DISCOASTERIDAE IN THE BARRACOUTA ~~A - 1 WELL,~~ GIPPSLAND BASIN, AUSTRALIA.

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A B S T R A C T .

Ten main species of the Discoasteridae, of which three are new, have been considered in the Barracouta A - 1 well, Gippsland basin, Australia. Six informal biostratigraphic zones based entirely on the Discoasteridae have been established for the Oligocene and Miocene sediments.

I N T R O D U C T I O N .

Calcareous nannoplankton attain an important role in the biostratigraphic zonation all over the world. The Discoasteridae as a group has proved their values in such zonation. Many papers have been written concerning the calcareous nannoplankton in which an important part has been devoted to this group. Here it is sufficient to mention only few of them, e. g. Bramlette and Riedel (1954), Martini (1958, 1960, 1961), Stradner (1958, 1959, 1961), Stradner and Papp (1961), Bramlette and Sullivan (1961), Sullivan (1964, 1965), Levin and Joerger (1967), Stradner and Edwards (1968).

Glaessner (1963) has mentioned the occurrence of the Discoasteridae in New Guinea. The writer has stressed the significance of the calcareous nannoplankton in general, for the Tertiary biostratigraphic zonation in Australia, which of course includes also the Discoasteridae (Rade, 1969a, b, c, d, 1970 a, b, c, d), and also for New Guinea (Rade, 1970b).

Discoasteridae are favourable for the biostratigraphic zonation purposes because of their comparatively large size (10 - 25 μ), ubiquity and in their constancy in the percentage frequencies in the Tertiary sediments in the Australian - New Guinea - Far East and New Zealand region.

Barracouta A - 1 well is the discovery well

for the hydrocarbons in the Gippsland basin, Australia, and it is located on the latitude 38°16'41''S and longitude 147°42'45''E.

Kind permission to use the core samples of the Barracouta A - 1 well was granted by Esso Exploration Australia, Inc. and these samples were supplied by Victorian Mines Department. Gratitude for this is especially expressed to Dr. D. Spencer - Jones, Director of Geological Survey of Victoria and Mr. J. H. Hafenbrack, Esso Standard Oil (Australia) Ltd.

PRESERVATION AND AMOUNT OF DISCOASTERIDAE.

Preservation of the Discoasteridae was satisfactory for the present purposes. However, in the amount of the specimens, they are not so rich as the Discoasteridae from the same strata in the Otway basin. The amount of the specimens in the Barracouta A - 1 well can be compared approximately with the offshore area from eastern Queensland, i. e. Capricorn 1A (latitude 22°42'14''S and longitude 152°16'55''E) and Aquarius 1 (latitude 22°37'13''S and longitude 152°39'2''E) wells (Rade, 1970 d). It even looks that the overall amount of the specimens of the Discoasteridae is greater in the Marlin A - 1 (latitude 38°14'03''S and longitude 148°13'33''E), which is located 28 miles to the east of the Barracouta A - 1 well.

The small amount of the specimens present of the Discoasteridae in the Barracouta A - 1 well can be explained in twofold manner :

1) Fast rate of sedimentation

2) Occurrence of regressions.

The rate of sedimentation has been fast in the Miocene, where the overall amount of the specimens of the calcareous nannoplankton is small (Rade, 1970 d). There is only one exception in the Miocene and it is in the core 7

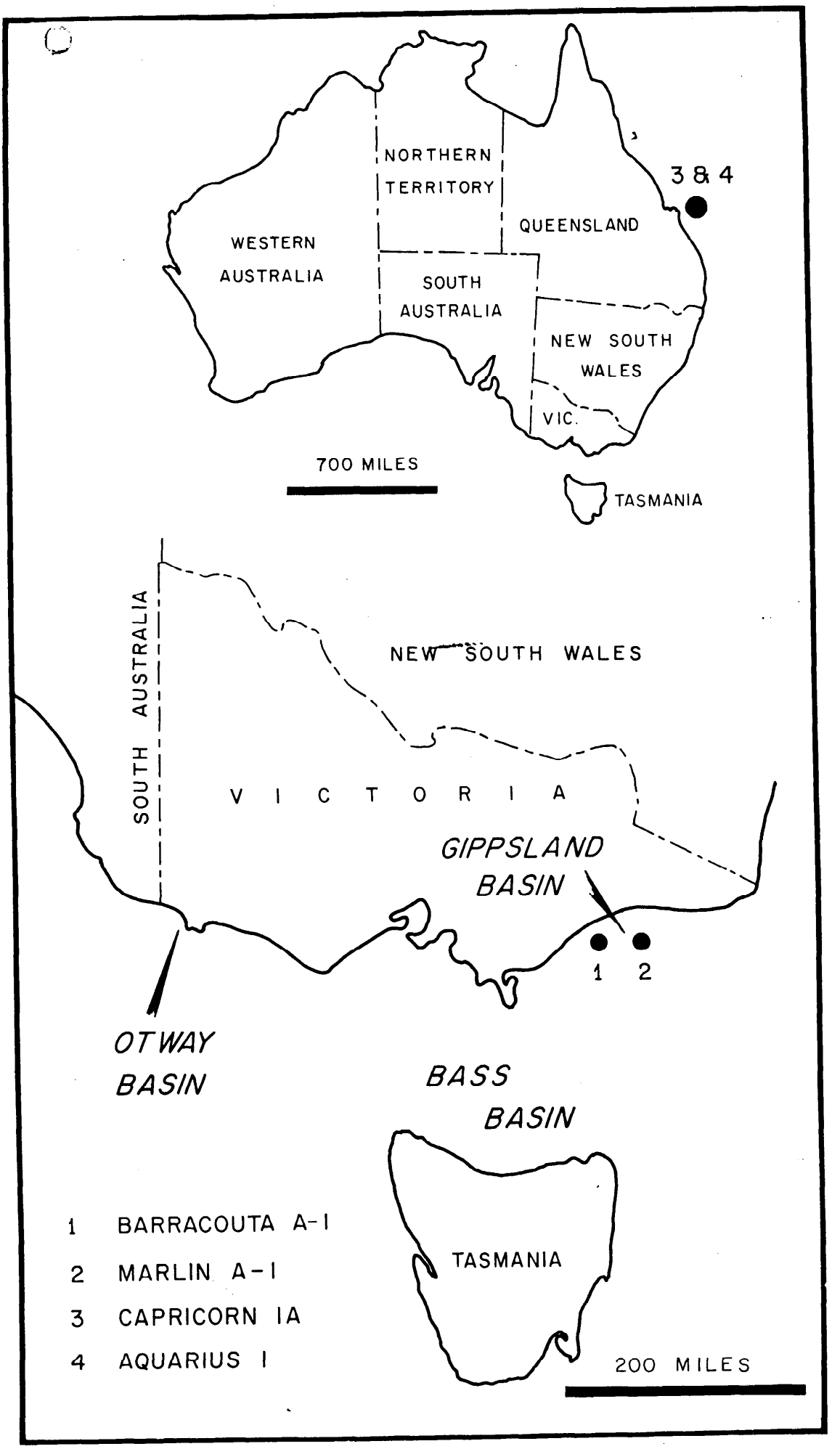
(3020 feet to 3050 feet depth) in this well which contain considerably large amounts of the Discoasteridae, in this manner of their occurrence more or less resembling the Pliocene sediments in the area offshore from the eastern Queensland, i. e. Capricorn 1A and Aquarius 1 wells (Rade, 1970c).

It has been worked out by THE RADE STRATIGRAPHIC LABORATORY that the regressions of the sea are characterized by the predominance of the Coccolithophoridae (Rade, 1970d). The same can be applied also to the Barracouta A - 1 well, where the Discoasteridae are not represented in the Upper Miocene core 1 (at 1010 feet depth) and the core 2 (1501 feet depth), which has been stressed already elsewhere by the writer (Rade, loc. cit.).

S T R A T I G R A P H Y A N D P A L E O N T O L O G Y .

Taylor (1966) has established the stratigraphic sequence based on the Foraminifera in the Barracouta A - 1 well. Eight cores and one sidewall core have been investigated on the Discoasteridae from this well which embraces the time interval from the Oligocene to the Upper Miocene (from 1010 feet to 3760 feet depth). The age of these strata obtained by the investigations of the calcareous nannoplankton agrees with the age given to them for the abovementioned time interval by Taylor (loc. cit.).

Only the main species of the Discoasteridae, which bear significance for the biostratigraphic zonation of the other Tertiary areas in Australia, have been choosen in the present paper. Six species are characteristic for the Oligocene strata in Australia, which are Discoaster sp. A, D. musicus Stradner, D. sp. B, D. gemmifer Stradner, D. sp. C and D. trimus Stradner. The other four remaining species of the Discoasteridae - Discoaster challengeri Bramlette and Riedel, D. brouweri (Tan), D. molengraaffi Tan Sin Hok, and D. deflandrei Bramlette and Riedel have been encountered in the Miocene strata in this well. The lastmentioned species occur also in the Oligocene in the same well.


NORTHERN TERRITORY
QUEENSLAND
WESTERN AUSTRALIA
SOUTH AUSTRALIA
NEW SOUTH WALES
VIC.
3 & 4
700 MILES
TASMANIA
SOUTH AUSTRALIA
NEW SOUTH WALES
V I C T O R I A
GIPPSLAND BASIN
1
2
OTWAY BASIN
BASS BASIN
TASMANIA
200 MILES
1 BARRACOUTA A-1
2 MARLIN A-1
3 CAPRICORN IA
4 AQUARIUS 1

D I S C U S S I O N .

Discoaster gemmifer Stradner, and D. trinus Stradner and D. sp. C are characteristic for the lower portion of the Oligocene represented by the sidewall core from 3750 feet to 3760 feet depth. The greatest percentage, attaining 30 % of the total amount of the Discoasteridae , posseses Discoaster gemmifer Stradner. This species has been proved to be significant for the lower portion of the Upper Oligocene in the Otway basin.

D. trinus Stradner which makes out 18 % of the total - is also a significant form for the Oligocene. Levin and Joerger (1967, p. 173) have stated that this species occurs from the Middle Eocene to the Middle Oligocene of Alabama, U. S. A. This species has been encountered in the Upper Oligocene in the Otway basin, where it marks a distinctive horizon. D. sp. C has been encountered only in 6 % of the total in the sidewall core from 1750 feet to 1760 feet depth.in the Barracouta A - 1 well.

D. sp. A represents a species which in the Australian Tertiary commonly has been encountered in the Oligocene. This species constitutes 17 % of the total in the same sidewall core.

D. deflandrei Bramlette and Riedel is a longranging species which has been reported also from the Lower Miocene of California. This species occurs from the core 3 (2024 feet to 2037 feet depth) , except the core 7 (3020 feet to 3050 feet depth), until the side wall core from 3750 feet to 3760 feet depth in the Barracouta A - 1 well.

It is interesting to mention here that in the Oligocene sediments in this well the percentage of this species is very constant being 29 % in the sid wall core from 3750 feet to 3760 feet depth and 28 % in the core 8 (3342 feet to 3352 feet depth). Higher up in the well sequence in the core 6 (2876 feet to 2896 feet depth) the percentage of D. deflandrei Bramlette and Riedel has not changed very much , making out 25 % of the total amount of the Discosteridae[a/]. The greatest percentage of this species has

been encountered in the core 5 (2630 feet to 2655 feet depth) where it constitutes 64 % of the total amount of the Discoasteridae. Higher up in this well the variations of the percentages of this species are not large being 50 % in the core 4 (2325 feet to 2351 feet depth) and 60 % in core 3 (2024 feet to 2037 feet depth).

It is further interesting to note that D. sp. A shows nearly the same percentage in the core 8 as in the sidewall core from 3750 feet to 3760 feet depth, where it is 17 % and 15 % respectively. Considering the fact that the percentages of Discoaster deflandrei Bramlette and Riedel and D. sp. A are nearly similar in each respect in the both abovementioned cores, and also considering the lithology of these cores investigated which consists in the both cores of grey shale, then it looks from the first sight, that the same [illegible] horizon [illegible] has been represented in the both these cores . However, this is not the case, because the other species of the Discoasteridae encountered are quite different in both these cores which characterizes them as being very distinct and located in completely different biostratigraphic zones of the Oligocene.

Discoaster sp. B and D. musicus Stradner represent the distinctive discoasterid species which distinguish the both abovementioned Oligocene cores from each other. 16 % of D. sp. B and 41 % of D. musicus Stradner have been encountered in the core 8. Stradner (1961, p. 85 and Bapp/) havementioned D. musicus Stradner for the Lower Tortonian in [illegible] Europe. D. sp. B is very characteristic for the uppermost portion of the Upper Oligocene in the Otway basin. The present writer accepts D. sp. B as an intermediate form between D. deflandrei Bramlette and Riedel and D. challengeri Bramlette and Riedel .

D. challengeri Bramlette and Riedel is characteristic for the Tertiary sediments. D. deflandrei Bramlette and Riedel commences in New Zealand in the Oligocene (Stradner and Edwards, 1968). The same occurrence for this species has been observed in Australia, where the Oligocene forms are characterized by a well expressed central knob.

D. challengeri Bramlette and Riedel together with D. brouweri (Tan) and D. molengraaffi Tan Sin Hok are characteristic for the Miocene sediments. D. challengeri Bramlette and Riedel has been found in three cores in the Barracouta A - 1 well, i. e. 4, 5 and 7. The greatest percentage of this species - 76 % has been encountered in the core 7. The core 5 contains 36 % and the core 4 - 50 % of this species of the total amount of the Discoasteridae. in each core.

D. challengeri Bramlette and Riedel together with D. molengraaffi Tan Sin Hok are both fairly well represented in the Miocene cores in the Barracouta A - 1 well. The last species even appears higher up than the first one, i. e. in the core 3. D. molengraaffi Tan Sin Hok attains its greatest percentage in the core 6, represented by 50 % of the total amount of the Discoasteridae. This species has not been found in the cores 5 and 4; it makes out 40 % in the core 3.

Interesting is the occurrence of D. brouweri (Tan), which is comparatively poorly represented in the Barracouta A - 1 well. It attains only 4 % in the core 7. The percentage of this species increases suddenly to 25 % in the core 6. D. brouweri (Tan) appears only in the both abovementioned cores and is missing in the higher located cores in the Miocene sediments in the Barracouta A - 1 well. This is in a sharp contrast with the occurrence of this species observed in the area offshore from the eastern coast of Queensland, where it is much more represented.

B I O S T R A T I G R A P H I C Z O N A T I O N .

Discoasteridae can be used for the biostratigraphic zonation purposes in the Australian Tertiary sediments. Basing on the data in this line obtained from other Australian Tertiary areas, than only the offshore portion of the Gippsland basin, by THE RADE STRATIGRAPHIC LABORATORY, then the Oligocene and the Miocene sequences in the Barracouta A - 1 well as discussed in the present paper can be subdivided into six provisional informal biostratigraphic zones based on distinctive assemblages of the Discoasteridae.

On the basis of the Discoasteridae the Oligocene sequence in the Barracouta A - 1 well can be divided into two biostratigraphic zones. The lower one - zone I, is characterized by the Discoaster gemmifer - D. trinus assemblage being represented by the sidewall core from 3750 feet to 3760 feet depth. The accessory species of the Discoasteridae are Discoaster sp. C, D. deflandrei Bramlette and Riedel and D. sp. A.

The next higher one - zone II, is characterized by D. sp. B - D. sp. A assemblage expressed in the core 8, the other species being D. musicus Stradner and D. deflandrei Bramlette and Riedel.

The Miocene sediments in the Barracouta A - 1 well contain four biostratigraphic zones based on the Discoasteridae. The first lower one in the Miocene - the biostratigraphic zone III, is characterized by the D. challengeri - D. brouweri assemblage represented by the core 7. The other species is D. molengraaffi Tan Sin Hok. The higher next one in the Miocene - zone IV is characterized by the D. deflandrei - D. brouweri - - D. molengraaffi assemblage represented by the core 6.

The cores 5 and 4 belong to the biostratigraphic zone V, characterized by the D. deflandrei - D. challengeri assemblage.

The core 3 represents the biostratigraphic zone VI characterized by the D. deflandrei - D. molengraaffi assemblage.

Of course, here should be pointed out, that much more detailed biostratigraphic zonation can be carried out in the Gippsland basin in the case if the Discoasteridae are used together with the Braarudosphaeridae and Coccolithophoridae. However, Taylor (1966) has subdivided the stratigraphic sequence in the Barracouta A - 1 well from the core 3 to the core 7 only in three biostratigraphic units - zonules, but using the Discoasteridae for the same purpose, subdivision into four biostratigraphic units has been achieved.

The biostratigraphic zonation scheme based entirely on the Discoasteridae as have been presented in the present paper can be used successfully in the biostratigraphic correlation in the oil search in Gippsland-, Otway - and Bass basins, Australia.

C O N C L U S I O N S .

Ten species of the Discoasteridae being characteristic for the Oligocene and Miocene sediments in Australia have been evaluated in the Barracouta A - 1 well, Gippsland basin. It has been proved in the present investigations that the sidewall core from 3750 feet to 3760 feet depth and the core 8 belong to the Oligocene, the lastmentioned core representing approximately the boundary between the Upper Oligocene and the Lower Miocene. The cores 1 - 7 represent the Middle to Upper Miocene being characterized by significant Miocene species of the Discoasteridae. The Oligocene and Miocene stratigraphic sequence in the Barracouta A - 1 well has been divided into six provisional informal biostratigraphic zones based on the Discoasteridae, which can be used for biostratigraphic correlation in the oil search in the Bass Strait.

S Y S T E M A T I C D E S C R I P T I O N S .

Family Discoasteridae Tan Sin Hok, 1927

Genus Discoaster Tan Sin Hok, 1927

Discoaster deflandrei Bramlette and Riedel

Plate , fig.

Discoaster deflandrei Bramlette and Riedel, 1954, pp. 399 - 400, pl. 39, fig. 6, text - fig. 1 a - c. Discoaster deflandrei Bramlette and Riedel; Martini, 1958, p. 363, pl. 5, fig. 23 a - c. Discoaster deflandrei Bramlette and Riedel; Manivit, 1959, p. 37, pl. 9, fig. 4. Discoaster deflandrei Bramlette and Riedel; Bramlette and Sullivan, 1961, p. 158, pl. 11, fig. 4 a,b. Discoaster deflandrei Bramlette and Riedel; Martini, 1961, pl. 3, fig. 27. Discoaster deflandrei Bramlette and Riedel; Stradner and Papp, 1961, p. 71, pl. 10, fig. 1 & 6, text - fig. 8/7. Discoaster deflandrei

Bramlette and Riedel; Hay et al., 1966, p. 396. Discoaster deflandrei Bramlette and Riedel; Levin and Joerger, 1967, p. 172, pl. 4, fig. 1 - 2.

REMARKS: Stradner (1961, p. 71) and Papp have written that this species possesses wide possibilities for the form - development. The most characteristic features are the blocky forms of the contours of the rays. The central knob is not present on the inferior face of the specimens from the Eocene, however, Oligocene representatives of this species exhibit characteristics comparable with those present in younger Tertiary species, e. g. Discoaster challengeri Bramlette and Riedel, D. brouweri (Tan) and D. pentaradiatus (Tan).

Stradner (loc. cit. p. 72) and Papp have pointed out that D. deflandrei Bramlette and Riedel occur in situ only in the Eocene in Austria, and in Oligocene strata this species is not in situ. Stradner has also stressed that the specimens of this species from Middle America are better developed than specimens from Europe; in Mexico this species has been found in situ in the Oligocene. Martini (1960, p. 77) has written that most specimens of D. deflandrei Bramlette and Riedel encountered in the Mainz basin in Germany are not in situ, while in zone 2 and 4 in the Rupelton they may be in situ. Martini has also pointed out the great variability of this species; specimens with strongly widened ends of the rays and also with narrow ends of rays occur. According to Martini specimens which posses 8 and 9 rays have very great centralfields; such forms occur in the Eocene of southern Germany but are not present in northern Germany. According to Martini this species occurs in situ in Middle Eocene to Lower Miocene strata; Stradner and Edwards (1968) state that it first appears in New Zealand in the Oligocene. This coincides with the occurrence of D. deflandrei Bramlette and Riedel in Australia.

OCCURRENCE IN BARRACOUTA A - 1 WELL, GIPPSLAND BASIN:
Core 3 (2024 feet to 2037 feet depth), core 4 (2325 feet to 2351 feet depth), core 5 (2630 feet to 2655 feet depth), core 6 (2876 feet to 2896 feet depth), core 8 (3342 feet to 3352 fee feet depth), sidewall core from 3750 feet to 3760 feet depth.
S RATIGRAPHIC RANGE IN BARRACOUTA A - 1 WELL, GIPPSLAND BASIN: Taylor's (1966) zonules C, D, E, H, I, J (Oligocene - Miocene). Informal biostratigraphic zones I, II, IV, V, VI.
OCCURRENCE IN AUSTRALIA: D. deflandrei Bramlette and Riedel has been encountered in the core 3 (4634 feet to 4649 feet depth) in Marlin A - 1 well in Gippsland basin. The writer (Rade, 1969 d) has mentioned the occurrence of this species in the Otway basin. This species is common there from the Upper Oligocene to the Lower Miocene. It is widely encountered also in the Lower Miocene in the offshore area from eastern Queensland . The percentage frequencies in the Oligocene and Miocene strata are very significant, i. e. they are around 20 % in the Oligocene and the lowermost portion of the Lower Miocene which increase up to 60 % in the uppermost part of the Lower Miocene. Capricorn 1A well located offshore eastern coast of Queensland provides a good example for this interesting feature in the Lower Miocene, which is well comparable with the same strata in the Barracouta A - 1 well in the Gippsland basin. D. deflandrei Bramlette and Riedel constitutes 50 % of the total amount of the Discoasteridae in the core 5 (interval from 2875 feet to 2875 feet 9 inches depth) and 47 % of the total in the core 8 (interval from 3939 feet to 3939 feet 6 inches depth) in the Capricorn 1A well. This species designates very exactly the upper boundary of the Lower Miocene in the Capricorn 1A and Aquarius 1 wells located offshore from the eastern coast of Queensland.
OCCURRENCE IN NEW ZEALAND: Stradner and Edwards (1968) have mentioned this species from the Lower Oligocene London Series , Whaingaroan Stage in New Zealand.

DISTRIBUTION: D. deflandrei Bramlette and Riedel has been encountered in Alabama in the Eocene and Oligocene and in California in the Paleocene, Eocene, Lower Miocene. It occurs also in Cuba, Trinidad, Mexico and France in the Oligocene and in the Eocene it has been found in Austria and Saipan (Mariana Islands).

Discoaster sp. C

Plate , fig.

TYPE LOCALITY: Barracouta A - 1 well, 3750 feet to 3760 feet depth, Gippsland basin, Australia.

TYPE STRATIGRAPHIC INTERVAL: Oligocene, Gippsland basin, Australia.

DIMENSIONS: 12 - 16 μ.

DESCRIPTION: This species has six rays, which are fairly short. The ends of the rays do not posses a blocky appearance - they are not widened at all or are only very slightly swollen. A notch is available at the end of the rays which forms an angle approximately of 90 ^{c} or a little more or sometimes less. Interradial incisions are rounded. The central disc is fairly large.

REMARKS: D. sp. C differs from D. deflandrei Bramlette and Riedel in the outer form of the ends of the rays. The rays at D. sp. C are slender comparing with these of D. deflandrei Bramlette and Riedel , the lastmentioned form being mainly characterized by the blocky appearance of the ends of the rays. D. sp. C differs from D. gemmifer Stradner that the first one has no any side notches at the ends of the rays.

D. sp. C. differs from D. sp. A that the lastmentioned species has no any notch at the end of the rays, the arms itself being very short and possessing a very large central disc. D. sp. C can be distinguished very easily from D. trinus Stradner because the lastmentioned species is of the hemidiscoaster type. These both species differ also in their outer forms of the rays. D. sp. C differs from D. sp. B according to the form of the rays - the first one has more D. deflandrei - type rays and the second one has more the D. challengeri - type rays.

OCCURRENCE IN BARRACOUTA A - 1 WELL, GIPPSLAND BASIN:
Sidewall core from 3750 feet to 3760 feet depth.
STRATIGRAPHIC RANGE IN BARRACOUTA A - 1 WELL, GIPPSLAND BASIN:
Taylor's (1966) zonule J (Oligocene) . Informal biostratigraphic zone I (Oligocene).
OCCURRENCE IN AUSTRALIA: D. sp. C occurs in the core 3 (4634 feet to 4649 feet depth) in Marlin A - 1 well, Gippsland basin. It has been observed in the area offshore from the eastern coast of Queensland.

Considering the fact, that D. sp. C has been encountered in the Australian Oligocene strata, where also D. deflandrei Bramlette and Riedel occurs, then it can be accepted as an offshoot of the lastmentioned species. In the lineage the main characteristic would be the more expressed slenderness of the rays at D. sp. C than at D. deflandrei Bramlette and Riedel. This slenderness is modified and much more strongly expressed ~~at~~ D. sp. B - the last species being considered as the transitional form to the Miocene species D. challengeri Bramlette and Riedel. The development lineage in this case would be as follows:
D. deflandrei → D. sp. C → D. sp. B → D. challengeri

Discoaster gemmifer Stradner

Plate , fig.

Discoaster distinctus Martini in Stradner , 1959, p. 1086, fig. 20. Discoaster distinctus Martini; Stradner, 1959, p. 478, fig. 33 - 39. non Discoaster distinctus Martini; Martini, 1958/, p. 363, pl. 4, fig. 17 a, b. non Discoaster distinctus Martini; Martini, 1960, p. 395, fig. 6. Discoaster gemmifer Stradner, 1961, p. 86, fig. 83. Discoaster gemmifer Stradner; Stradner and Papp, 1961, p. 69, pl. 8, fig. 1 - 10 and 24/4 - 6, pl. 9, fig. 1 - 5, text - fig. 8/6.

and Papp/

REMARKS: Stradner (1961, p. 70) havepointed out that Discoaster gemmifer Stradner has close affinities with D. distinctus Martini from which this species differ in the form of the ends of the rays. The same writer (Stradner, loc. cit) haveproposed affinities of different species of Discoaster as follows: Discoaster binodosus - D. mirus - D. distinctus - D. gemmifer - - D. corniger . Stradner (loc. cit. p. 71) have stressed that D, gemmifer Stradner is common in material from Aragon in Mexico. However, the forms of D. gemmifer Stradner which have spanner - like ends of the rays and which have been found in the Eocene of NW Germany are very rare in Austria (Stradner, loc. cit. p. 70).

and Papp/

and Papp/

OCCURRENCE IN BARRACOUTA A - 1 WELL, GIPPSLAND BASIN: Sid wall core from 3750 feet to 3760 feet depth.

STRATIGRAPHIC RANGE IN BARRACOUTA A - 1 WELL, GIPPSLAND BASIN: Taylor's (1966) zonule J (Oligocene). Informal biostratigraphic zone I (Oligocene).

OCCURRENCE IN AUSTRALIA: D. gemmifer Stradner is one of the commonest discoasterids in the uppermost portion of the Upper Eocene and in the lower portion of the Upper Oligocene in the Otway basin. This species has been used for the delineation of the lower portion of the Upper Oligocene in the Otway basin.

This species has been encountered in lesser amounts than in the Otway basin also in the core 3 (4634 feet to 4649 feet depth) in Marlin A - 1 well in the Gippsland basin and it occurs also in the area offshore from the eastern coast of Queensland.

DISTRIBUTION: Austria, Mexico.

Discoaster trinus Stradner

Plate , fig.

Discoaster molengraaffi Tan Sin Hok; Stradner, 1959, p. 1085, fig. 15 and 24. Discoaster trinus Stradner, 1961, p. 85, fig. 79. Discoaster trinus Stradner; Stradner and Papp, 1961, p. 79, pl. 14, fig. 1 - 4, text - fig. 8/16. Discoaster trinus Stradner; Levin and Joerger, 1967, p. 172, pl. 4, fig. 7, 8a-b.

REMARKS: Discoaster trinus Stradner is characterized by its appearance as consisting of two triradiate units superimposed upon one another. Stradner and Papp (1961, p. 80) havereported this species from the Middle Eocene from Salzburg, Austria.

OCCURRENCE IN BARRACOUTA A - 1 WELL, GIPPSLAND BASIN: Sidewall core from 3750 feet to 3760 feet depth.

STRATIGRAPHIC RANGE IN BARRACOUTA A - 1 WELL, GIPPSLAND BASIN: Taylor's (1966) zonule J (Oligocene). Informal biostratigraphic zone I (Oligocene).

OCCURRENCE IN AUSTRALIA: This species occurs in the core 3 (4634 feet to 3649 feet depth) in Marlin A - 1 well, Gippsland basin. D. trinus Stradner is abundant in the upper part of the Upper Oligocene in the Otway basin. This species also occurs in a considerable abundance in the area offshore from the eastern coast of Queensland.

Discoaster challengeri Bramlette and Riedel

Plate , fig.

Discoaster challengeri Bramlette and Riedel, 1954, p. 401, pl. 39, fig. 10. Discoaster challengeri Bramlette and Riedel; Stradner, 1959, p. 1088, fig. 26. Discoaster challengeri Bramlette and Riedel; Martini, 1960, p. 395, fig. 8. Discoaster challengeri Bramlette and Riedel; Stradner and Papp, 1961, p. 83, pl. 17, fig. 1 - 3, 6, pl. 18, fig. 1, 3 - 6, pl. 19, fig. 4 and 6, text - fig. 8/21, 24/10, and 24/11.

REMARKS: Stradner and Papp (1961, p. 84) have written that in material from Rumania and Sicily in Europe forms with three rays are also present and that forms with seven rays are very rare. In Australia only forms with six rays have been observed.

OCCURRENCE IN BARRACOUTA A - 1 WELL, GIPPSLAND BASIN: Core 4 (2325 feet to 2351 feet depth), core 5 (2630 feet to 2655 feet depth) and core 7 (3020 feet to 3050 feet depth).

STRATIGRAPHIC RANGE IN BARRACOUTA A - 1 WELL, GIPPSLAND BASIN: Taylor's (1966) zonules D and E (Middle Miocene). Informal biostratigraphic

biostratigraphic zones III and V .

OCCURRENCE IN AUSTRALIA: D. challengeri Bramlette and Riedel occur in Miocene strata in the Otway basin. This species has been encountered in the large amounts of specimens in Miocene and Pliocene strata in the area offshore from the eastern coast of Queensland in Capricorn 1A and Aquarius 1 wells.

The overall amount of the specimens of this species are much larger in the Pliocene than the Miocene sediments in these abovementioned wells. This species occurs as 50 % of the total amount of the Discoasteridae in core 5 (interval from 2875 feet to 2875 feet 7 inches) and 22 % in core 8 (interval from 3939 feet to 3939 feet 6 inches depth) in Capricorn 1A well in the area offshore from the eastern coast of Queensland. These both cores represent the Lower Miocene in this well. It is interesting to stress here that D. challengeri Bramlette and Riedel is much more less represented concerning the amount of the specimens in the Otway basin and also Gippsland basin comparing with NE Australia. Only the core 7 in Barracouta A - 1 well more or less can be compared with NE Australia in the comparative amount of the specimens of this species. However, another factor is of a large importance for all Australian Tertiary sediments, i. e. the constancy of the percentage frequencies in biostratigraphic zones of the Tertiary strata. In such a way D. challengeri Bramlette and Riedel provides a very important species into the selected other species of the Discoasteridae for biostratigraphic zonation purposes in the Tertiary sediments in Australia. This species is very well represented in the Pliocene and Miocene sediments in Papua - New Guinea.

DISTRIBUTION: Tortonian in Austria, Rumania, Italy. Lower Miocene in Trinidad.

Discoaster musicus Stradner

Plate , fig.

Discoaster musicus Stradner, 1959, p. 1088, fig. 28.

Discoaster musicus Stradner and Papp, 1961, p. 85, pl. 17, fig. 4, 5, 7 - 10, pl. 18, fig. 2, text - fig. 8/22.

REMARKS: Stradner and Papp (1961, p. 85) have mentioned that Discoaster musicus Stradner is morphologically intermediate between D. gemmifer Stradner and D. challengeri Bramlette and Riedel and thus between the discoasterids of the Eocene and the Miocene.

OCCURRENCE IN BARRACOUTA A - 1 WELL, GIPPSLAND BASIN: Core 8 (3342 feet to 3352 feet depth).

STRATIGRAPHIC RANGE IN BARRACOUTA A - 1 WELL, GIPPSLAND BASIN: Taylor's (1966) zonule H (Mio - Oligocene). Informal biostratigraphic zone II.

OCCURRENCE IN AUSTRALIA: D. musicus Stradner has been encountered in Miocene strata in the Otway basin. This species has been used to delineate the Lower Miocene in the Otway basin. This species marks the upper boundary in Barracouta A - 1 well in the Gippsland basin in the same way as it is doing in the Otway basin. For this reason D. musicus Stradner in Australia can be suggested as a fairly important index discoasterid for the use of detailed biostratigraphic zonation.

DISTRIBUTION: Lower Tortonian in Austria.

Discoaster sp. B

Plate , fig.

TYPE LOCALITY: Barracouta A - 1well, 3342 feet to 3352 feet depth, Gippsland basin, Australia.

TYPE STRATIGRAPHIC INTERVAL: UPPER OLIGOCENE - LOWER MIOCENE boundary, Gippsland basin, Australia: the uppermost portion of the Upper Oligocene.

DIMENSIONS: 12 - 18 μ.

DESCRIPTION: This species has six rays which are fairly long and slender. The central disc is comparatively small. The median lines are very strongly expressed and a central knob is present. The median lines on the rays are sometimes slightly elevated at the end. The angle of the notch at the

end of the ray forms commonly more than 90 degrees.

REMARKS: The ends of the rays have features which place Discoaster sp. B morphologically between D. sp. C and D. challengeri Bramlette and Riedel. D. sp. B is closely similar to D. challengeri Bramlette and Riedel and significantly differs from that species in respect to the ends of the rays and by having strong median lines. The central disc is present in D. sp. B. Stradner and Papp, (1961, p. 71) and Martini have stated that D. deflandrei Bramlette and Riedel does not possess a central knob on the one side - facies inferior. The central knob first appears in Oligocene forms of D. deflandrei Bramlette and Riedel. This feature is also present in D. sp. B.

D. musicus Stradner differs from D. sp. B in having a starlike central knob while the central knob of D. sp. B is more or less rounded. D. musicus Stradner has very short rays while D. sp. B possesses very long rays. The central disc of D. sp. B is small in contrast to the large central disc of D. musicus Stradner.

D. sp. B differs from D. deflandrei Bramlette and Riedel by having smaller ends of the rays and stronger median lines. The developing sequence of these species can be expressed approximately as follows: D. gemmifer → D. corniger → D. deflandrei → D. sp. C → → D. sp. B → D. challengeri .

The vertical range of D. sp. B allows it to be regarded as a transitional species between the discoasterids of Oligocene and Miocene.

OCCURRENCE IN BARRACOUTA A - 1 WELL, GIPPSLAND BASIN:
Core 8 (3342 feet to 3352 feet depth).

STRATIGRAPHIC RANGE IN BARRACOUTA A - 1 WELL, GIPPSLAND BASIN: Taylor's (1966) zonule H (Mio - Oligocene). Informal biostratigraphic zone II.

REMARKS: D. sp. A has the closest morphological relationship with D. deflandrei Bramlette and Riedel. The first one differs from the second one especially by the strong bulging of the middle portion of the central disc, and the lack of the notch at the end of the rays. The ends of the rays do not have the blocky appearance at D. sp. A which is so characteristic for D. deflandrei Bramlette and Riedel.

D. sp. A differs from D. sp. C according to the shorter rays and the bulging of the middle portion of the central disc. The last abovementioned species has a smaller disc than the first one. D. sp. C differs from D. sp. A also by the feature, that the first above mentioned species has distinctively expressed notch at the end of the rays.

D. sp. A differs from D. sp. B according to the large central disc, strong bulging of the middle portion of the central disc and very short rays.

OCCURRENCE IN AUSTRALIA: D. sp. A occurs in core 3 (4634 feet to 4649 feet depth) in Marlin A - 1 well, Gippsland basin. This species occurs widely in the Otway basin and in the area offshore from the eastern coast of Queensland.

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REMARKS: Stradner and Papp (1961, p. 87) have mentioned that this species is closely related to D. challengeri Bramlette and Riedel.

OCCURRENCE IN BARRACOUTA A - 1 WELL, GIPPSLAND BASIN: Core 6 (2876 feet to 2896 feet depth) and core 7 (3020 feet to 3050 feet depth).

STRATIGRAPHIC RANGE IN BARRACOUTA A - 1 WELL, GIPPSLAND BASIN: Taylor's (1966) zonule E (Middle Miocene). Informal biostratigraphic zones III and IV.

OCCURRENCE IN AUSTRALIA: This species is well represented in the Pliocene and Miocene sediments in the area offshore from the eastern coast of Queensland.

DISTRIBUTION: This species has been encountered in Island Rotti in Moluccas Archipelago; also in Tortonian and Pliocene in Italy and Recent in Mediterranean.

Discoaster sp. A

Plate , fig. ----

TYPE LOCALITY: Barracouta A - 1 well, 3750 feet to 3760 feet depth, Gippsland basin, Australia.

TYPE STRATIGRAPHIC INTERVAL: Oligocene, Gippsland basin, Australia.

DIMENSIONS: 10 - 16 μ.

DESCRIPTION: This species has six or seven rays. The rays are short possessing ends which are either straight cut off or have a slightly triangular appearance. The rays at their ends are slightly widened. The interradial incisions are rounded. The central disc is very large. A very characteristic feature is the bulging of the middle portion of the disc. The facies superior of the disc is concave and the facies inferior is strongly convex.

OCCURRENCE IN BARRACOUTA A - 1 well, GIPPSLAND BASIN: Sidewall core from 3750 feet to 3760 feet depth and core 8 (3342 feet to 3352 feet depth).

STRATIGRAPHIC RANGE IN BARRACOUTA A - 1 WELL, GIPPSLAND BASIN: Taylor's (1966) zonule H and J (Mio - Oligocene). Informal biostratigraphic zones I and II.

OCCURRENCE IN AUSTRALIA: This species occurs in the uppermost portion of the Upper Oligocene, Otway basin, Australia. The same species has been widely encountered in the area offshore from the eastern coast of Queensland.

Discoaster molengraaffi Tan Sin Hok

Plate , fig.

Discoaster molengraaffi Tan Sin Hok, 1927, p. 120, text - fig. 1/9. Discoaster molengraaffi Tan Sin Hok; Stradner and Papp, 1961, p. 80, pl. 14, fig. 5, 6, text - fig. 8/17.

REMARKS: Specimens encountered in Barracouta A - 1 well, Gippsland basin, Australia agree closely with descriptions and figures of this species by Tan Sin Hok (1927) and Stradner and Papp (1961).

OCCURRENCE IN BARRACOUTA A - 1 WELL, GIPPSLAND BASIN: Core 3 (2024 feet to 2037 feet depth), core 6 (2876 feet to 2896 feet depth) and core 7 (3020 feet to 3050 feet depth).

STRATIGRAPHIC RANGE IN BARRACOUTA A - 1 WELL, GIPPSLAND BASIN: Taylor's (1966) zonules C and E (Middle Miocene). Informal biostratigraphic zones III, IV, VI.

OCCURRENCE IN AUSTRALIA: D. molengraaffi Tan Sin Hok has been encountered in the Miocene and Pliocene strata in the area offshore from the eastern coast of Queensland.

DISTRIBUTION: This species has been encountered in Island Rotti, Moluccas Archipelago; Miocene of Haiti and in Italy in Pliocene.

Discoaster brouweri (Tan) Bramlette and Riedel

Plate , fig.

Discoaster brouweri Tan Sin Hok, 1927, p. 120, text - fig. 2/8a, and 8b. Discoaster brouweri (Tan) Bramlette and Riedel, 1954, p. 402, pl. 39, fig. 12, text - fig. 3A and 3b. Discoaster brouweri Tan, Martini, 1960, p. 396, fig. 12. Discoaster brouweri (Tan) Bramlette and Riedel; Stradner and Papp, 1961, p. 85, pl. 20, fig. 1 - 6, text - fig. 8/23.