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Giuseppe Sirna

The Lower Cretaceous Charophyta and the paleogeography of Mediterranean basin

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Paleontologia. — *The Lower Cretaceous Charophyta and the paleogeography of Mediterranean basin* (*). Nota di GIUSEPPE SIRNA, presentata (**) dal Socio B. ACCORDI.

RIASSUNTO. — L'utilizzazione di resti di Carofite per scopi stratigrafici e paleogeografici è divenuta da alcuni anni sempre più frequente poiché tra questo gruppo vi sono specie che offrono la possibilità di effettuare correlazioni stratigrafiche a grande distanza. Così avviene infatti per i termini di passaggio Giurassico–Cretaceo, per il Cretaceo inferiore (in special modo per l'Aptiano), per il Cretaceo superiore ed anche per alcuni periodi del Cenozoico.

Le specie più caratteristiche dell'Aptiano sono *Atopochara trivolvis* PECK e *Flabellochara harrisi* (Peck), presenti in tutto il bacino del Mediterraneo in sedimenti in facies di shelf. In una precedente Nota [19] lo scrivente aveva segnalato, per la prima volta in Italia, la presenza di queste specie, mettendo in risalto il loro valore per la stratigrafia delle monotone serie carbonatiche dell'Appennino laziale–abruzzese e per una ricostruzione paleogeografica del gruppo dei Monti Lepini e Ausoni. Nel presente lavoro si dà notizia di altri ritrovamenti nell'Appennino centro–meridionale e viene segnalata per la prima volta la presenza di *Atopochara trivolvis* e *Flabellochara harrisi* negli orizzonti aptiani della parte meridionale delle Dinaridi esterne della Jugoslavia dove lo scrivente nell'estate del 1966, con la preziosa guida della Dr. R. Radoicic, ha avuto modo di prelevare dei campioni argillosi. Vengono esaminate inoltre le situazioni stratigrafiche, note dalla letteratura, di tutti gli affioramenti distribuiti nell'area europea in special modo nel bacino del Mediterraneo e viene fatto un tentativo di ricostruzione paleogeografica dell'Aptiano. Dall'esame di tutti i dati si giunge alla conclusione che, nella area interessata dalla presenza delle suddette caracee, durante l'Aptiano si era instaurato un ambiente lagunare o semilagunare documentato da sedimenti argillo–marnosi, con resti di carofite, intercalati alla normale serie marina. In alcune zone, per esempio in Algeria, si sono trovati fino a sei livelli contenenti *Atopochara trivolvis* interposti a calcari a foraminiferi, di chiaro ambiente marino.

In Francia al di sotto dell'orizzonte aptiano a caracee si sono rinvenute evaporiti, mentre in Romania al posto di queste si trovano bauxiti. Ciò testimonia un sollevamento della piattaforma che ha favorito l'instaurarsi di bacini lagunari e lo sviluppo in ambiente adatto delle caracee. È ovvio che queste condizioni non hanno interessato tutta l'area europea e il bacino mediterraneo, ma accanto a zone lagunari si avevano anche vaste aree soggette a normale subsidenza con sedimentazione di tipo marino.

During the last years the stratigraphical and paleogeographical studies of the Meso–Cenozoic have considerably developed due to, at least for certain areas, the discovery in many levels of Charophyta remains among which some species are found which, according to their vast areal distribution and limited vertical expansion, are considered as index-fossils.

In one of his previous works, the writer has noted for the first time in Italy, the presence of *Atopochara trivolvis* Peck and *Flabellochara harrisi*

(*) Lavoro eseguito nell'Istituto di Geologia e Paleontologia dell'Università di Roma, diretto dal prof. B. Accordi al quale esprimo la mia gratitudine per i consigli e gli aiuti fornitimi.

(**) Nella seduta del 20 aprile 1968.

(Peck, in clayey-marly beds of the Lepini mountains and of the western Ausoni (Southern Latium). On that occasion the importance of the discovery was pointed out since the above mentioned species would allow to date as Aptian a characteristic level recognizable on the field, besides being of great help to the field geologist with regard to the monotonous carbonatic series of the « laziale–abruzzese » facies. The attribution to the Aptian of the Charophyta level could be made because *Atopochara trivolvis* and *Flabellochara harrisi* were discovered in areas outside of Italy, but within the Mediterranean basin, almost always in Aptian levels, also because such level in the Apennines is heteropic with the clayey marls containing abundant remains of *Pianella dinarica* (Radoicic), dasyclad alga which, as is known, has its level of largest extent corresponding exactly to the Aptian [3].

The presence of Charophyta, in addition to the stratigraphy, has its own particular paleo-environmental meaning, and exactly in the above mentioned work the writer has tentatively tried the paleoecological reconstruction of the Aptian in marly facies reaching the conclusion that the sediments have formed in fresh to brackish environments. Whenever evident traces of wear exist on the sculptures of the Charophyta utricles; this indicates the transfer of the Charophyta from an original lake basin to the sea.

With the progress of surveying the Central-Southern Apennines, other outcrops have been localized which have extended considerably the area of distribution of *Atopochara trivolvis* and *Flabellochara harrisi* and furthermore give the possibility of outlining more objectively paleo-geographical reconstructions of larger areas. In one of his recent works, Devoto points out that on the Simbruini mountains (Eastern Latium) there exist outcrops of clayeymarly limestones, at times extending for some kilometers, containing the well known species of Aptian Charophyta besides a large number of smooth ostracods and fragments of *Pianella dinarica*. The most important of these outcrops are localized at the foot of the Southern-Western side of Colle Viglio (Filettino) and near the Sanctuary of the Holy Trinity of Vallepietra. The author believes that the clayey limestone level is of brackish facies and originally connected to a positive movement (or to a general stop of the subsidence) of the " laziale–abruzzese " shelf.

Another outcrop of clayey limestones was noted by De Castro [4], along the road Meta-Positano, a few kilometers west of this last mentioned village. In this respect the author generically mentions the presence of Charophyta oogonia. However, in some samples which were kindly donated to the writer by De Castro, it was possible to ascertain that were present specimens of *Atopochara trivolvis* and *Flabellochara harrisi*.

In the above mentioned work De Castro notes, as does the writer [19], that the Charophyta level is heteropic of the known *Orbitolina* level in which the most extended development of *Pianella dinarica* (Radoicic) can be observed, which is also present in numerous specimens in the Charophyta limestone, attributed by the author to the Aptian and whose origin is in relation to the instability of the sea bottom.

Atopochara trivolvis and *Flabellochara harrisi* have been found for the first time by Peck [13] in sediments of fresh water belonging to the Texas Aptian while in Europe their presence was noted in Algeria by Bär and Magné [1], in Spain by Busnardo [2], in France by Feuillée & Grambast [9], in Germany by Mâdler [12], in Hungary by Rasky [16], in Rumania by Dragastan, Istocescu and Diaconu [6] and in Syria by Van Bellen [20]. Up to now their presence was not known in the Cretaceous sediments of the Yugoslavian Outer Dinarides. However, during the summer of 1966, the writer had the opportunity of visiting the Dinarides under the expert guidance of Dr. R. Radoicic, to whom he extends warm thanks. In the Lower Cretaceous he was able to observe a limestone level containing numerous remains of Charophyta which, once analyzed, appeared to be small branches and utricles of *Atopochara trivolvis*. *Flabellochara harrisi* does not appear, at least among the samples which have been chosen. Previously Dr. Radoicic had already observed in the marly beds which she ascribed to the Aptian-Albian, some Charophyta which she attributed with some doubts to the genus *Clavator*. Having examined the samples upon invitation of his colleague, the writer points out that there are present, instead, specimens of *Atopochara trivolvis*, whose presence was first signalled in Yugoslavian Cretaceous.

Besides the previously mentioned authors who have noted the presence of the two species of which we are discussing, other students gave further information on the lithobiostratigraphy of the Lower Cretaceous. Their data are useful in order to be able to make a tentative paleogeographical reconstruction leisurely.

In Algeria the Charophyta level has been localized in the Cretaceous area of the Dj. Meimel, South of the district of Costantina. On a Barremian in shelf facies with *Toucasia*, there is an alternation of micrites with miliolids and marls with *Orbitolina*. There are also some sheetlike beds of marl and marly-limestone with plenty of *Atopochara trivolvis* interstratified with the miliolids-limestone. The authors have discovered up to six of such interstratifications and have interpreted them as fresh water phases in a clearly marine series which can be attributed to the Lower Aptian.

In Rumania the Charophyta level has been found in the Lower Cretaceous of the Padurea Craiului mountains (Virciorog-Fisca area). Here above Jurassic reef limestone with *Nerinea* and *Diceras* there is a lack of sedimentation represented by bauxite deposits; above these an Hauterivian lies consisting of *Atopochara trivolvis*, *Flabellochara harrisi* and *Porochara* limestone. Then reef limestone with *Requienia ammonia* (Barremian) follows in sedimentation continuity; on top lie Aptian marly shales with Ammonites.

The first finding of *Atopochara trivolvis* in Spain is attributed to Busnardo [2]; this recovering was in lacustrine limestone interstratified in a marine series with shelf facies. The outcrops which the author attributes to the Aptian are found in the immediate vicinity of Jaén (Andalusia). Other sediments containing *Atopochara trivolvis* have been found later by Feuillée and Grambast [9] in the Lower Cretaceous of Oña province, near Burgos.

The presence of *Atopochara trivolvis* and *Flabellochara harrisi* in France is limited to the Aquitanian basin and predominantly in its most western side. In the zone of Parentis, just south of Bordeaux, Lower Cretaceous is characterized by a shallow water transgressive sedimentary environment, but sometimes limestone levels with Charophyta are interbedded essentially in Neocomian as well as in Aptian. *Atopochara trivolvis* has been found exactly in the Aptian, while, according to Séronie-Vivien, Sens, Malmoustier [18] it appears that *Flabellochara harrisi* exists in beds between Upper Jurassic and Lower Cretaceous. As a first impression this fact actually is confusing because till now this latter species was known as a good fossil of the Aptian, and this is also confirmed by Grambast [10]. However, as it has been noted, *Flabellochara harrisi* has been found in Rumania at a level which is certainly Hauterivian; for this reason it is possible that the stratigraphic distribution of this species extends lower than the Aptian.

Unfortunately Mädler [12] does not furnish any information concerning the outcrops of the Lower Cretaceous lithostratigraphic series in North Western Germany; but since they are localized in the Northern limy Alps about which we have an abundant recent literature, it is possible to affirm that the lithofacies is that of a shelf similar to those which have been described so far.

In Hungary, the areas where *Atopochara trivolvis* was found are located near Oroszlany west of Budapest and in the Bakony mountains at Zirc, Kisgyon, Alsohajag, Tés, Tundermajor, Bakonynana, Perepuszta, Alsoperepuszta. Here Cretaceous shelf sequences are also found, with a marly shaly horizon interstratified in the Lower Aptian and containing the well known charophyta, ostracods and *Orbitolina* sp. Rasky [16, 17] interprets this level as a phase of continentality in a series which is clearly marine. According to the authoress there were lagoon or lacustrine basins which favoured the development of the Charophyta whose oogonia have been subsequently transported by rivers to the nearby coast.

In Yugoslavia, the series outcropping on the external side of the Dinarides in the neighbourhood of Titograd, has been explained in detail by Radoicic [15] and later compared with that outcropping in the Lepini mountains (Southern Latium) by Farinacci and Radoicic [8]. As a result it appears an exclusively carbonatic shelf facies with the exception of some interbedded marly shaly levels, predominantly localized in the Aptian. From these levels the writer was able to isolate *Atopochara trivolvis*.

Paleogeographical remarks.

From the geographical distribution of *Atopochara trivolvis* Peck and *Flabellochara harrisi* (Peck), from their stratigraphical position and from the examination of the lithofacies, it can be deduced that in the Mediterranean basin and Northern Europe there were, during Lower Cretaceous particularly Aptian, fresh and brackish water condition due to the uplifting of the carbonatic shelf. There is no doubt that during such a period the uplift was not

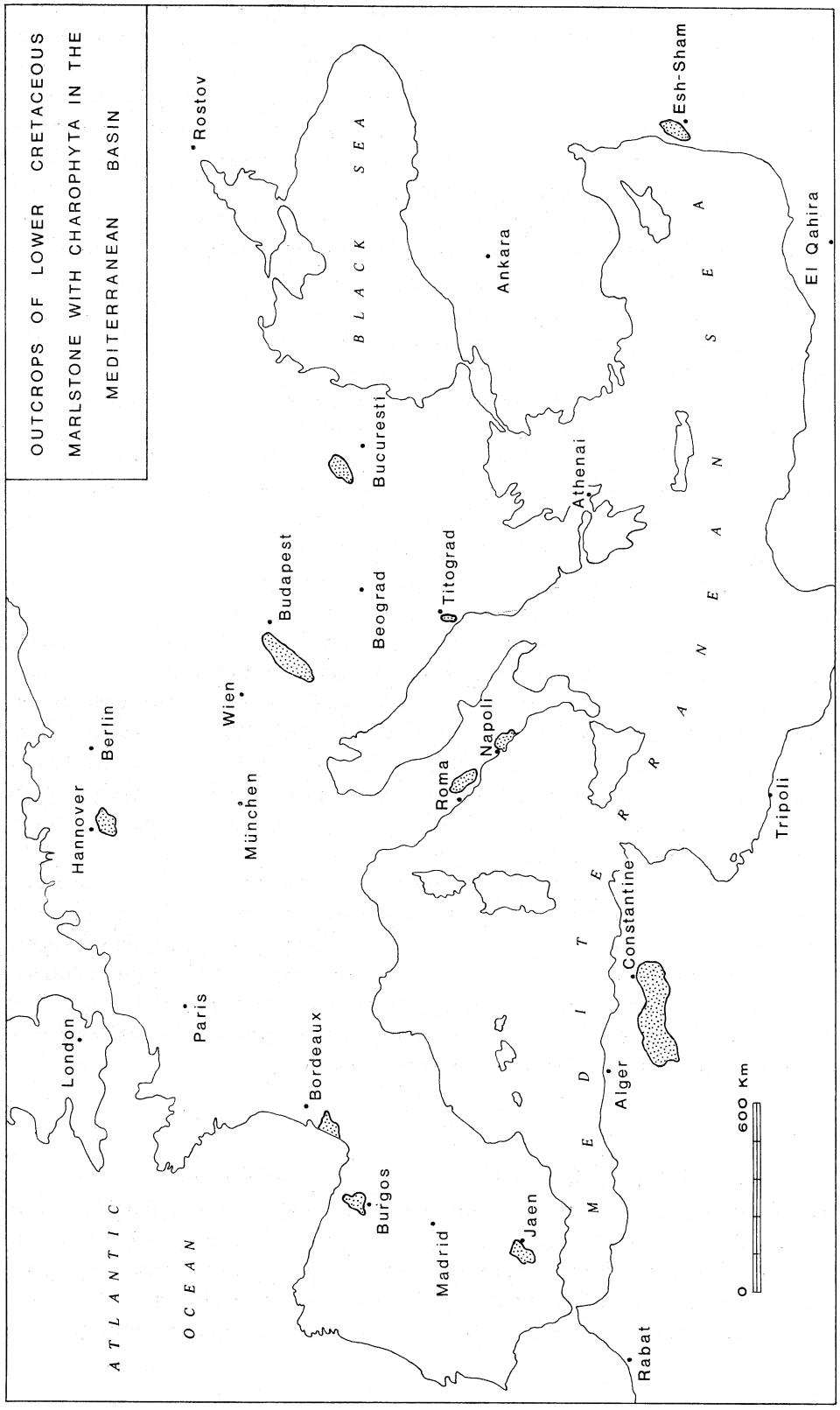

OUTCROPS OF LOWER CRETACEOUS MARLSTONE WITH CHAROPHYTA IN THE MEDITERRANEAN BASIN
ATLANTIC OCEAN
BLACK SEA
MEDITERRANEAN SEA
London
Paris
Hannover
Berlin
Bordeaux
Burgos
Madrid
Jaen
Wien
München
Budapest
Beograd
Bucuresti
Rostov
Titograd
Roma
Napoli
Ankara
Athenai
Constantine
Alger
Rabat
Tripoli
Esh-Sham
El Qahira
0
600 Km

Fig. 1.

the same in all areas. Different modes and times during which this phenomenon occurred were in fact in the Mediterranean basin and in Northern Europe. In Algeria, as an example, after the rising, conditions of stability of the bottom did not occur, but a series of movements conditioned the sedimentation of six shaly levels with Charophyta in a clearly marine series. In the Western side of the Aquitanian basin beneath the marly Aptian, boreholes revealed the presence of evaporites. This is clearly an indication of the almost complete emergence of the shelf and its subsequent lowering with the installation of lagoon basins. The same happened for the rising of the carbonate shelf in Rumania and Yugoslavia, but in this case there was a total emergence.

As it has been mentioned formerly, in the area of the Padurea Craiului mountains, North of Bucarest, on Jurassic reef sediments with *Nerinea* and *Diceras* there is a bauxite level which marks a stratigraphical lack and indicates a rising with conseguent emergence of the shelf. Subsequently a gradual lowering of the bottom occurred with the installation at the beginning of brackish water environment (which correspond to the Hauterivien) and later of clearly marine environment with deposits with *Requienia ammonia* and *Toucasia* belonging to Barremian. Succesively on this carbonatic shelf pelagic sediments containing Aptian Ammonites were deposited.

In the Outer Dinarides of Yugoslavia the movements have followed one after the other and different bauxite levels are interbedded in the marine sediments from Trias on; this, according to Grubic proves the periodic emergence of the bottom. One of these horizons has at the bottom Hauterivian-Barremian limestone, and on the top the Aptian one which might represent, at least for the portion which lies on the bauxites, a lagoon deposit.

Therefore, in this case the environmental conditions, which favoured the development of the Charophyta, have also prevailed after a total emergence and subsequent lowering of the shelf. In the rest of Europe, as in Spain, Italy, Germany, Hungary and in Syria, probably there was no total and prolonged emergence, since there is no information concerning the presence of continental sediments. Also in this case the presence of Charophyta indicates fresh and brackish water sedimentation. In fact, in Italy, a continental phase exists only at the transition Jurassic-Cretaceous where, as an example, remains of plants have been found by Praturlon [14] in the Lepini mountains. In the Aptian of Central-Southern Apennines the Charophyta horizon is always marly-clayey and proves a rising on large areas of the carbonatic shelf. This rising may be interpreted as a first indication of what will be later real emergence (with bauxite deposits) regarding both Albian and Cenomanian as well as one part of Upper Cenomanian.

Concluding, it can be affirmed that during Lower Cretaceous (generally Aptian) over the areas which at present border the Mediterranean basin, there was a shallow marine water landscape, with some emerged areas where lake-like and lagoon-like basins took place; they made possible the areal expansion of *Atopochara trivolvis* and *Flabellochara harrisi*. Naturally normal marine sedimentation was present in other areas subject to regular subsidence.

REFERENCES.

[1] BÄR C. and MAGNÉ J., *Découverte de niveaux a Charophytes dans le Crétacé inférieur du Dj. Meimel (Constantine, Algérie). Etude de la série stratigraphique*, « Bull. Soc. Géol. Fr. » (6), *5*, 249–256, 1 tav., 3 figg., Paris 1955.

[2] BUSNARDO R., *Aperçu sur le Prébétique de la région de Jaén (Andalousie, Espagne)*, « Bull. Soc. Géol. Fr. » (7), *2*, 324–329, Paris 1960.

[3] DE CASTRO P., *Nuove osservazioni sul livello ad Orbitolina in Campania*, « Boll. Soc. Naturalisti in Napoli », *71*, 103–135, Napoli 1963.

[4] DE CASTRO P. *Su alcune* Soritidae (Foraminiferida) *del Cretacico della Campania. Note stratigrafiche sul gruppo montuoso del Tifata*, « Boll. Soc. Naturalisti in Napoli », *74*, 317–372, 22 tavv., Napoli 1965.

[5] DEVOTO G., *Note geologiche sul settore centrale dei monti Simbruini ed Ernici (Lazio nord–orientale)*, « Boll. Soc. Naturalisti in Napoli », *76*, 1–112, 23 figg., Napoli 1967.

[6] DRAGASTAN O., ISTOCESCU D. and DIACONU M., *Etude du niveau a Charophytes d'age Crétacé inférieur des Monts Padurea Craiului (Romanie)*, « Revue de Micropaléontologie », (9), *1*, 23–28, 2 tavv., Paris 1966.

[7] EMBERGER G. and MAGNÉ J., *Observations sur les niveaux a Charophytes de l'Aptien des Monts des Oulad–Nail (Atlas saharien, Algérie)*, « Bull. Soc. Géol. Fr. », (6), *6*, 1029–1039, Paris 1956.

[8] FARINACCI A. and RADOICIC R., *Correlazione fra serie giuresi e cretacee dell'Appennino centrale e delle Dinaridi esterne*, « La ricerca scientifica », 7, *2*, 269–284, 15 tavv., Roma 1964.

[9] FEUILLEE P. and GRAMBAST L., *Présence* d'Atopochara multivolvis PECK *dans le Cénomanien d'Ona (prov. de Burgos, Espagna)*, « C. R. Soc. Géol. Fr. », 7, 202–204, Paris 1961.

[10] GRAMBAST L., *Etat des connaissances acquises sur les Charophytes du Crétacé inférieur*, « Mem. du Bureau de Rech. Géol. et Min. », Colloque sur le Crétacé inf. (Lyon, septembre 1963), *34*, 577–582, 3 tabb., Paris 1965.

[11] GRUBIC' A., *Les bauxites de la province dinarique (Yugoslavie)*, « Bull. Soc. Géol. Fr. », *4*, 382–388, 3 figg., Paris 1964.

[12] MADLER K., *Charophyten aus dem nordwest deutschen Kimmeridge*, « Geol. Deusche Jahrb. », *67*, 1–45, 8 figg., 2 tavv. (1953).

[13] PECK R. E., *A new family of Charophyta from the Lower Cretaceous of Texas*, « Journ. Paleont. », *12*, 173–176, 1 fig., 1 tav. (1938).

[14] PRATURLON A., *Resti di conifere al passaggio Giurese–Cretaceo nei Monti Lepini*, « Boll. Soc. Geol. It. », *84*, 279–288, 2 tavv., Roma 1965.

[15] RADOICIC R., *Microfacies du Crétacé et du Paleogene des Dinarides externes de Yugoslavie*, « Inst. des Rech. Géol. de la R.P. Crna Gora », *4*, 1–36, 67 tavv., Titograd 1960.

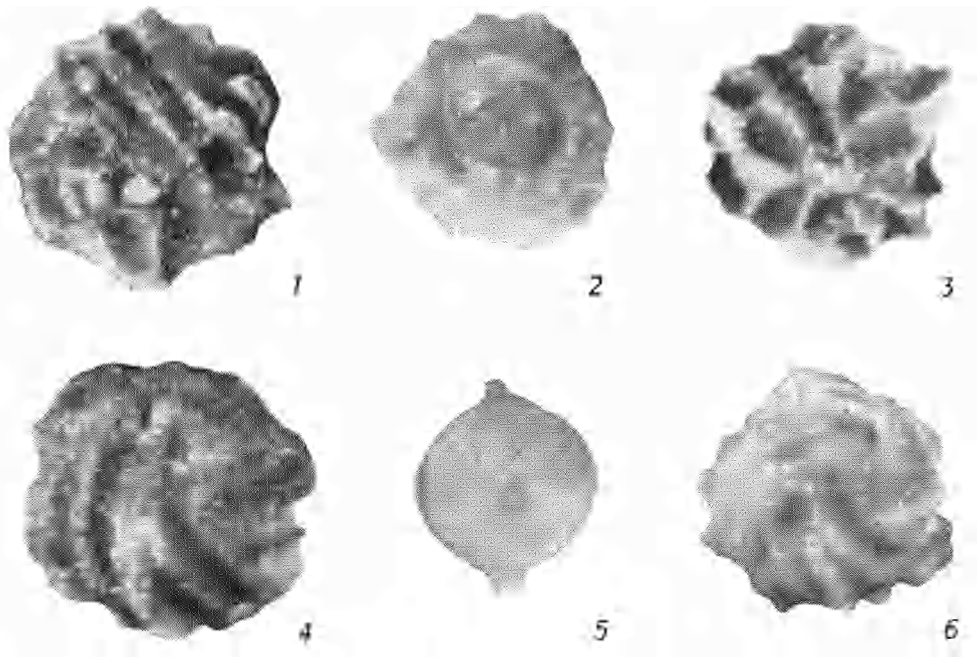
[16] RASKY K., *Fossile Charophyten. Früchte aus Ungarn*, « Magyor Nemzeti Mus. Naturw. », Mon. 2, 1–75, tav. 1–3, Budapest 1945.

[17] RASKY K., *New occurrence of* Atopochara trivolvis Peck *in Hungary*, « Földt Közl. », 461–463,3 figg., Budapest 1958.

[18] SERONIE–VIVIEN R., SENS J. and MALMOUSTIER G., *Contribution a l'étude des formations du Crétacé inférieur dans le bassin de Parentis (Aquitaine)*, « Mem. du Bureau de Rech. Géol. et Min. », Colloque sur le Crétacé inf. (Lyon, septembre 1963), *34*, 671–692, Paris 1965.

[19] SIRNA G., *Aptian* Charophyta *of Southern Latium*, « Geologica Romana », *2*, 279–290, 13 figg., Roma 1963.

[20] VAN BELLEN R. C., *On the presence of* Atopochara PECK *in the Lower Cretaceous of the Yebel Ansariyeh*, « The Micropal. », *2*, 4, 16, New York 1948.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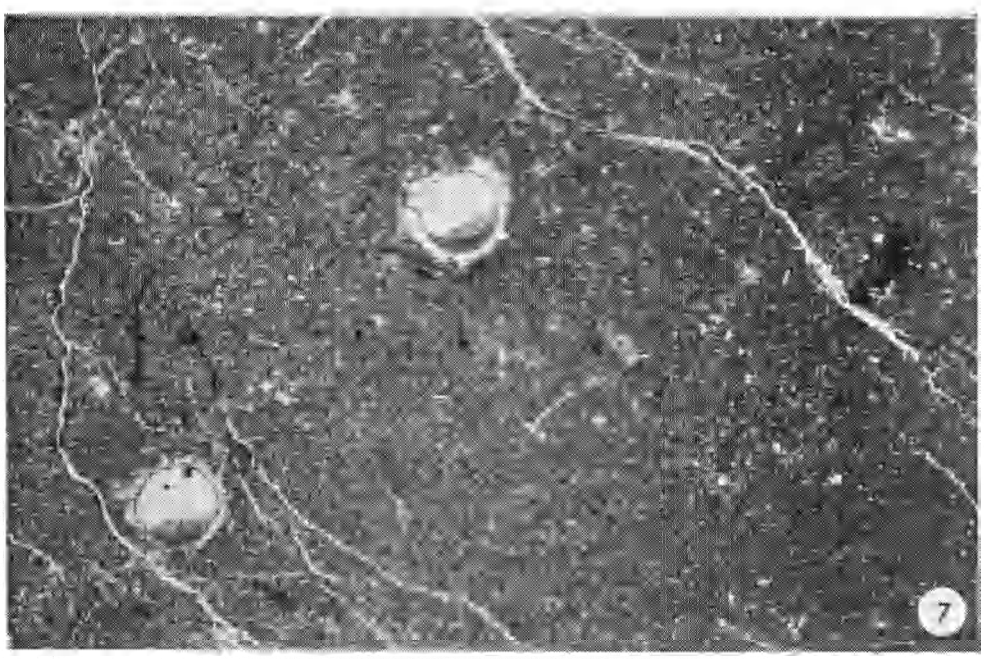
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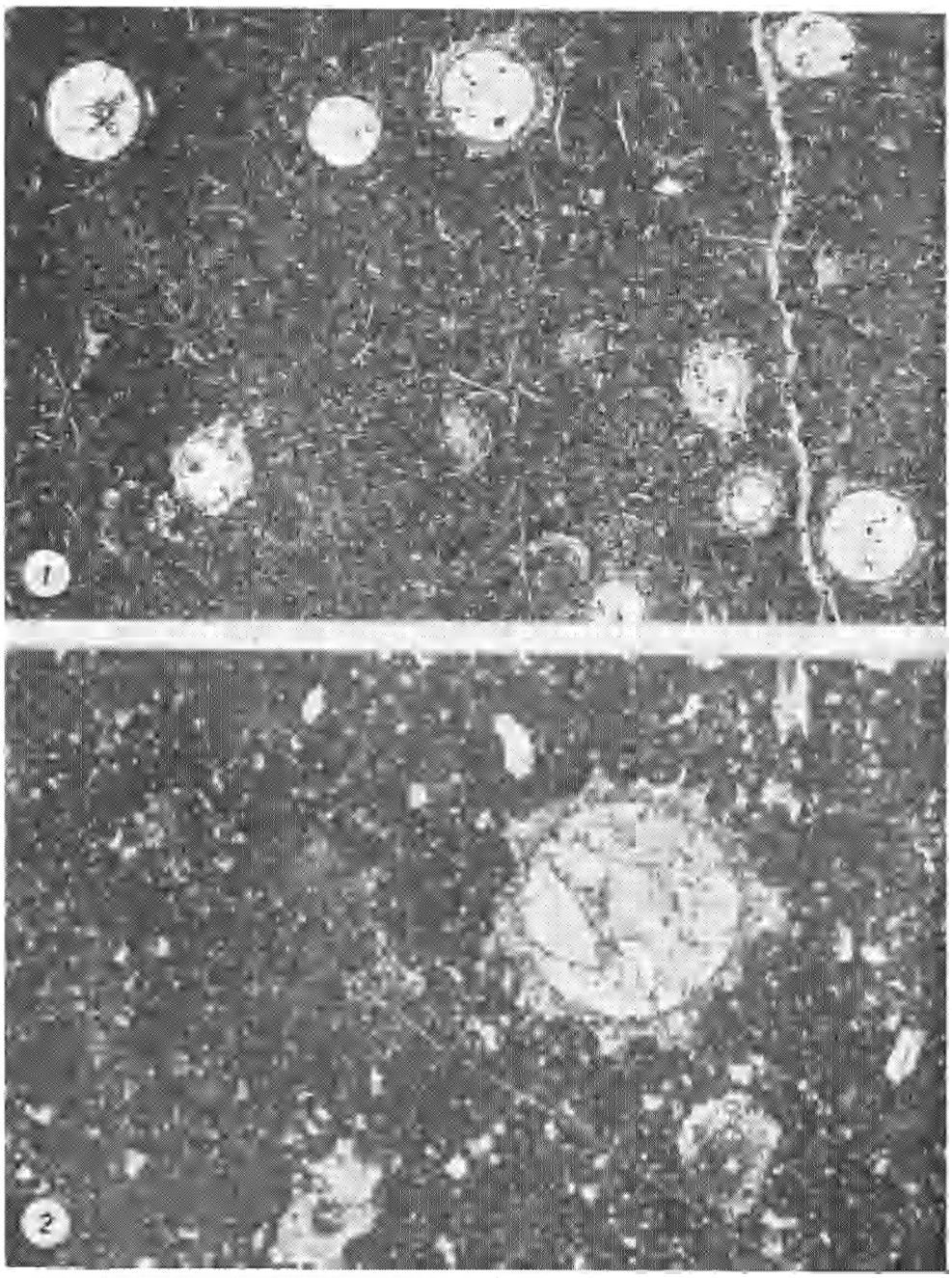
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EXPLANATION OF THE PLATES I–II

PLATE I.

Fig. 1. – *Atopochara trivolvis* Peck – Lateral view of the utricle characterized by spiral cells. Lekìci (Titograd). Aptian. ×30.

Fig. 2. – *Atopochara trivolvis* Peck – Exfoliated specimen showing the oogonium. Castro dei Volsci (Lepini Mountains) Aptian. ×30.

Fig. 3. – *Atopochara trivolvis* Peck – Basal view of the utricle; note the nine radial cells. Vuksan – Lekìci (Titograd). Aptian. ×30.

Fig. 4. – *Atopochara trivolvis* Peck – Summital view; note the spiral cells. Vuksan – Lekìci (Titograd). Aptian. ×30.

Fig. 5. – *Atopochara trivolvis* Peck – Lateral view of the separated oogonium; specimen from Lepini Mountains (Castro dei Volsci). Aptian. ×30.

Fig. 6. – *Atopochara trivolvis* Peck – Summital view; specimen from Lepini Mountains (Castro dei Volsci). Aptian. ×30.

Fig. 7. – Microfacies with two specimens of *Atopochara trivolvis* Peck. Note the internal oogonium and the geopetal structures inside the utricles. Meta–Positano road. Aptian. ×30.

PLATE II.

Fig. 1. – Microfacies with *Atopochara trivolvis* Peck and *Flabellochara harrisi* (Peck) (the more elongate ones). Santuario della SS. Trinità di Vallepietra (Simbruini Mountains) Aptian. ×25.

Fig. 2. – Microfacies with *Atopochara trivolvis* Peck. Vuksan – Lekìci (Titograd). Aptian. ×30.