Mineral Res. Expl. Bull., 108, 49-56, 1988

DASYCLADACEAN ALGAE FROM THE MESOZOIC CARBONATE FACIES OF THE SARIZ-TUFANBEYLİ AUTOCHTHON (KAYSERİ, SE TURKEY)

Baki VAROL* ; Demir ALTINER** and Yavuz OKAN*

ABSTRACT .— Some levels of the Mesozoic carbonates of the Sanz-Tufanbeyli area yield abundant dasycladacean algae which are useful parameters to define the chronostratigraphic position and depositional environment of these sequences. The following forms identified in the carbonate sequences of the Mesozoic are typical to subdivide these levels : *Griphoporella curuata* Gümbel, *Diplopora* sp. in the Upper Triassic; *Selliporella donzellii* Sartoni and Crescenti in the Dogger; *Macroporella sellii* Crescenti, *Clypeina jurassica* Favre and *Campbelliella striata* (Carozzi) in the Malm; *Salpingoporella annulata* Carozzi, *Salpingoporella steinhauseri* Conrad, Praturlon and Radoicic, *Salpingoporella pygmaea* (Gümbel), *Munieria baconica* (Carozzi), *Clypeina? solkani* Conrad and Radoicic in the Lower Cretaceous (Neocomian); *Salpingoporella dinarica* Radoicic, *Salpingoporella hasi* Conrad, Radoicic and Rey in the Aptian-Albian and *Heteroporella lepina* Praturlon in the Upper Cretaceous (Cenomanian). In addition to these forms, many other algal species have been sporadically recognized in these levels.

INTRODUCTION

In the eastern prolongation of the taurids, the autochthonous Mesozoic carbonates of the Sariz - Tufanbeyli region (Fig. 1), limited in the NW by Soğanlıdağ and in the SE by Binboğa Dagları, preserve their shallow water depositional characteristics in a 1000 to 1500 m thick sequence of Early Trjassic to Late Cretaceous age. The facies variations in this sequence were mostly controlled by movements of tides and sea level changes due to the epirogenic movements of the platform. In the time intervals when these movements were accelerated, sudden changes in the sea level and salinity variations cont-rolled the mechanism of dolomitization and highly limited the distribution of foraminifers. On the contrary, the dasycladacean algae showed an increase in abundance and became more frequent especially at Jurassic-Cretaceous boundary and in the Neocomian of the study area. In general, these units represented by the same environmental characteristics in the whole taurus carbonate platform, except few studies carried out up to now (Jaffrezo et al., 1978; Altıner and Septfontaine, 1979 ; Altıner and Decrouez, 1982), the absence of detailed studies on dasycladacean algae led to the incomplete interpretations on these units, treatment of the Neocomian as a whole, undivided chronostratigraphic unit and incomplete description of the Jurassic-Cretaceous boundary.

Approximately 100 samples coming from 11 stratigraphic sections (Fig. 2) measured in the autochthonous Mesozoic carbonates of the Sariz - Tufanbeyli region have been analyzed and dasycladacean algae have been identified. Nearly 30 species of dasycladacean algae have been listed in the strati graphic column according to the character of being biostratigraphic zonal marker or of local occurrence (Fig. 3).

GEOLOGIC SETTING

The studied Mesozoic unit belongs to the autochthonous Geyikdağı unit of Özgül (1976). The main unconformity surfaces recognized in the sequence He at Lower — Middle — Upper Triassic and Triassic — Jurassic (Dogger) boundaries. The unconformity observed within the Triassic system is only local importance. On the other hand, the unconformity seperating the Triassic and Jurassic systems is characteristic for whole region but difficult to observe because of local dolomitization. In the areas where the Jurassic seems to overlie the Permian, the boundaries are mainly tectonic in origin.

The continuous sedimentation through the Jurassic-Cretaceous boundary can only be followed in the areas where the interval corresponding to this boundary is not masked by dolomitization. The sedimentation of the Mesozoic sequence shows a hiatus between Cenomanian - Turonian and Santonian in the upper levels in the uppermost stages of the Upper Cretaceous, the carbonate sequence is either represented by rudistid or pelagic limestones depending on the variation in the paleogeographic setting of the region. In the studred carbonates, the fundemental geologic studies

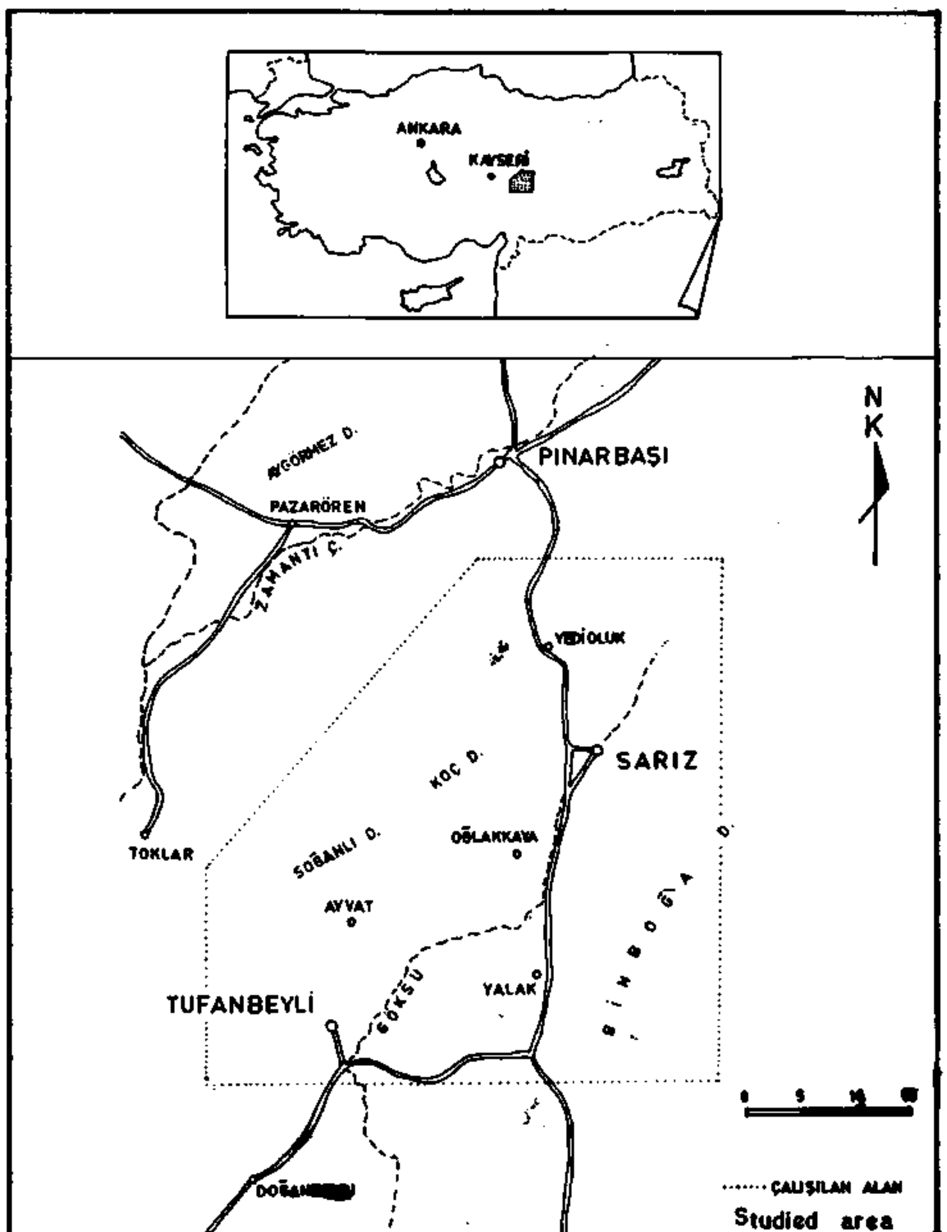

Fig.1 – Location map of the study area.

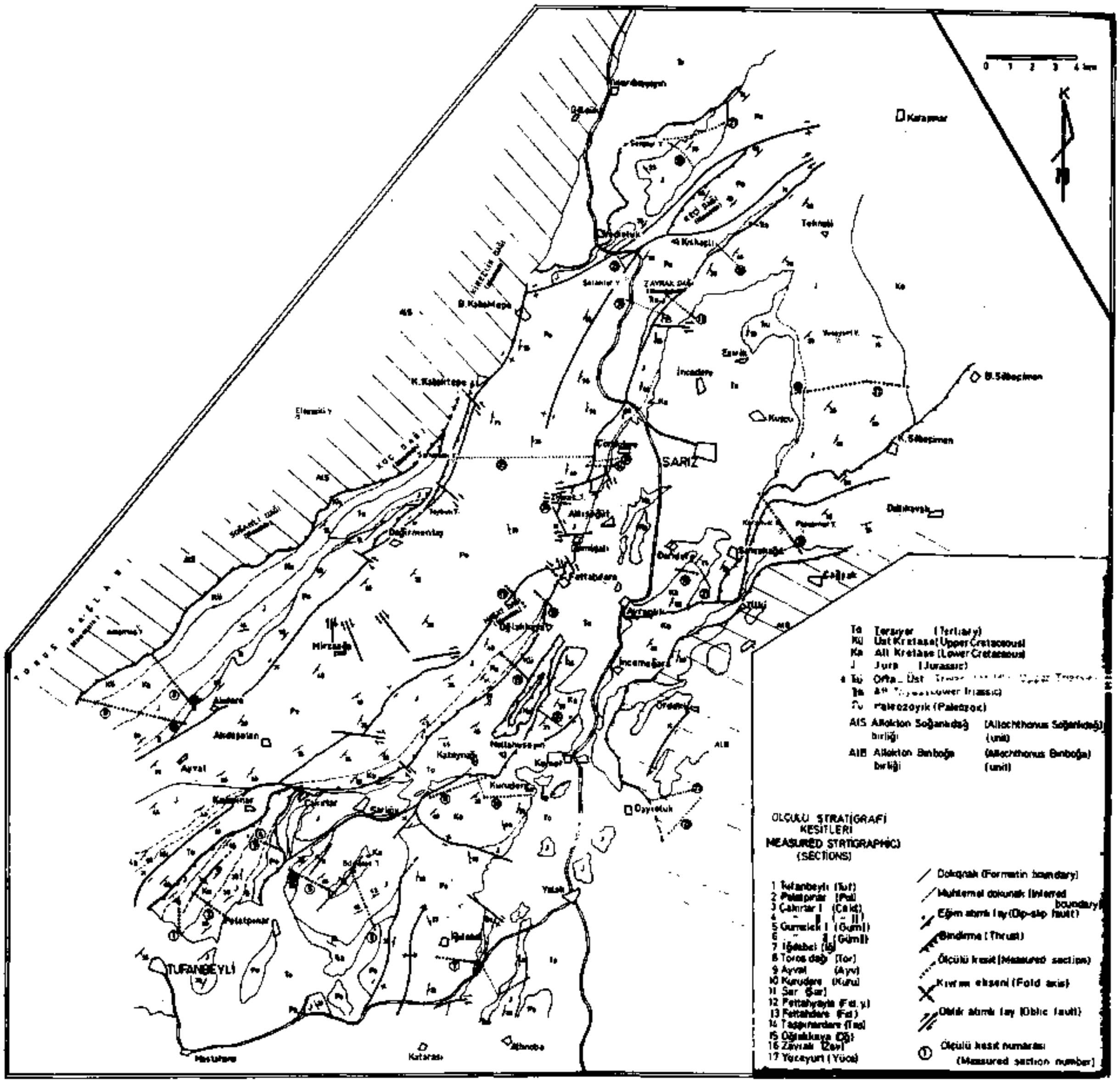

Fig.2— Location of the stratigraphic sections and generalized geologic map of the study area. Geologic map of the eastern part of the autochthonous Geyikdağı unit in the eastern taurids has been prepared after Özgül (1976) and Metin et al. (1982).

and lithostratigraphic subdivisions have been carried out for the first time by Demirtaşlı (1967). More recent studies, such as Metin et al. (1982) presented detailed maps and geological investigations of the area. The Jurassic - Lower Cretaceous limestones containing rich dasycladacean algal levels have been previously described as the Köroğlutepe formation (Demirtaşlı, 1967) or the Yüceyurt formation (Aziz-et al., 1980).

TRIASSICALGAE

The Lower Triassic carbonates of very shallow marine (infralittoral) character do not yield any dasycladacean algae. Although the Middle - Upper Triassic is also characterized by shallow water carbonates, the depositional characteristics differ from those of the Lower Triassic sequence. The dasycladacean algae and other bioclastic elements are found in the cavities of green algal biolithites or in the back-reef mudstones which were laid down in lagoonal environment of relatively normal marine conditions. *Griphoporella curvata* Gümbel and *Diplopora* sp. (Plate I, fig. 1,2) are the algal species recognized among the dasycladacean associations of the Upper Triassic.

JURASSIC ALGAE

In the Jurassic limestones, the dasycladacean algae are the major constituens of the lime -mudstone-wackestone and dolomitic mudstone facies. They constitute 4 important biostratigraphic zones and are associated with many species, some of which are recognized for the first time in the study area.

Selliporella donzellii .— Selliporella donzellii Sartoni and Crescenti is the major algal species recognized in the lowermost limestone levels of the transgressive Jurassic sequence. The presence of the species in two distinct textural types, such as lime-wackestone and grainstone, indicates variable energy conditions in a shallow littoral belt. The whole or fragmented nature of the specimens generally follow the character of the depositional texture (Plate I,fig. 3).

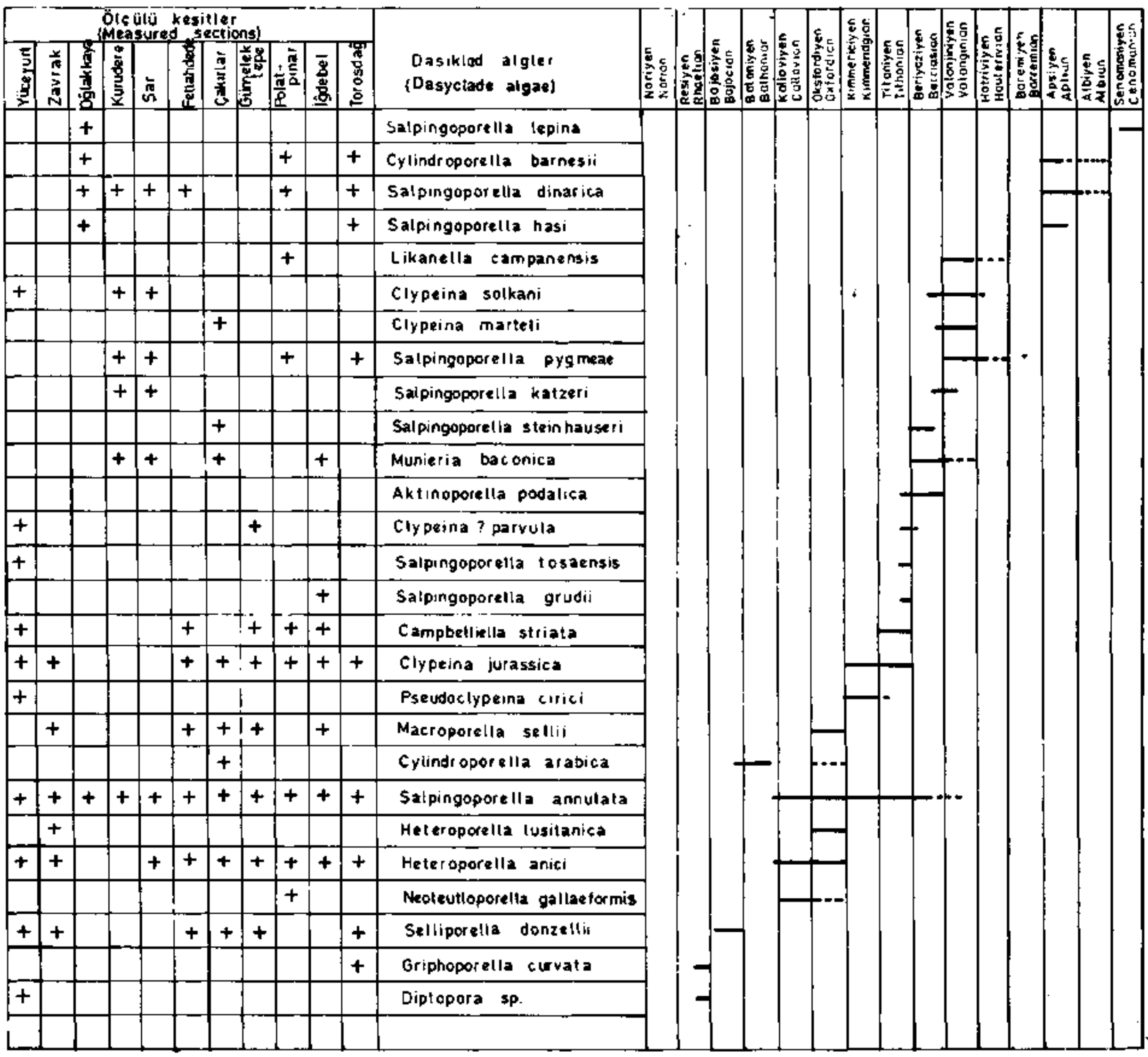

Fig.3— Mesozoic dasycladacean algal species and their stratigraphic distributions in the measured stratigraphic sections.

The levels containing *Selliporella donzellii* Sartoni and Crescenti have been defined for the first time in Turkey as the *Selliporella donzellii* Cenozone by Altıner and Septfontaine (1979) and these authors placed this zone in the Bajocian stage. The same zone has been previously recognized by Farinacci and Radoicic (1964) in the Lower Dogger of the apennines and dinarids in Europe. In the study area, the presence of *Teutloporella gallaeformis* Radoicic (Plate 1, fig.4) has been noted in the upper part of this zone. The typical examples of this form were reported from the Upper Dogger ?— Lower Malm sequences of Yugoslavia, Italy and Greece (Radoicic, 1964, 1966) and of the Katran Dağı (Antalya) in Turkey (Bassoulet and Poisson, 1975).

In the Çakırlar section, an interesting algal population has been recognized in the *Selliporella donzellii* zone. This population which has comparable dimensions to those of *Cylindroporella arabica* Elliott is found in association with some *Valvulina* sp., gastropods and plant roots in the dark coloured limestones deposited in reducing conditions (Plate I, figs. 5, 6). The absence of diagnostic marker fossils present some difficulties to determine the chronostratigraphic position of these levels since *Cylindropnrella arabica* Elliott has been usually noted from the Upper Jurassic sequences elsewhere. In the studied samples, the presence of *Mesoendothyra croatica* Gusic in the upper levels of *Cylindroporella arabica* bearing sequence indicates that the stratigraphic distribution of this form should be shifted to older chronostratigraphic levels. Probably represented in the Bajocian? — Bathonian stages this population has also been reported from the same chronostratigraphic levels by some previous studies (Elliott, 1975).

Macroporella sellii .— This form recognized in the algal - foraminiferal wackestones of the Lower Malm series has been used as the biostratigraphic zonal marker of the Lower Malm in apennines and dinarids (Sartoni and Crescenti, 1962; Nikler and Sokac, 1968; Velic, 1977). In the studied area, *Salpingoporella annulata* Carozzi and *Heteroporella anici* Nikler and Sokac are recorded in the Upper Bathonian substage, below this zone, and frequently found in the limestones limited at the top by the Kimmeridgran stage (Plate I, figs. 7, 8). In this zone, *Heteroporelta lusitanica* (Ramalho) and *Cylindroporella? arabicc* Elliott identified in the Zavrakdağı and Gümelektepe sections respectively, are the other important dasycladacean algal species noted in the region (Plate I, fig.9; Plate II, fig. 1).

Clypeina jurassica .— In the studied region, the *Clypeina jurassica* zone corresponds to the *Clypeina* cenozone of Altıner and Septfontaine (1979) and *"Clypeina jurassica* Favre bearing Kimmeridgian beds" of western taurids (Bassoulet and Poisson, 1975). In apennines and dinarids this form is used as biostratigraphic zonal marker in the recognition of the Upper Malm series (Sartoni and Crescenti, 1962; Farinacci and Radoicic, 1964; Nikler and Sokac, 1968; Gusic, 1969; Velic, 1977).

In the studied area, the limestones containing *Clypeina* are massive in character in the lower levels but later dark coloured, medium bedded, alternating with dolomites. An increase in the amount of algae and hydrozoa *(Cladocorapsis mirabilis* Felix) is observed in the levels which show a considerable increase in bed thickness and these levels are characterized by algal packstone facies. Associated with *Clypeina jurassica* Favre, *Pseudoclypeina cirici* Radoicic has been also frequently noted in several stratigraphic sections (Plate I, fig. 10).

Campbelliella striata .— *Campbelliella striata* (Carozzi), known as the diagnostic form of the Tithonian stage, has been used to define the uppermost Malm (Tithonian) zonal marker in apennines and dinarids (De Castro, 1962; Farinacci and Radoicic, 1964; Velic, 1977).

This zone, which also contains *Clypeina jurassica* Favre, is characterized by the formation of brecciation, internal cavities, vadose silt and intense bioturbation. The slow rate or discontinuities in sedimentation sometimes reflect the atmospheric influence. As in the whole Tethys region, in contrast to the rare occurrence of the foraminifers at Jurassic-Cretaceous boundary, a definite increase in the dasycladacean algae is noted by the appearance of the interesting algal species in the study area. In addition to *Campbelliella striata* (Carozzi) and *Clypeina jurassica* Favre, *Salpingoporella annulata* Carozzi recorded in all stratigraphic sections, *Salpingoporclla tosaensis* Yabe and Toyama, *Clypeme parvula* Carozzi, *Aktinoporella pudalica* Praturlon and Radoicic (Yüceyurt section), *Aktinoporella* sp. and *Salpingoporella* cf. *grudii* Conrad, Praturlon and Radoicic (İğdebel section) are the most frequently observed forms (Plate II, figs. 2-6).

LOWER CRETACEOUS ALGAE

Neocomian

It is quite difficult to draw the Jurassic-Cretaceous boundary because of dolomitization and facies similarities of the limestones. In dolomitized Upper Jurassic and Lower Cretaceous series it is quite impossible to recognize the Jurassic and Cretaceous systems. However, in the dolomitic limestone lithologies intercalated within the dolomites, the original texture is partially preserved and the facies analysis make the recognition of this boundary possible. The dasycladacean algae are the most important elements in the recognition of these facies because the textural properties of the limestones are highly monotonous at Jurassic - Cretaceous boundary. Two main dasycladacean groups whose definitions are given below are used to define the lowermost Cretaceous and subdivide the Neocomian.

Salpingoporella annulata - Munieria baconica . — The most remarkable facies types at Jurassic - Cretaceous boundary are the laminated blue-green algal mudstones, coprolithic packstones and dolomites intercalated with the typical Upper Jurassic algal mudstone-wackestone facies. Following the rapid disappearance of *Clypeina jurassica* Favre, *Campbelliella striata* Carozzi, new dasycladacean algal species accompanied by *Salpingoporella annulata* Carozzi indicate the presence of the Berriasian stage. These species show some differences in distribution in the different stratigraphic sections. Among these, *Munieria baconica* (Carozzi), *Aktinoporella podalica* Praturlon and Radoicic and *Clypeina* sp. in the pelletic mudstones of the İğdebel, Çakırlar, Kurudere and Şar sections (Plate II, figs. 7-9), *Clypeina? solkani* Conrad and Radoicic and *Salpingoporella katzeri* Conrad and Radoicic in the section (Plate II, fig. 10; Plate III, fig. 6) and *Salpingoporella steinhauseri* Conrad, Praturlon and Radoicic in the dolomitic mudstone facies of the Çakırlar section (Plate III, figs. 1-3) yield many characteristic sections. *Salpingoporella steinhauseri* Conrad, Praturlon and Radoicic is an imfportant chronostratigraphic marker of the Middle Berriasian in France and Switzerland (Conrad et al., 1973).

Salpingoporella pygmaea. — The lime-mudstone-wackestone facies, characteristic and frequent in the lower part of the Neocomian are overlain by a new facies belt characterized by pelletic and intraclastic grainstones. The most frequent dasycladacean algal species recognized in the grainstone facies is *Salpingoporella pygmaea* (Gümbel) and this form is usually accompained by *Salpingoporella katzeri* Conrad and Radoicic which has already appeared in the underlying mudstone facies (Plate HI, figs. 4-6). This assemblage and the other dasycladacean algal species identified in the various stratigraphic sections of the study area indicate that this sequence is in Valanginian - Hauterivian age. The other accompanying species recognized in the study of stratigraphic sections are *Likanella campanensis* Azema and Jaffrezo (Polatpınar section), *Clypeina marteli* Emberger and *Linoporella?* sp. (Kurudere and Şar sections) (Plate III, figs. 7-10; Plate IV, fig. 1). Among these, *Salpingoporella katzeri* Conrad and Radoicic and *Clypeina marteli* Emberger are the diagnostic fossils of the Berriasian-Valanginian strata in Yugoslavia and Switzerland (Conrad and Radoicic, 1978).

The algal species found in the grainstone facies dissappear in the Barremian and dismicritic mudstone facies rich in algal structures of schizophytoid type become predominant in this stage.

Aptian - Albian

The Aptian and Albian stages are recognized by a thick sequence of frequently occuring blue-green algae lamination and stramatolithic limestones. These facies are usually intercalated with miliolid packestone-grainstone and dasycladacean algae mudstone - wackestone facies whose definition is given below. The overall facies characteristics generally reflect an intertidal-supratidal depositional environment.

Salpingoporella dinarica.— In the eastern taurids, the presence of this algal species has been recognized by Altıner(1981) and later Altıner and Decrouez (1982) defined this form and the accompanying foraminiferal species *Vercorsella scarsellai* (De Castro) as the zonal markers in this belt. The same zone has been previously introduced in Italy and dinarids as corresponding to the Barremian and Lower Aptian stage and substage (Chiocchini et al., 1979; Velic, 1977). In the study area this form has been found together with an assemblage which mainly characterize the Aptian stage. It is usually accompanied by *Salpingoporella hasi* Conrad and Radoicic?*Salpingoporella melitae* Radoicic, *Cylindroporella barnesii* Johnson, *Acicularia antiqua* Pia and the problematic and complex *Bacinella irregularis* Radoicic (Plate IV, figs. 2-7).

UPPER CRETACEOUS ALGAE

In the studied Upper Cretaceous units, the dasycladacean algae have been identified only in one level of the brecciated limestones of the Oğlakkaya section. In this facies, accompained by *Cuneolina pauonia* d'Orbigny, *Heteroporella lepina* Praturlon is easily identified by its typical yellowish calcareous wall. In Apennines and Yugoslavia, this form has been reported from the Cenomanian - Turanian stages (Praturlon, 1966; Berthou and Poignant, 1969).

CONCLUSIONS

By the study of many samples collected from the Mesozoic autochthonous sequence of the Sanz - Tufanbeyli region (Geyikdağı unit), several dasycladacean algal species have been identified in the platform deposits and these identifications made the recognition of the Jurassic-Cretaceous boundary and the subdivision of the Neocomian possible. Thus, in the subdivision of the Neocomian which is considered to be an undivided series in the Taurids, the use of dasycladacean algae seems to be an excellent tool.

ACKNOWLEDGEMENTS

This study is a part of a TÜBİTAK Project (TBAG-613). The authors would like to thank to Assistant Prof. Dr. Nizamettin Kazancı for his contributions during the field and to Dr. Marc A. Conrad for his help in the identification of the dasycladacean algae.

Manuscript received September 11, 1986

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P L A T E S

PLATE -1

Fig.1— *Griphoporella curvata* Gümbel, Toros dağı section, Tor. 7, X 40.

Fig.2- *Diplopora* sp.. Yüceyurt section, Yü.18, X 10.

Fig.3— *Selliporella donzellii* Sartoni and Crescenti, Zavrak dağı section, Zav. 11a, X 40.

Fig.4— *Teutloporella gallaeformis* Radoicic, Polatpınar section, Pol. 2, X 30.

Fig.5 and 6— *Cylindroporella arabica* Elliott, Çakırlar section, Ça.11, Ça.12, X 40.

Fig.7— *Macroporella sellii* Crescenti, Taşpınar section, Taş.39, X 40.

Fig.8— *Heteroporella anici* Nikler and Sokac, Gümelek Tepe section, Gü. 29a, X 30.

Fig.9— *Heteroporella lusitanica* (Ramalho), Zavrak dağı section, Zav.16, X 40.

Fig.10— *Pseudoclypeina cirici* Radoicic, Yüceyurt section, Yü.44, X 30.

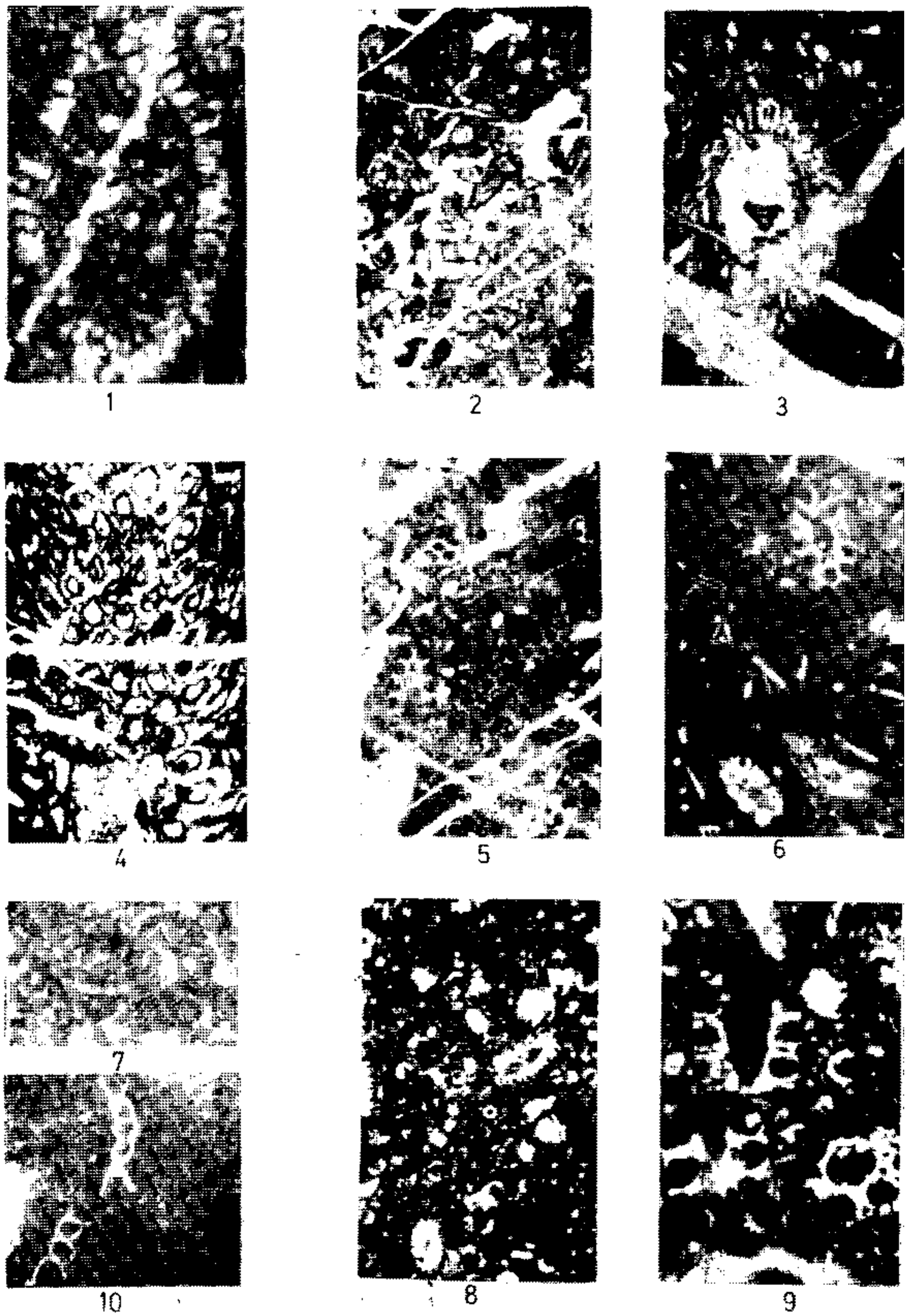
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PLATE - II

Fig.l— *Cylindroporella ? arabica* Elliott, *Salpingoporella annulata* Carozzi, Gümelek tepe section, Gü.29, X 3

Fig.2— *Clypeina jurassica* Favre, Çakırlar section, Ça.21, X 100.

Fig.3— *Campbelliella striata* (Carozzi), *Clypeina jurassica* Favre, *Salpingoporella annulata* Carozzi, İğdebel section, İğ.90, X 20.

Fig.4— *Salpingoporella tosaensis* Yabe and Toyama, Yüceyurt section, Yü.64, X 10.

Fig.5— *Clypeina jurassica* Favre, *Clypeina parvula Carozzi, Aktinoporella podalica* Praturlon and Radoicic, Yüceyurt section, Yü.64a, X 10.

Fig.6— *Salpingoporella* cf. *grudii* Conrad, Praturlon and Radoicic, İğdebel section, İğ.92, X 40.

Fig.7— *Munieria baconica* (Carozzi), İğdebel section, lg.93a, X 30.

Fig.8— *Clypeina* sp., İğdebel section, İğ.93a, X 40.

Fig.9— *Aktinoporella podalica* Praturlon and Radoicic, İğdebel section, lg.93a, X 30.

Fig.10— *Clypeina ? solkani* Conrad and Radoicic, Kurudere - Şar section, Şar. 18, X 30.

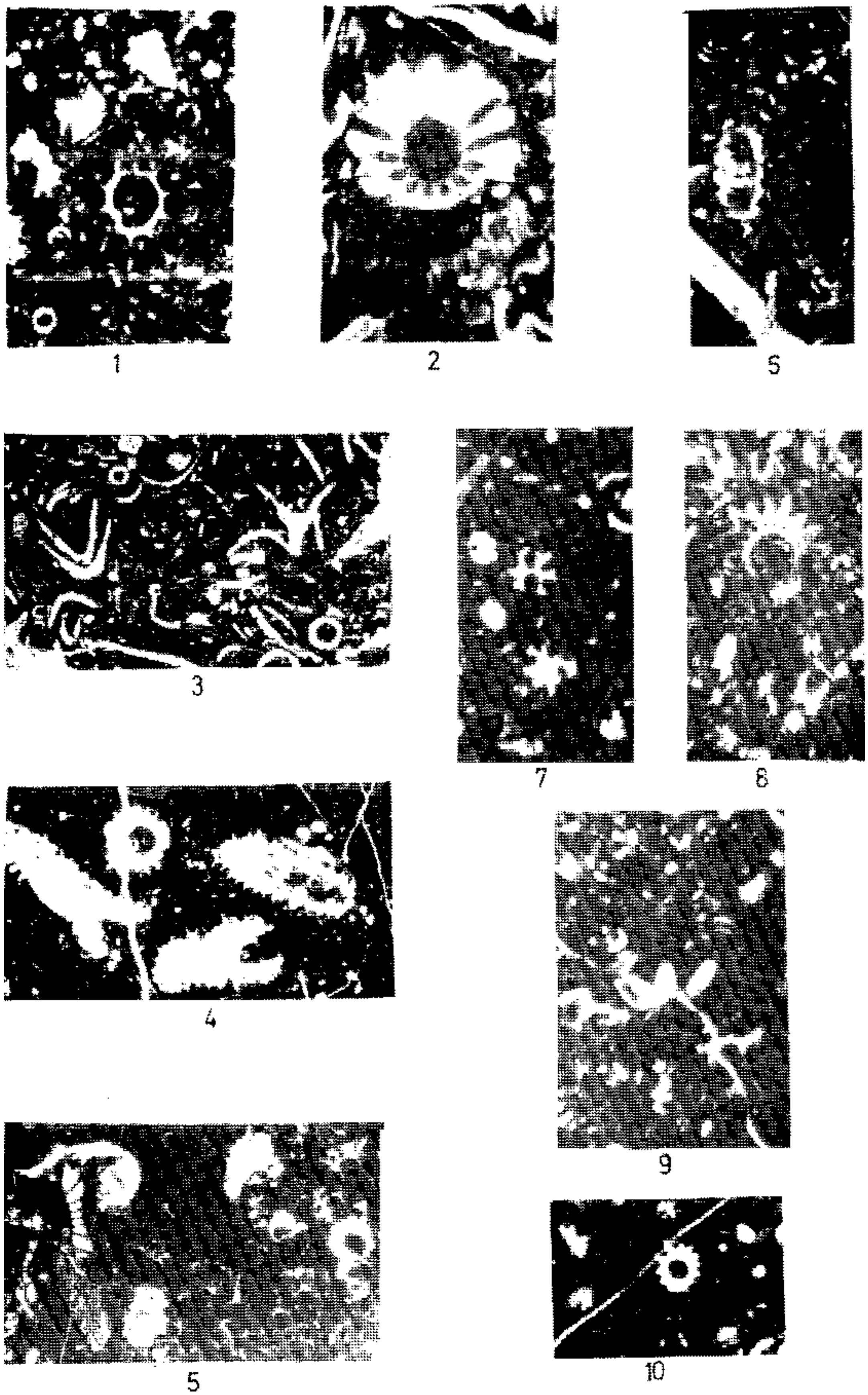
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PLATE - III

Fig.1,2 and 3— *Salpingoporella steinhauseri* Conrad, Praturlon and Radoicic, *Salpingoporella annulata* Carozzi, Çakırlar section, ga.26, X 100.

Fig.4 and 5— *Salpingoporella pygmaea* (Gümbel), Polatpınar section, Pol.32 and 33, X 100.

Fig.6— *Salpingoporella ? katzeri* Conrad and Radoicic, Kurudere - Şar section, Şar.12, X 40.

Fig.7— *Clypeina marteli* Emberger, Kurudere - Şar section, Kur.13, X 50.

Fig.8— *Linoporella* sp., Kurudere - Şar section, Kur.13a, X 40.

Fig.9 and 10— *Likanella campanensis* Azema and Jaffrezo, Polatpınar section, Pol.32 and 33, X 50.

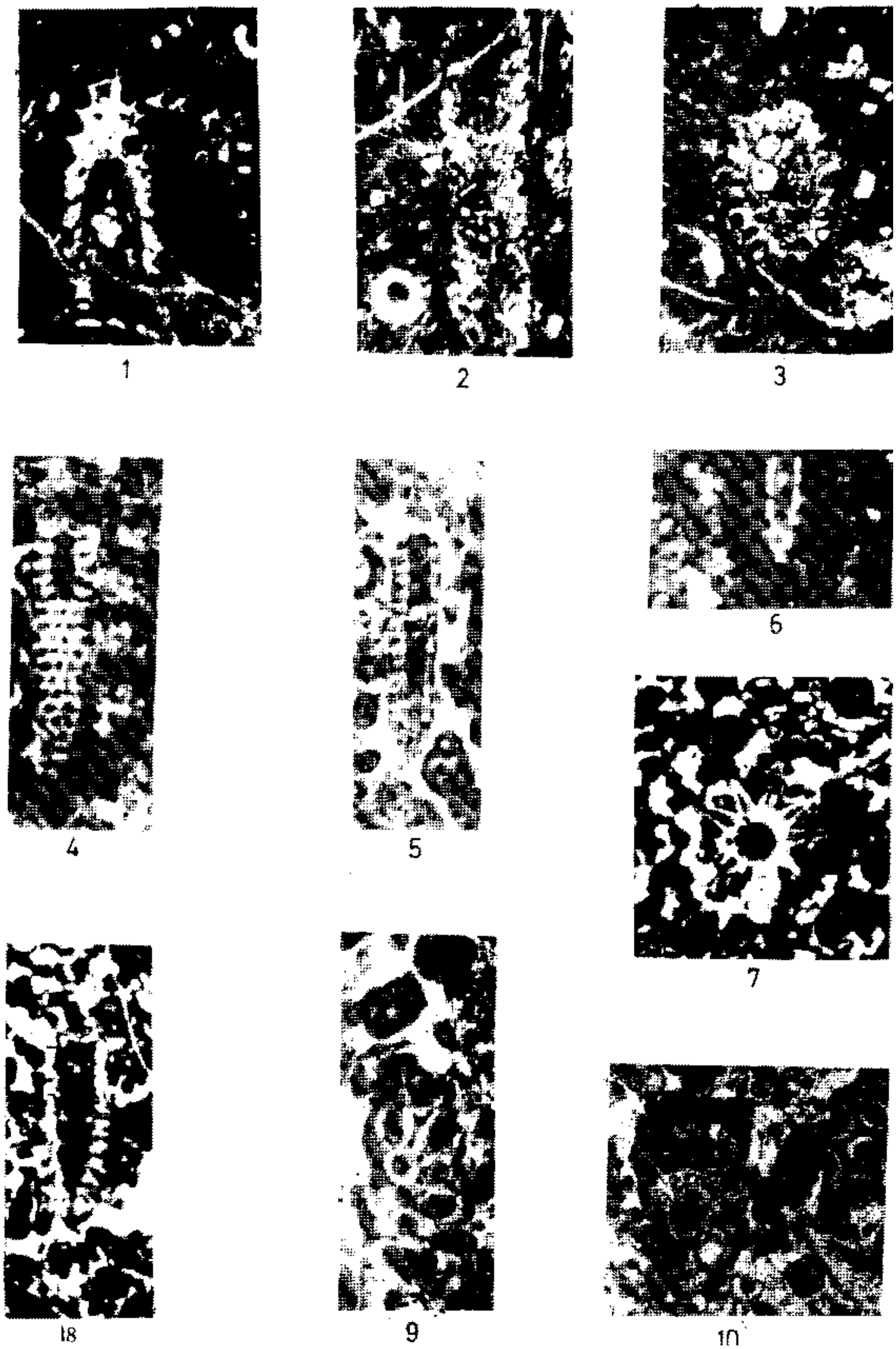
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PLATE - IV

Fig.1— *Salpingoporella pygmaea* (Gümbel), Kurudere - Şar section, Kur.13, X 40.

Fig.2— *Salpingoporella dinarica* Radoicic, Toros dağı section, Tor.72, X 10.

Fig.3 and 4— *Salpingoporella hasi* Conrad, Radoicic and Rey, Oğlakkaya section, Oğ.19, X 70.

Fig.5— *Cylindroporella barnesii* dohnson, Oğlakkaya section, Oğ.40, X 70.

Fig.6— *Salpingoporella ? melitae* Radoicic, Toros dağı, section, Tor.72, X 70.

Fig.7— *Acicularia antiqua* Pia, Toros dağı section, Tor.74, X 30.

Fig.8— *Heteroporella lepina* Praturlon, Oğlakkaya section, Oğ.10, X 30.

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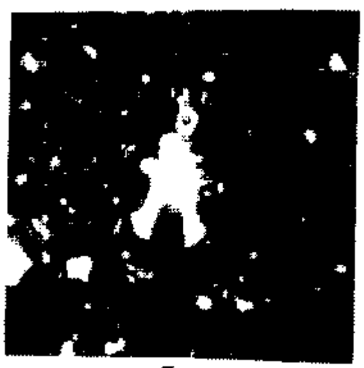

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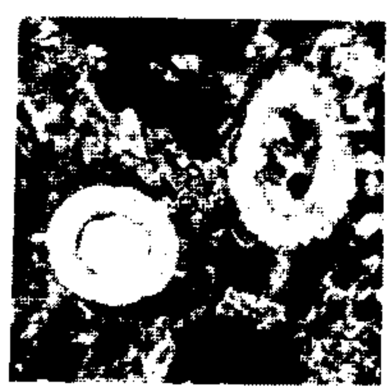

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