Coralline Algae from the Neoegne and Pleistocene Sequence of Mersa Alam, Red Sea, Egypt.

by

H. Khalifa and M. A. Boukhary
Department of Geology, Qatar University,
Doha, Qatar

ABSTRACT

Ten speciecs of family Corallinaceae (Coralline Algae) are herein recorded and described for the first time from the stratigraphic sequence of Mersa Alam, Red Sea, Egypt. Of these, **Amphiroa knolli, Jania johnsoni** and **Archaeolithothamnium alamensis** are described as new.

The studied sequence is subdivided according to its coralline algae and larger foraminiferal content into three biozones; which are from top to bottom: 3. **Amphiroa knolli** Zone, 2. **Amphiroa prefragilissima** Zone and 1. **Borelis melo** Zone. The age of these biozones ranges from Miocene to Pleistocene.

Introduction

Except for the series of studies by Souaya (1963 a, b) on the Neogene and Pleistocene coralline algae from Zug El-Behar section, Red Sea, and Gabal Gharra, Cairo-Suez road, there is no published information on the fossil algae from this part of Egypt.

The main object of this paper is to study the coralline algae from the Miocene-Pleistocene stratigraphic sequence of Mersa Alam area, Red Sea, Egypt (Fig. 1). This sequence is composed of 115m of limestones, marls, shales, sandstones, arenaceous marls, arenaceous limestones, evaporites and conglomerates.

The lithostratigraphic classification of the Miocene and younger rocks exposed in the area of study and the adjacent areas was carried out by Akkad and Dardir (1966) and El-Haddad (1979). According to them, the exposed sedimentary sequence is subdivided, from top to bottom, into the following lithostratigraphic units :—

5. Organic Reef.
4. Shagra Formation.
3. Gasus Formation.
2. Abu Dabbab Evaporites.
1. Gabal El-Rusas Formation.

This classification is followed here. In the studied section only the upper three rock units (58m thick) yielded abound species of coralline algae and larger foraminifera (Fig. 2).

Biostratigraphy and Age Assignment

The vertical distribution of the microfossils through the studied sequence (58 m thick) allows to subdivide it into three biozones which coincide with the lithostratigraphic units. These biozones are from top to base as follows :—

3. **Amphiroa knolli** Zone (corresponding to Organic Reef unit).
2. **Amphiroa prefragilissima** Zone (coincides with Shagra Formation).
1. **Borelis melo** Zone (occupies the Gasus Formation).

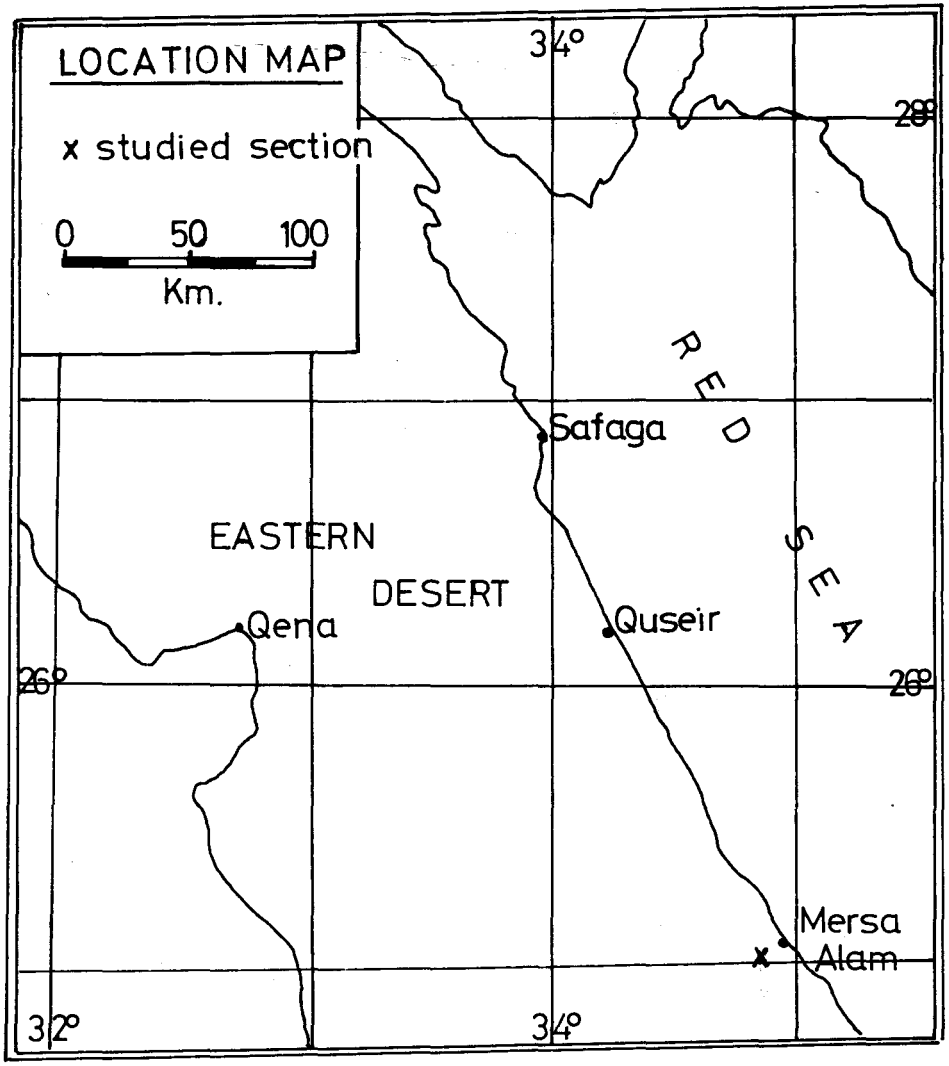

LOCATION MAP
x studied section
0 50 100
Km.
34°
28°
RED SEA
Safaga
EASTERN DESERT
Qena
Quseir
26°
28°
Mersa Alam
32°
34°

Fig. 1

Borelis melo Zone: This represents the lowest recognised biozone in the succession studied. It coincides with the Gasus Formation (25 m thick). The **Borelis melo** Zone comprises abundant specimens of **Borelis melo** (Fichtell & Moll), **Borelis haueri** (d'Orbigny), rare **Borelis** sp. cf. **B. costulatus** (Eichwald), **Lithophyllum ghorabi** Souaya, **Lithophyllum prelichenoides** Lemoine and common **Amphiroa droogeri** Souaya.

The **Borelis melo** (Fichtell & Moll) and **Lithophyllum prelichenoides** Lemoine were previously dated to be of Miocene age (Beadnell, 1924; Johnson, 1961; Souaya, 1963 a, b).

Amphiroa prefragilissima Zone: This zone corresponds to the Shagra Formation (about 25 m thick). It yielded the following algal species: abundant **Amphiroa prefragilissima** Lemoine, **Lithophyllum ghorabi** Souaya, **Archaeolithothamnium erythraeum** Rothpltez and abundant **Archaeolithothamnium alamensis** n. sp. Moreover, this zone comprises abound foraminiferal specices of **Borelis** cf. **B. costulatus** (Eichwald) and common **Borelis haueri** (d'Orbigny) and **Gypsina globula** (Reuss).

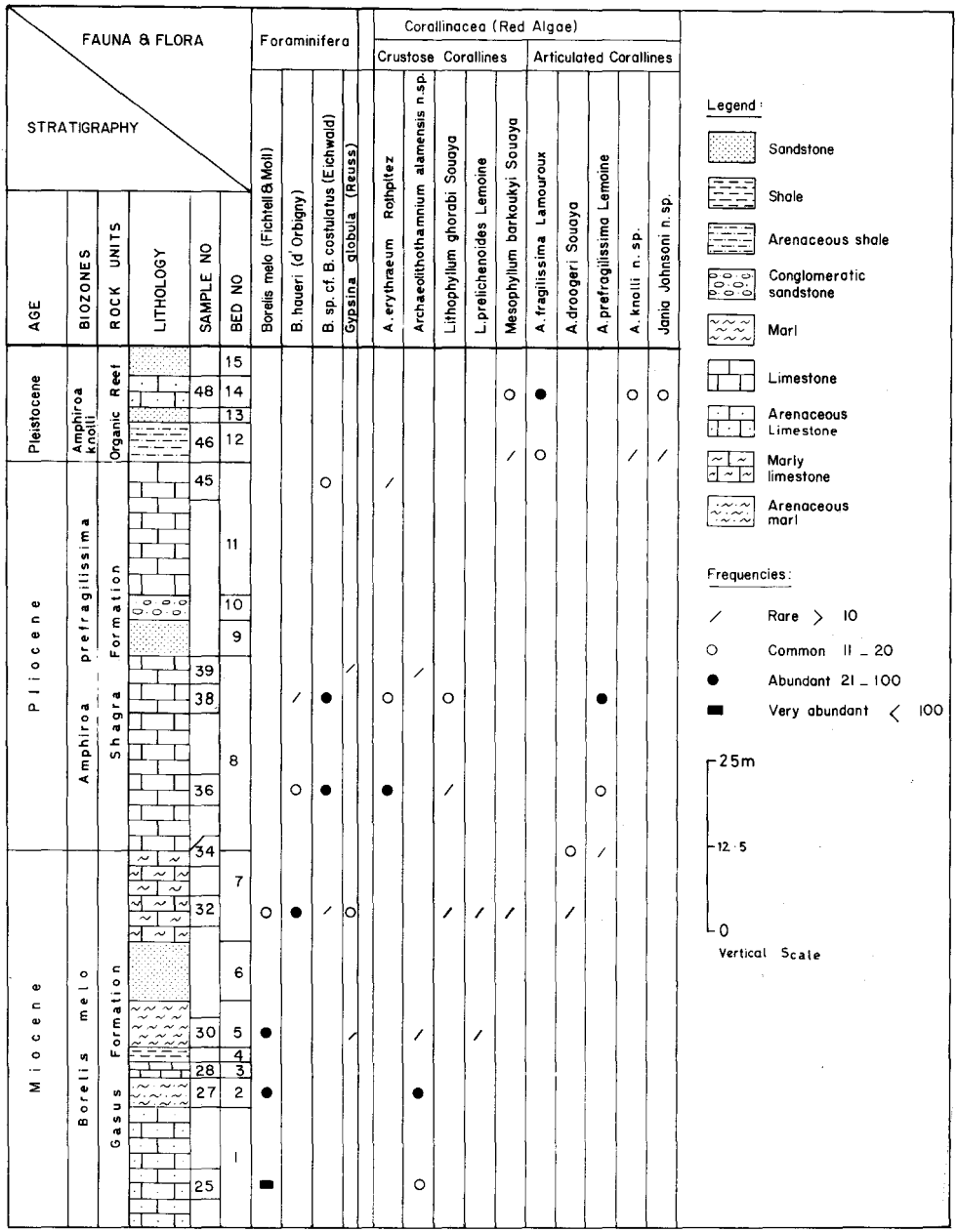
It is well known, in and outside Egypt that **Archaeolithothamnium erythraeum** Rothpltez, **Amphiroa prefragilissima** Lemoine, **Borelis** sp. cf. **B. costulatus** (Eichwald) and **Gypsina globula** (Reuss) are typical Pliocene fossils (Cox, 1929; Stainforth, 1949; Johnson 1962 and Souaya, 1963 a, b).

Amphiroa knolli Zone: The **Amphiroa knolli** Zone corresponds to the "Organic Reef" lithostratigraphic unit which forms the top (8m thick) of the succession studied. It is characterised by the abudance of **Amphiroa knolli** n. sp., **Amphiroa fragilissima** Lamouroux, **Mesophyllum barkoukyi** Souaya and **Jania johnsoni** n. sp. of this florizone, **Amphiroa fragilissima** Lamouroux and **Mesophyllum barkoukyi** Souaya give a clue of the age of this part of the succession to be Pleistocene (see Johnson, 1961; Souaya, 1963 a. b). The described biozones and their algal assemblages are shown on Figure 2.

Systematic Description of Algae

The classification scheme of the coralline algae followed here is based on the classical paleontological works by Papenfuss (1955); Johnson (1961, 1969); Ginsburg et al (1971); Adey & Johansen (1972)) Adey & Macintyre (1973) and Wray (1977). According to this scheme, generic and specific identification is mainly based on the differences in the character of the thallial tissue, hypothallium, perithallium, sporangia and conceptacles.

Fig(2) OCCURRENCE AND RELATIVE ABUNDANCE OF MICROFOSSILS IN MERSA ALAM SECTION, RED SEA, EGYPT.



Among the family Corallinaceae, the tissue of the thallus is differentiated mainly into two parts, the hypothallium and perithallium. The hypothallium forms the basal portion of the thallus in the crustose forms and the central part in the branching forms. The perithallium develops above or upon the hypothallium in the crustose forms and is outside the medullary hypothallium in the branching forms.

The material described is deposited in the Department of Geology, Assiut University, Egypt. Dimensional data are shown on Table 1.

Phylum RHODOPHYCOPHYTA (Red Algae), Papenfuss, 1946.
Family CORALLINACEAE (Coralline Algae)
Subfamily MELOBESIODEAE (Crustose Coralline Algae)
Genus **Archaeolithothamnium** Rothpltez 1981

Archaeolithothamnium erythraeum Rothpltez
(Pl. 1, Fig. 11)

Archaeolithothamnium erythraeum Rothpltez. Lemoine, 1911, PP. 67 - 70, Pl. 1, Fig. 1, text-figs. 28-29.
Archaeolithothamnium sp. cf. **A. erythraeum** Rothpltez, Souaya, 1963a, P. 246, Pl. 1, Figs. 1, 6.

Description: Tissue is formed of many layers of cells, differentiated into hypothellium and perithallium. The basal hypothallium is poorly developed or absent. The perithallium is commonly quite regular. The sporangia are not collected into conceptables, but form lenses or layers embedded in the tissue which is a distinctive feature of the genus.

Occurrence: Mersa Alam, Red Sea, Egypt (Fig. 1); Gasus Formation, **Borelis melo** Zone (Miocene) bed Nos. 1, 2, 5, sample Nos. 25, 27, 30.

Archaeolithothamnium alamensis n. sp.
(Pl. 1, Fig. 10)

Etymology: From Wadi Alam, in the vicinity of Mersa Alam, Red Sea, Egypt.

Type locality: Mersa Alam, Red Sea, Egypt (Fig. 1).

Occurrence: Shagra Formation, **Amphiroa prefragilissima** Zone, bed No. 8, sample No. 36.

Table 1
Dimentional data of the described species of coralline algae (given in microns).

Genera & Species		Segment Sizes		Hypothallic cells		Perithallic cells		Sporangia		
		Length	Width	Length	Width	Length	Width	Height	Dia meter	
Archaeolithothamnium	**A. erythraeum**	3500	1200	15	8	8	5	50	15	
	Rothpltez	3600	2500	18	11	10	8	70	20	
	A. alamensis	—	300	12	5	9	5	80	50	
	n. sp.		350	15	7	11	7	95	65	
Lithophyllum	**L. ghorabi**	1800	300	20	13	6	5	—	—	
	Souaya	2000	400	28	15	8	7	—	—	
	L. prelichenoides	1700	350	25	12	—	—	—	—	
	Lemoine									

Genera & Species		Segment Size		Formula	Hypothallic cells Long cells		Hypothallic cells Short cells		Perithallic cells	
		Length	Width		Length	Width	Length	Width	Length	Width
Amphiroa	**A. fragilissima**	1600	300	5L- 1S	40	10	20	6	—	—
	Lamouroux	1800	250		50	15	25	8	—	—
	A. prefragilissima	1200	500	5L-6L	30	10	15	8	10	6
	Lemoine	1800	600	/IS	70	15	20	10	12	8
		2000	800		75	20	25	12	14	10
	A. knolli n. sp	800	300	2L-1S	20	7	15	6	6	5
		1000	400		25	8	20	8	8	8
		1200	600		45	11	22	10	10	10
		1500	700		50	15	25	15	15	12
Jania johnsoni		1200	250	—	50	12	—	—	10	8
n. sp.		1500	300	—	60	10	—	—	12	10

Description: Thallus develops as a thin crust. The tissue, which is differentiated into hypothallium and perithallium, is composed of regular layers of cells. The perithallic tissue is fairly regular with horizontal layering partitions. The horizontal partitions are slightly thick, more pronounced than the vertical ones. The perithallium is considerably thicker, especially in the central part, than the hypothallic tissue. The cells of the hypothallic crust are in the form of regular horizontal layers, apparently more steeply inclined on the sides. These cells at one of the two extremes forming concentric layering like structure. The sporangia, which are not collected into conceptacles, are pierced by single aperture embedded in the concentric layers of the basal hypothallic crust.

Remarks: The Egyptian new species **A. alamensis** n. sp. differs from **Archaeolithothamnium cretaceum** (Pfender, 1926) by having pronounced horizontal partitions in the perithallic tissue, and in having sporangle embedded in the concentric layers of the hypothallic crust.

Genus **Lithophyllum** Philippi 1837
Lithophyllum perlichenoides Lemoine
(Pl. 1, Fig. 8)

Lithophyllum prelichenoides Lemoine. Johnson, 1961, P. 54, Pl. 1, Fig. 3.

Lithophyllum prelichenoides Lemoine. Souaya, 1963 a, P. 1212, Pl. 161 Figs. 2, 6; Pl. 162, Fig. 2.

Lithophyllum prelichenoides Lemoine. Johnson, 1964 b, P. 19.

Lithophyllum prelichenoides Lemoine. Buchbinder, 1977, PP. 424-426, Pl. 5, Figs. 4-6.

Description: Regular crusts and branching (1.7 mm in length and 0.35 mm in width). The tissue is composed of well-developed hypothallium and very thin perithallium. The hypothallium cells form concentric arched layers.

Remarks: The present specimens are similar in all respects to **L. prelichenoides,** which is very abundant in the Miocene of the Mediterranean, Caribbean and Pacific regions and at Gebel Gharra in Egypt (Buchbinder, 1977).

Occurrence: Mersa Alam, Red Sea, Egypt (Fig. 1); Gasus Formation, **Borelis melo** Zone, Miocene, bed No. 7, sample No. 32.

Lithophyllum ghorabi Souaya
Pl. 1, Fig. 7.

Lithophyllum ghorabi Souaya, 1963 a, P. 1121, Pl. 163, Figs. 1-4.

Lithophyllum ghorabi Souaya. Souaya, 1963 b, P. 247, Pl. 1, Fig. 7.

Lithophyllum ghorabi Souaya. Buchbinder, 1977, Pl. 4, Fig. 6, Pl. 5, Figs. 1-2.

Description: Regular crusts and branching crusts (1.8 mm - 2 mm in length; 0.3 mm - 0.4 mm in width). The thallus is composed of thick hypothallium and thin perithallium. The hypothallium is co-axial and consists of arched layers of cells. The cells are rectangular.

Occurrence: Mersa Alam, Red Sea, Egypt. (Fig. 1); rare in Gasus Formation, **Borelis melo** Zone (Miocene) becoming common in Shagra **Amphiroa prefragilissima** Zone, (Pliocene), bed Nos. 7 & 8, sample Nos. 32, 39.

Subfamily CORALLINOIDEAE (Articulated Coralline Algae)
Genus **Amphiroa** Lamouroux 1812

Amphiroa prefragilissima Lemoine
(Pl. 1, Figs. 1, 2, 6)

Amphiroa prefragilissima Lemoine, 1917, PP. 275-277, text-fig. 23.

Amphiroa prefragilissima Lemoine, Souaya, 1963 a, P. 256, Pl. 3, Figs. 5, 6.

Description: This species includes fragments varying in length up to 2 mm. The diameter of the branches varies from 0.5 mm to 0.8 mm. The perithallium, when present, may vary in thickness from 40 μ to 100 μ. The medullary hypothallium is co-axial and consists of two types of cells which alternates so that from five to six rows of long cells followed by one row of short cells. The long cells of the hypothallium are nearly straight whereas the short ones form arched layers.

Occurrence : Mersa Alam, Red Sea, Egypt (Fig. 1); Shagra Formation, **Amphiroa prefragilissima** Zone, Pliocene, bed No. 8, sample Nos. 34, 36, 38.

Ampliroa fragilissima Lamouroux
(Pl. 1, Fig. 12)

Amphiroa fragilissima Lamourous. Johnson, 1961, P. 70 Pl. 14, Fig. 5.

Description: This species is represented by two specimens which are fragments of thin branches 1.6 mm to 1.8 mm in length and 0.3 mm - 0.25 in diameter. The tissue is composed entirely of medullary co-axial hypothallium surrounded by very thin outer marginal perithallium. The co-axial hypothallium consists of layers of long and short cells following the formula 5L - 1S.

Occurrence: Mersa Alam, Red Sea, Egypt (Fig. 1); **Amphiroa knolli** Zone, Pleistocene, bed No. 14, samples 46, 48.

Amphiroa knolli n. sp.
(Pl. 1, Figs. 3, 4, 5)

Etymology: This species is named in the honour of Dr. Andrew Knoll, Obrelin College, Ohio, U.S.A.

Type locality: Mersa Alam, Red Sea, Egypt (Fig. 1).

Type level: Organic Reef, **Amphiroa prefragilissima** Zone, Organic reef, **Amphiroa knolli** Zone, Pleistocene, bed No. 14, sample No. 48, arenaceous limestone (Fig. 2).

Description: The specimens of this species include fragments of branches which reach up to 1.5 mm in length. Their width is slightly medium, varying between 0.3 and 0.7 mm. Branching is typically pinnate (dichotomous to trichotomous). The cellular tissue is composed of tiers of medullary hypothallium surrounded by a weekly developed perithallium. The medullary hypothallium is co-axial and consists of layers of long and short cells following the formula 2L 1S or 1L - 1S. The long cells are rectangular in shape and their height appear to be smaller on the sides. The walls of the cell layers appear to be slightly arched in the central part and more curved on the peripheries. The characteristic feature of this taxon is the presence of lateral branches originated from the original one. The lateral branches show regular rows of cell layers following the formula 1L - 1S.

Remarks: The specimens of **A. knolli** n. sp. have the very distinctive and characteristic structure of the genus **Amphiroa** namely the alternation of long cell

layers with short cell layers. It differs from other species of **Amphiroa** in having pinnate branching (dichotomous to trichotomous). Each branch shows regular rows of cell layers following the formula 1L - 1S.

Genus **Jania** Lamouroux, 1812
Jania Johnsoni n.sp.
(Pl. 1, Fig. 9)

Etymology: This species is named after Dr. Harlian Johnson, Professor of Geology, Colorado School of Mines.

Type locality: Mersa Alam, Red Sea, Egypt (Fig. 1).

Occurrence: Organic Reef, **Amphiroa knolli** Zone, bed No. 14, sample No. 48.

Description: The Egyptian specimens comprise fragments varying in length up to 1.5 mm. The original branch is about 0.3 mm in diameter. The thallial tissue is composed of well-developed thick hypothallium surrounded by thin marginal perithallium. The perithallium has a very distinctive characteristic structure of single layer of small rectangular cells. The hypothallium is co-axial and consists of regular rows of cell layers with hexagonal shape. The number of the rows of the hypothallial tissue is 12, with rectangular and straight cells especially in the central part. These rows of cell layers are almost joined together forming zigzag line on both sides. The marginal cells of the perithallial tissue are almost square.

Remarks: This species differs from **Jania** sp. Johnson, described by Johnson (1961) from the Miocene of Saipan in having much bigger cells of hexagonal shape in the hypothallial tissue and very thin perithallial tissue.

Acknowledgements

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EXPLANATION OF PLATE 1

1, 2, 6 **Amphiroa prefragilissima** Lemoine
Vertical section through crust showing the coaxial hypothallium, thin perithallium, and an alternation of long cells layers with short cells layers following the formula 5L - 1S. 6, holotype; 1, 2, paratype, X50. Sections from samples 34, 36, 38.

3, 4, 5 **Amphiroa knolli** n. sp.
Vertical section showing the coaxial hypothallium and perithallic tissue with an alternation of long cells layers and short cells layers following the formula 2L - 1S. 3, holotype; 4, 5, paratype, X40.
Sections from samples 46, 48.

7 **Lithophyllum ghorabi** Souaya
Vertical section showing coaxial hypothallium and perithallium, X S0, sample 38.

8 **Lithophyllum prelichenoides** Lemoine
Section through branch showing coaxial hypothallium, X 40, sample 32.

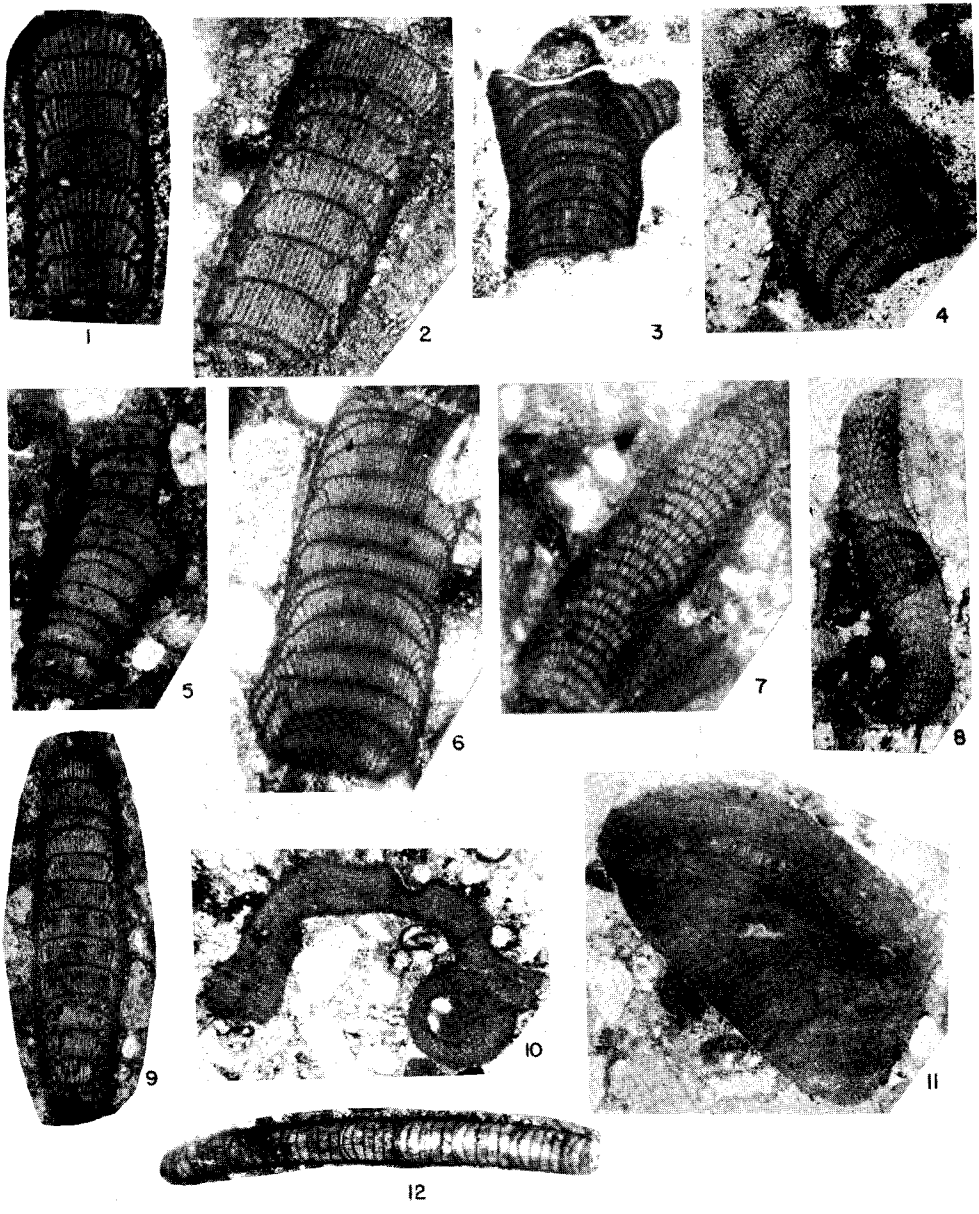
9 **Jania johnsoni** n.sp.
Section, from sample 48, showing the characteristic equal rows of arched layers of cells and thin perithallium, holotype, X50.

10 **Archaeolithothamnium alamensis** n.sp.
Section, from sample 36, showing perithallium with sporangia, holotype, X40.

11 **Archaeolithothamnium erythraeum** Rothpletz
Portion of a branch exhibiting the pronounced arched layers of the tissue and sporangia, X50, sample 25.

12 **Amphiroa fragilissima** Lamouroux
Vertical section through branch showing the medullary coaxial hypothallium and perithallium, X50, sample 46.

PLATE 1



REFERENCES

1. Adey, W. H. and Johansen, H. W., (1972): Morphology and Taxonomy of Corallinaceae with special reference to Clathromorphum, Mesophyllum, and Neopolyporolithon gen. nov. (Rhodophyceae, Cryptonemiales). Phycologia, vol. 11, No. 2, pp. 159-180.
2. Adey, W. H. and Macintyre, I.G., (1973): Crustose coralline algae: a revaluation in the geological sciences. Geol. Soc. Am., Bull. vol. 84, No. 3, pp. 883-903, text-figs. 1-31, tables 1-6.
3. Akkad, S. and Dardir, A. A., (1966): Geology of the Red Sea Coast between Ras Shagra and Mersa Alam, Egypt. Geol. Surv., Paper No. 35, 67 pp.
4. Beadnell, H. J. L., (1924): Report on the geology of the Red Sea Coast between Quseir and Wadi Ranga, Egypt. Min. Fin., Cairo, (Petrol. Research Ser.), Bull. No. 13.
5. Buchbinder, B., (1977): Systematics and Paleoenvironments of the calcareous algae from the Miocene Tziqlag Formation, Israel. Micropaleont. vol. 23, No. 4, pp. 415-435, pls. 1-6.
6. Cox, L. R., (1929): Notes on the Miocene Ostriadae and Pectinidae of the Red Sea region, with remarks on the geological significance of their distribution. Malac. Soc., vol. 18, pls. 4-5, pp. 165-209.
7. El-Haddad, A., (1979): Geological studies on the Miocene and younger sediments south of Safaga, Red Sea, Egypt. M.Sc. thesis, Assiut University, Faculty of Science, pp. 169.
8. Ginsburg, R., Rezak, R., and Wray, J. L., (1971): Geology of calcareous alges (notes for short courses). Miami Univ., Rosenstiel School Mar. Atm. Sci., pp. 1-15.
9. Johnson, J. H., (1961): Limestone - building algae and algae limestones. Golden, Colorado: Colorado School of Mines, pp. 1-297, pls. 1-139, tables 1-13.
10. Johnson, J. H., (1962): The algal genus Lithothamnium and its fossil representatives. Colorado School Mines Quart., vol. 57, No. 1, pp. 111, 13 pls., 14 tables.
11. Johnson, J. H., (1964): Paleocene calcareous red algae from northern Iraq. Micropaleont., vol. 10, No. 4, pp. 477-485, pls. 1-3.
12. Johnson, J. H., (1969): A review of the Lower Cretaceous algae. Colorado School of Mines Prof. Contrib., No. 4, 71 pp.
13. Lemoine, Mme. Paul, (1917): Contribution a' l'etude des Corallinaces fossiles. I. generalites sur la structure de corallinacees. Soc. geol. France Bull., 4^{e} ser'., vol. 17, pp. 223-240.
14. Lemoine, Mme. Paul. (1939): Les algues calcaires fossiles de l'Algerie.

Materiaux pour la Carte geol. de L' Algerie, ser. 1, Paleontologie, No. 9, 128 pp., 3 pls., 80 figs.
15. Papenfuss, G.F., (1955): Classification of the algae: a century of progress in the natural science 1853-1953. Calif. Acad. Sci., San Francisco, pp. 115-224.
16. Pfender, J., (1926): Les Melobesiees dans les calcaire cretaces de la Basse - provence: Soc. geol. France Mem. 3 (42) 31 pp. 10 pls.
17. Said, R., (1962): The geology of Egypt. Elsevier Publishing Comp., Amsterdam, New York, 377 pp.
18. Souaya, F.J., (1963 a): On the calcareous algae (Melobesioideae) of Gebel Gharra (Cairo - Suez road) with a local zonation and some possible correlations. J. Paleont., vol. 37, No. 6, pp. 1204-1216, pls. 161-165, text-figs. 1, 2.
19. Souaya, F.J., (1963) b): Micropaleontology of four sections south of Qoseir, Egypt. Micropaleont., vol. 9, No. 3, pp. 233-266, pls. 1-8, text-figs. 1-2.
20. Stainforth, R.M., (1949): Foraminifera in the Upper Tertiary of Egypt. J. Paleont., vol. 23, pp. 419-422.
21. Wray, J.L., (1977): Calcareous algae. Elsevier Pub. Comp., Amsterdam, New York, 185 pp.

الأشنات المرجانية من تتابع النيوجين والبليستوسين بمرسى علم ، البحر الأحمر ، مصر .

حامد خليفة و محمد البخاري

كلية العلوم ـ جامعة قطر

ملخـــــــــص

تم تسجيل ووصف عشرة أنواع تنتمي إلى الاشنات المرجانية من التتابع الاستراتجرافي بمرسى علم ، البحر الأحمر ، مصر . منها ثلاثة أنواع : **أمفورا نولي ، جانيا جونسوني ، اركيوليثوسامنيم الامنسيس** تم وصفها جديده .

وبناء على أنواع الاشنات المرجانية بالاضافة إلى المحتوى الفورامنيفري الكبير ، امكن تقسيم التتابع إلى ثلاثة نطق (عمرها يتراوح من الميوسين إلى البلستوسين) هي على التوالي من أعلى إلى أسفل :

٣ ـ نطاق امفورا نولي

٢ ـ نطاق امفورا بريفلاجيليسيما

١ ـ نطاق بورلس ميلو