy top.

Comparisons.

As the morphological and structural features of our specimens resemble *Lithothamnium ponzonense* Conti 1943 (p. 41, pl. 5, fig. 1; pl. 8, fig. 1), *Lt. fluxum* Mastrorilli 1958 (p. 12, pl. 3, fig. 1; text. fig. 1) and *Lt. manni* Johnson & Stewart 1953 (p. 133, pl. 15, fig. 4), it was compared with these forms.

The new species differs from the above ones by different dimensions of cells and conceptacles, and distinctive characters of hypothallus and perithallus.

Lithothamnium ponzonense differs by smaller hypothallial cells ($15-17 \mu \times 11-12 \mu$), and mean value of conceptacles height ($110-130 \mu$).

Lithothamnium fluxum differs by smaller hypothallial cells ($10-12 \mu \times 8-10 \mu$), and by shorter perithallial cells ($10-12 \mu$) and conceptacles ($80-120 \mu$).

Lithothamnium manni differs by shorter hypothallial cells ($13-20 \mu$), and smaller maximum height of conceptacles (135μ).

Remarks. The level ("livello r" - Fig. 2) from which the new species comes, is an oncolithic (only rhodoliths) rudstone body that fills an erosional channel cutting a grainstone stratum. The rudstone shows a grainstone matrix with sparry calcite cement and very low porosity. Fine, rounded grains of serpentinites, calcschist, quartz, mica, and spheroidal aggregates of microcrystalline glauconite form the scanty silicoclastic skeletal fraction. Echinoid spines and plates, coral fragments, bivalve and serpulid shell fragments, bryozoans, foraminifers, and small fragments of coralline algae are present as bioclastic skeletal fraction. Among the foraminifers *Amphystegina* sp. and *Miogypsina* sp. are very common and globigerinids, textularids, buliminids, nonionids, rotalids are less abundant.

The rhodoliths are spheroidal, with diameters up to 4 cm, with globular growth and usually with bioclastic nucleus.

Besides the new species, the algal assemblage of the level includes: "*Archaeolithothamnium*" cf. *fijiensis* Johnson & Ferris 1950, *Lithothamnium exuberans* Mastrorilli 1968, *Lt. florea-brassica* (Millet) Lemoine 1924b, *Lt. moreti* Lemoine 1928, *Lt. operculatum* Conti 1950, *Lt. peleense* Lemoine 1918, *Lt. pianfolchi* Mastrorilli 1968, *Lt. ponzonense* Conti 1943, *Lt. roveretoi* Airoldi 1932, *Lt. cf. ponzonense* Conti 1943, *Lt.*

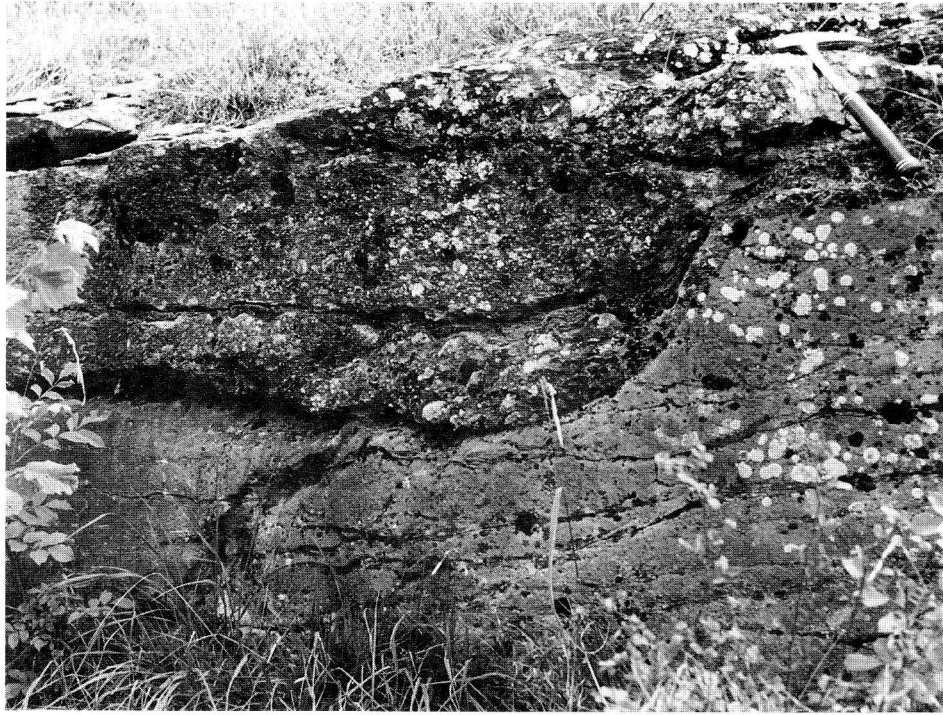


Fig. 2 - Bric Cardinelle Section: r level, in which the holotype of *Lithothamnium cardinellense* is found, is the upper bed.

cf. *saxorum* Capeder 1900, *Mesophyllum roveretoi* Conti 1943, *Mp.* cf. *yuyashimaensis* Ishijima 1954, *Lithophyllum albanense* Lemoine 1924a, *Lp. lemoinei* Krivanné-Hutter 1962, *Lp. ligusticum* Airoidi 1932, *Lp. pactum* Ishijima 1954, *Lp. platticarpum* Maslov 1962, *Lp.* cf. *aequinnixum* Conti 1946a.

Type locality. The holotype is present in a rhodolith coming from the top of the "livello r" of the Bric Cardinelle Section (Visone Formation) (Fig. 2). This level outcrops on the north-western slope of Bric Cardinelle: elevation 620 m a.s.l., longitude E 3°59'06" and latitude N 44°34'37".

The rhodolith has spheroidal shape with diameter 3 cm long, clastic nucleus, and globular growth. An isotype of *Lt. cardinellense* forms the first colonisation. The holotype occurs in the middle zone of the coating sequence and overgrows partly a thallus of *Lt.* cf. *ponzonense* and partly a silicoclastic and bioclastic grains. Besides the new species, *Lithothamnium exuberans*, *Lt. operculatum*, *Lt. peleense*, *Lt. ponzonense*, *Lt.* cf. *ponzonense*, *Lt.* cf. *saxorum*, *Mesophyllum roveretoi*, *Lithophyllum albanense*, *Lp. lemoinei*, and *Lp. ligusticum*, form the rhodolith.

Age. Burdigalian.

Genus *Lithophyllum* Philippi, 1837***Lithophyllum tedeschii* sp. n.**

Pl. 34, fig. a-d

1989 *Lithophyllum* sp. 1 Piazza, p. 171.**Holotype.** Coll. Bric Cardinelle, slide P29c.**Isotypes.** Coll. Bric Cardinelle, slides P29c(1), P29cI, P29cIII.**Derivatio nominis.** The species was dedicated to Prof. Dante Tedeschi in acknowledgement of his activity in the field of biostratigraphy of the Tertiary Piedmont Basin.**Description.**

Intumescens crustose thallus (1150-1750 μ thick and 3 cm long) sometimes with superimposed growth.

Hypothallus. Sturdy, coaxial hypothallus (140-180 μ in thickness) with cells measuring 15-24 μ x 10 μ (mean value 22 μ x 10 μ , n = 30).

Perithallus. The perithallus (100-1600 μ thick) is not very homogeneous and close-pocked and shows variable evidence and regularity of the growth zones. Rectangular and quite stocky cells are arranged in wavy rows, and measure 10-12 μ x 6-8 μ (mean value 11.5 μ x 7 μ , n = 50).

Reproductive organs. Roundish, single-pored conceptacles, 275-350 μ in diameter and 160 μ height (mean value 310 μ x 160 μ , n = 20). The chambers are usually scattered in the perithallus but sometimes they are grouped. The fairly regular single-pores are thick and very long, and range from 50-60 μ in width and may attain up to 230 μ in high.

Comparisons.

The new species shows hypothallial and perithallial cells arranged in well evident rows and single-pored conceptacles. As these characters closely resemble the features of a sexed specimen of the genus *Mesophyllum*, we have compared our specimen with the species of *Mesophyllum* found in the same level and stratigraphic section.

In particular *Mesophyllum koritzae* Lemoine 1924a (p. 279, fig. 4,5), *Mp. marosticae* Mastrorilli 1973 (p. 265, pl. 5, fig. 3-5), *Mp. roveretoi* Conti 1943 (p. 55, pl. 7, fig. 1; pl. 8, fig. 6) were compared and they differ by dimension of cells and conceptacles, and also by the structure of thallus.

Mesophyllum marosticae, found in the same rhodolith, has a very different growth zones and arrangement of cells, and the sexed chambers of *Mesophyllum roveretoi* (chamber: 520-600 μ x 180 μ , and single-pore: 130 μ x 80 μ ; see in Conti, 1946b, and in Mastrorilli, 1968) are very different from reproductive organs of our species.

(1) More than one specimens assigned to this species are present in this thin section.

As the morphological and structural features of our specimens resemble *Lithophyllum inamurai* Ishijima 1954 (p. 40, pl. 19, fig. 3a-b), *Lp. aequinnixum* Conti 1946a (p. 59, pl. 5, fig. 2a-b), and *Lp. lateporatum* Mastrorilli 1973 (p. 270, pl. 6, fig. 2), it was compared with these forms.

The new species differs from the above ones by different dimensions of cells and conceptacles, and distinctive characters of hypothallus and perithallus.

Lithophyllum inamurai differs by the squarish and larger perithallial cells (12-15 μ), and by shorter conceptacles (100-120 μ).

Lithophyllum aequinnixum differs by the morphology of the conceptacles, as in this species the chamber has very concave top, oval shape, and shorter single-pore.

Lithophyllum lateporatum differs in hypothallus by shorter cells (10-15 μ) arranged in layers turning to grating.

Remarks. The level ("livello g"; Fig. 3) which supplied the new species, is formed by 1.5 m of biocalcarenes grading to biocalcirudites with rhodoliths. Biocalcirudites shows reversed graded bedding, sparry calcite cement (rarely lime mud matrix in smaller areas) and very low porosity. Fine and approximately rounded grains of serpentinites, calcschist, quartzite, quartz, mica, and spheroidal aggregates of



Fig. 3 - Bric Cardinelle Section: biocalcirudites with rhodoliths of g level, in which the holotype of *Lithophyllum tedeschi* is found.

microcrystalline glauconite form the scanty silicoclastic skeletal fraction. Echinoids spines and plates, bivalves shell fragments, bryozoans, and foraminifers are present as bioclastic skeletal fraction. Among foraminifers miliolids, textularids, rotalids, epiphitic form, globigerinids are the most abundant forms.

The rhodoliths are spheroidal, with diameter in the range 3-6 cm, and have sandy or bioclastic nucleus. Laminar to globular growth form mainly occurs in the inner zone of the coating sequence of the large rhodoliths and in smaller rhodoliths, the laminar type is more common in outer zone of the larger rhodoliths.

Besides the new species, the algal assemblage of the level, includes: "*Archaeolithothamnium*" *cyrenaicum* Raineri 1924, *Lithothamnion giammarinoi* sp. n., *Lithothamnium moreti* Lemoine 1928, *Lt. operculatum* Conti 1950, *Lt. peleenese* Lemoine 1918, *Lt. pianfolchi* Mastroianni 1968, *Lt. ponzonense* Conti 1943, *Lt. cf. saxorum* Capeder 1900, *Mesophyllum koritzae* Lemoine 1924a, *Mp. marosticae* Mastroianni 1973, *Mp. roveretoi* Conti 1943, *Lithophyllum albanense* Lemoine 1924a, *Lp. pactum* Ishijima 1954, *Lp. perrandoi* Airoldi 1932, *Lp. platticarpum* Maslov 1962, and *Lp. cf. minae* Ishijima 1968.

Type locality. The holotype is present in a rhodolith coming from the top of the "livello g" of the Bric Cardinelle Section (Visone Formation) (Fig. 3). This level outcrops on the eastern slope of Bric Cardinelle: elevation 560 m a.s.l., longitude E 3°58'48" and latitude N 44°34'35".

The rhodolith has spheroidal shape with diameter 3 cm long, clastic nucleus, and globular growth. The first colonisation is made by *Mp. roveretoi* and *Lp. pactum*. The holotype occurs in the outer zone of the coating sequence and overgrows partly a thallus of *Mesophyllum roveretoi*, and partly serpulid shells. Besides the new species, "*Archaeolithothamnium*" *cyrenaicum*, *Lithothamnium moreti*, *Lt. operculatum*, *Lt. cf. saxorum*, *Mesophyllum marosticae*, *Mp. roveretoi*, *Lithophyllum pactum*, *Lp. platticarpum* form the rhodolith.

Age. Burdigalian.

Palaeoecological remarks

Lithothamnion giammarinoi, *Lithothamnion cardinellense*, and *Lithophyllum tedeschi*, are members of a unique algal assemblage (see "Cenosi algale CA2", in Piazza, 1989), which forms all the rhodoliths of the resedimentated bodies in the Bric Cardinelle Section.

The characters of algal assemblage and rhodoliths allow to recognize the life environment as an open platform with low terrigenous deposition, in tropical or subtropical warm waters with high hydrodynamic energy. The depth ranged between the upper part of circalitoral zone and the lower of infralitoral zone (we can hypothesize about - 50 m).

BIBLIOGRAPHY

- Airoldi M. (1932) - Contributo allo studio delle Corallinacee del terziario italiano. 1°. Le Corallinacee dell'Oligocene ligure-piemontese. *Palaeont. Ital., Mem. Paleont.*, v. 33, pp. 55-83, Siena.
- Capeder G. (1900) - Contribuzione allo studio dei Lithothamnion Terziari. *Malpighia*, v. 14, pp. 172-182, Genova.
- Conti S. (1943) - Contributo allo studio delle Corallinacee del terziario italiano. 2°. Corallinacee del Miocene ligure-piemontese. *Palaeont. Ital., Mem. Paleont.*, v. 41, pp. 37-61, Siena.
- Conti S. (1946 a) - Le Corallinacee del calcare miocenico (Leithakalk) del bacino di Vienna. *Pubbl. Ist. Geol. Univ. Genova*, quad. 1-2, sez. A, Paleontologia, pp. 31-68, Genova.
- Conti S. (1946 b) - Su alcune specie di Melobesie (Corallinacee) del Miocene di Ponzzone (Acqui). *Rend. Acc. Naz. Lincei, Cl. Sc. Fis., Mat. Nat.*, s. 8, v. 1, n. 10, pp. 1088-1093, Roma.
- Conti S. (1950) - Alghe Corallinacee Fossili. *Pubbl. Ist. Geol. Univ. Genova*, n. 4, s. A, Paleontologia, pp. 6-156, Genova.
- Heydrich F. (1897) - *Corallinaceae*, insbesondere *Melobesiae*. *Ber. Deut. Bot. Ges.*, v. 15, pp. 34-70, Berlin.
- Ishijima W. (1954) - Cenozoic Coralline Algae from the Western Pacific. Privately Published, pp. 1-87, Yuhodo.
- Ishijima W. (1956) - On some fossil Coralline Algae from the Tertiary of Japan. *St. Paul's Rev. Arts Sc.*, n. 1, pp. 1-9, Tokyo.
- Ishijima W. (1968) - Calcareous Algae from Makinogo near Shuzenji Izu Peninsula. *St. Paul's Rev. Arts Sc.*, v. 2, n. 7, pp. 245-254, Tokyo.
- Johnson J. H. (1957) - Geology of Saipan, Mariana Islands. Calcareous Algae. *Geol. Surv. Prof. Paper*, n. 280-E, pp. 245-254, Washington.
- Johnson J. H. (1964) - Eocene Algae from Ishigaki-Shima, Ryukyu-Retto. *Geol. Surv. Prof. Paper*, n. 399 C, pp. 1-13, Washington.
- Johnson J. H. & Ferris B. H. (1950) - Tertiary and Pleistocene Coralline Algae from Lau, Fiji. *Bernice P. Bishop Mus. Bull.*, n. 201, pp. 1-27, Honolulu.
- Johnson J. H. & Stewart W. A. (1953) - Eocene Coralline Algae from the Meganos Formations, California. *Journ. Paleont.*, v. 27, n. 1, pp. 130-136, Tulsa.
- Johnson J. H. & Tafur I. A. (1952) - Coralline Algae from the Eocene Atascadero Limestone. *Journ. Paleont.*, v. 26, n. 4, pp. 537-543, Tulsa.
- Krivanné-Hutter E. (1962) - Reef building red algae (Corallinaceae) from the Oligocene of the region of Eger. *Foldt. Kozl.*, v. 91, pp. 432-441, Budapest.
- Lemoine M. (Mme P.) (1918) - Contribution à l'étude de Corallinacées fossiles. III - Corallinacées fossiles de la Martinique. *Bull. Soc. Géol. France*, s. 4, v. 17, pp. 256-279, Paris.
- Lemoine M. (Mme P.) (1924 a) - Contribution à l'étude de Corallinacées fossiles. VII - Mélobésiées miocènes recueillies par M. Bourcart en Albanie. *Bull. Soc. Géol. France*, s. 4, v. 23, pp. 275-283, Paris.
- Lemoine M. (Mme P.) (1924 b) - Etude de quelques Nullipora de Millet et Michelin. *Compt. Rend. Congr. Soc. Sav.* 1923, pp. 178-185, Paris.
- Lemoine M. (Mme P.) (1928) - Sur quelques algues calcaires du Nummulitique de la Haute-Savoie. *Bull. Mus. Natl. Hist. Nat.* "1927", v. 33, pp. 545-551.
- Lemoine M. (Mme P.) (1934) - Algues calcaires de la famille des Corallinacées recueillies dans les Carpathes occidentales par M. D. Andrusov. *Vestn. Stat. Geolog. Ustávu Csl. Rep.*, v. 9, pp.

- 269-289, Praha.
- Maslov V. P. (1962) - Fossil red algae of the USSR and their relation to facies. *Trudieri Geol. Inst.*, v. 53, pp. 1-222, Moskva. (in russian).
- Mastrorilli V. I. (1958) - Contributo allo studio delle Corallinacee fossili dei Monti Lessini. Corallinacee eoceniche dei Lessini Veronesi. *Pubbl. Ist. Geol. Univ. Genova*, v. 12, s. A, Paleontologia, pp. 3-18, Genova.
- Mastrorilli V. I. (1968) - Nuovo contributo allo studio delle Corallinacee dell'Oligocene Ligure-Piemontese: i reperti della tavoletta Ponzone. *Atti Ist. Geol. Univ. Genova*, anno 5, v. 5, n. 2, pp. 153-406, Genova.
- Mastrorilli V. I. (1973) - Flore fossili a Corallinacee di alcune località venete tra i Berici e l'Altopiano di Asiago. *Atti Soc. Ital. Sc. Nat. Museo Civ. St. Nat. Milano*, v. 114, n. 3, pp. 209-292, Milano.
- Philippi R. (1837) - Beweis dass die Nulliporen Pflanzen sind. *Arch. Naturgesch. Her. Dr. Wiegmann*, v. 3, pp. 387-393, Berlin.
- Piazza M. (1989) - Evoluzione dell'evento trasgressivo, tardo-oligocenico, in alcuni settori del Gruppo di Voltri. Nuovi dati per una ricostruzione paleogeografico-ambientale del margine meridionale del Bacino Terziario del Piemonte. V. of 229 pp., E.R.S.U., Genova.
- Raineri R. (1924) - Alghe fossili mioceniche di Cirenaica. *La Nuova Notarisia*, v. 35, pp. 28-46, Padova.
- Woelkerling Wm. J. (1988) - The Coralline Red Algae: An Analysis of the Genera and Subfamilies of Nongeniculate Corallinaceae. V. of 268 pp., Oxford Univ. Press, Oxford.

PLATE 32

Fig. a-d - *Lithothamnion giammarinoides* sp. n. Holotype, Bric Cardinelle Section, z level, P18c. a) Section across the thallus; x 80; b) detail of hypothallus; x 200; c) detail of perithallus; x 200; d) detail of conceptacles; x 120.

PLATE 33

Fig. a-d - *Lithothamnion cardinellense* sp. n. Holotype, Bric Cardinelle Section, r level, P20I. a) Section across the thallus; x 50; b) detail of hypothallus; x 200; c) detail of perithallus; x 120; d) detail of conceptacles; x 140.

PLATE 34

Fig. a-d - *Lithophyllum tedeschi* sp. n. Holotype, Bric Cardinelle Section, g level, P29c. a) Section across the thallus; x 25; b) detail of hypothallus; x 200; c) detail of perithallus; x 120; d) detail of conceptacles; x 200.

