OCCURRENCE OF *PEYSSONNELIA* AND *DISTICHOPLAX* IN THE DECCAN INTERTRAPPEANS, WITH REMARKS ON THE AGE OF CHHINDWARA TRAPS AND PALAEOGEOGRAPHY OF THE REGION

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ABSTRACT

Two rhodophycean algal fossils, viz., *Peyssonnelia antiqua* Johnson and *Distichoplax raoi* Varma have been recorded from the Deccan Intertrappean beds of Mohgaonkalan for the first time. The occurrence of *Distichoplax* on one hand indicates a Palaeocene-Eocene age for these beds, while, on the other, *Peyssonnelia* provides an important evidence in support of the presence of marine conditions in this area during the early Tertiary Period.

INTRODUCTION

The record of the presence of algae in Deccan Intertrappean flora of India can be traced as early as 1854 when Carter for the first time described *Chara malcalmsonii* from Takli, near Nagpur. Since then, although a large number of plant fossils have been described from this interesting flora of the Indian Tertiary, the number of algal forms decsribed is very limited. Most of the algal fossils known from the various Deccan Intertrappean localities have been listed by PRAKASH (1960) and LAKHANPAL (1973). Besides Charophytes—mostly described from Rajahmundry, the fossil algae described from these beds include *Botryococcites shuklai* (SINGHAI, 1957), *Spirogyrites* (SHUKLA, 1950) and *Oedogonites* (DWIVEDI, 1959) from Mohgaonkalan, and *Halimeda*, *Dissocladella intertrappea* (NARAYAN RAO & RAO, 1940), *Terquemella lenticularis*, *Acetabularia*, *Neomeris*, *Holosporella* (PIA *et al.*, 1937), and *Acicularia* (NARAYAN RAO & RAO, 1937) from Rajahmundri, and a filament of *Ulothrix* (SAHNI & RAO, 1943) from Sausar. Recently BIRADAR (1977) has also described a cyanophycean alga, *Westiellopsis*, from Mohgaonkalan.

During the course of studies on the fossiliferous cherts collected from Mohgaonkalan, the authors came across two interesting forms of red algae which are described in the following pages. While one of them shows a close similarity to the already known fossil species *Peyssonnelia antiqua* Johnson (1964) of the family Squamariaceae, the other belongs to the interesting fossil genus *Distichoplax* Pia (1934) which enjoys an universal acceptance as an index fossil for the Palaeocene-Eocene age. Both these taxa were observed in a single section of the fossiliferous chert and were studied in sectional view.

Class	RHODOPHYCEAE
Order	CRYPTONEMIALES
Family	SQUAMARIACEAE
Genus	**Peyssonnelia** Decaisne

Peyssonnelia antiqua Johnson, 1964
Plate 1, Figs. 1-3

Description—Small thin crusts consisting of a basal hypothallus, a middle perithallus and a dermal layer. Maximum length of a thallus in section about 16 mm. The hypo-

thallus consisting of a single layer of large, vertically elongated cells, 35-45 μm in height and about 8-12 μm in width; perithallus about 80-160 μm thick, somewhat ill-preserved, made up of 4-5 layers of thin-walled, oval cells, 10-40 μm in diameter. Single-celled dermal layer consisting of thin-walled, rectangular cells, about 8-10 μm in diameter. At one end of the thallus the perithallus forming a dome-like structure which may represent the conceptacle.

Remarks—The alga belongs to the already known species *Peyssonnélia antiqua* first described by JOHNSON (1964) from the Palaeocene of Northern Iraq. It has also been recorded from the Bagh Beds of Madhya Pradesh by GHOSH AND PAL (1969). Similar forms showing similarity with the extant genus *Cruoriella* have been described by LEMOINE (1939). However, *Cruoriella* has been treated as a sub-genus of *Peyssonnelia* by FRITSCH (1952, p. 503). This is the first record of *Peyssonnelia* from the Deccan Intertrappean beds of India.

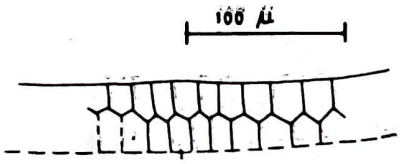
Specimen — B.S.I.P. Slide No. 6556.

Family	CORALLINACEAE
Sub Family	MELOBESIEAE
Genus	**Distichoplax** Pia, 1934

Distichoplax raoi Varma, 1962

Pl. 1, Figs. 4-6 ; Text-fig. 1

Description—Horizontally lying, flat, platy thalli, two-celled thick in sections. Two rows of cells with smooth outer margins arranged in alternate fashion on either side of the zig-zag axis ; cells 16-24 × 12-16 μm in dimension. Width of the thallus 36-50 μm and the length of the thallus in the section about 9 mm.



Text-fig. 1. *Distichoplax raoi*—Thallus in sectional view showing two rows of cells arranged along a zig-zag central axis. BSIP Slide No. 6556.

Remarks—In another specimen the thallus is exposed in surface view as also described by VARMA (1962). This specimen is about 150 μm in width and is made up of 5-7 rows of thin-walled, polygonal cells, being 20-50 μm in diameter. The illustrated specimen is almost identical to the already known species *Distichoplax raoi* Varma (1962).

Specimen — B.S.I.P. Slide No. 6556.

DISCUSSION

The occurrence of rhodophycean algal forms *Peyssonnelia antiqua* and *Distichoplax raoi* from the Deccan Intertrappean beds of Mohgaonkalan is highly significant in view of the fact that this discovery has a direct bearing on the age of Mohgaonkalan Intertrappean beds and the palaeogeography of this area.

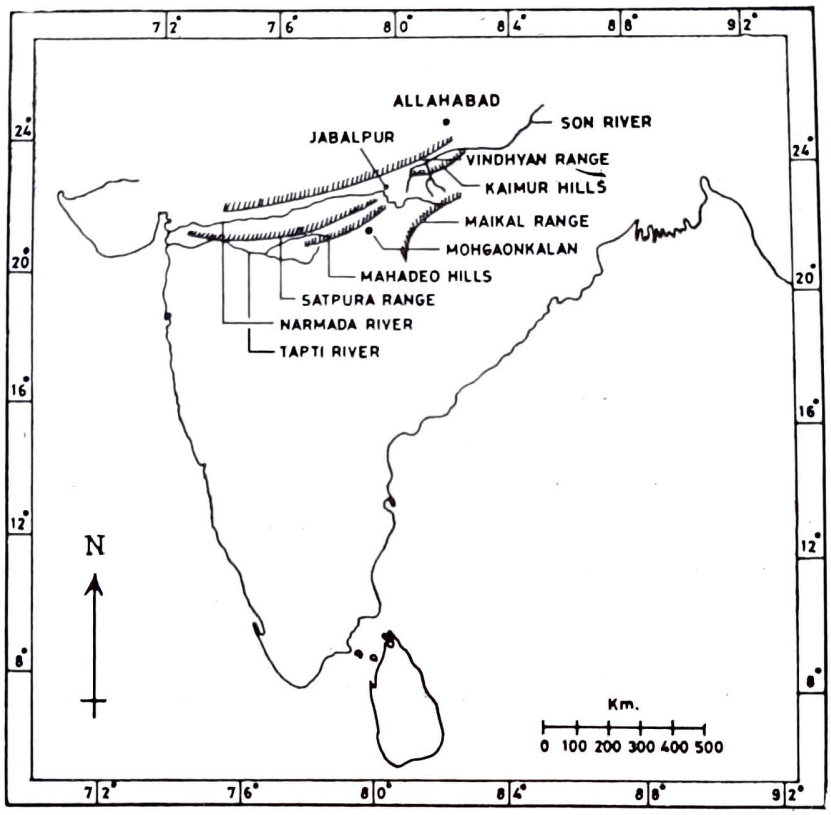
Although the genus *Peyssonnelia* Decaisne is a present day rhodophycean member, the fossil species *Peyssonnelia antiqua* Johnson (1964) has so far been recorded from the Upper Cretaceous to Palaeocene beds. It was originally described by JOHNSON (1964) from the Palaeocene limestone of Rowanduz in northern Iraq which unconfirmably overlies the Upper Cretaceous (Maestrichtian) strata. JOHNSON has again reported this species from Guatemala in the Petan Formation in association with Palaeocene

foraminiferal species, *Truncarotalia*, *Globorotalia*, *Globigerina*, etc. (JOHNSON, 1965, *in* GHOSH & PAL, 1969, p. 149). From India GHOSH AND PAL (1969) have described the same species from the Bagh beds near Chirakhan, Sitapuri mentioning the age as Palaeocene(?). However, the other genus *Distichoplax* Pia (1934) is known only in the fossil state and is universally accepted as an index fossil for the Palaeocene-Eocene age. This form was thought to belong to the perithallial parts of *Lithothamnium* by DIETRICH (1927) and accordingly named as *Lithothamnium biserialis*. PIA (1934) for the first time traced the affinities of this taxon to the subfamily Melobesieae showing a resemblance with *Lithoporella*. He accordingly instituted the genus *Distichoplax* for such fossils and placed them under a new species—*Distichoplax biserialis*, after the type species of DIETRICH. Although LEMOINE has doubted even the algal characterization of this genus (LEMOINE *in* PAUL, 1968), the majority of the workers agree with the views of PIA. VARMA (1962), while describing this species from the Laki Beds of Panjab Salt Range (Lower Eocene), created another species—*Distichoplax raoi*, based mainly on the difference in the thickness of the thallus. The thickness ranges from 90 to 140 μm in *D. biserialis* while it is 39 to 65 μm in *D. raoi*. As the thallus described here is 36-50 μm thick, the fossil has been placed under the species *Distichoplax raoi* Varma.

Since PIA's discovery, *Distichoplax* has been described from geographically widely separated areas such as Eastern Alps, Persia, Czechoslovakia, Pyrenees (VARMA, 1962), Iraq (ELLIOT, 1960), Salt Range in Pakistan (VARMA, 1962) and many Tertiary localities of India. From India, the genus has been described from Middle to Upper Eocene of Khasi Hills, Meghalaya (RAO, 1943), the Sylhet Limestone Formation of Meghalaya of early Eocene age (PAL & DUTTA, 1979), Nummulitic Limestone of Cherrapunji, Khasi Hills (NAGAPPA, 1951), the Palaeocene to Upper Eocene of Pondicherry area (RAMA RAU, 1953), the Nerinea beds of Pondicherry said to be of Palaeocene age (SASTRY *et al.*, 1963), the Palaeocene of Vridhachalam, South India (RAJAGOPALAN, 1967), and from the Bagh beds of the Man River section, Madhya Pradesh (PAUL, 1968). While showing a wide geographical distribution, the genus shows a fairly limited geological range. EAMES *et al.*, (1962), have clearly shown the age of this fossil as Palaeocene. GLAESSNER (1959) while dealing with the Tertiary stratigraphic correlation in the Indo-Pacific region and Australia has also observed that "the extinct alga *Distichoplax* is occasionally claimed to indicate Palaeocene age, but the genus was named for the specimens from the Upper Lutetian-Lower Peribonian (Middle Eocene) of the Carpathians and was recently recorded from the Middle and Upper Eocene of New Caledonia". Thus, the present finding of *Distichoplax* clearly indicates a Palaeocene-Eocene age for the Deccan Intertrappean beds at Mohgaonkalan and the nearby areas. Based on the occurrence of this genus in the Bagh beds of the Man River Section Madhya Pradesh, alongwith the presence of *Peyssonelia antiqua* from the same beds near Chirakhan, Sitapuri, GHOSH AND PAL (1969) have observed that as is the case in the Pondicherry area where Palaeocene-Eocene strata occurs in continuation and is overlying the Cretaceous rocks, it may not be out of place to suggest that the sedimentation in the Narmada Basin also continued beyond the Cretaceous and possibly through the Palaeocene.

The discovery of *Peyssonnelia antiqua* from Mohgaonkalan beds is also quite interesting. This alga today grows exclusively in marine water and its presence in the Intertrappean beds of Mohgaonkalan is strongly suggestive of such an environment in this area during the Palaeocene-Eocene times. Based on the presence of plant fossils of coastal forms, like *Cocos*, *Nypa* and *Sonneratia* from this locality, LAKHANPAL (1974, p.

518) has already suggested that "...there were marine conditions near Mohgaonkalan in the Palaeogene times. That there was an arm of a sea in Central India during the close of the Mesozoic Era is confirmed by the occurrence of marine beds in the Cretaceous of Narmada Valley. Most probably this arm continued into the Early Tertiary". From the above statement of LAKHANPAL (1974) and from the map of the Lower Eocene palaeogeography of India given by him (See LAKHANPAL, 1974 ; Map 1), it appears that this arm of sea was transgressing Central India through the present day Narmada Valley. If this suggestion is accepted as a working hypothesis, it raises an important palaeogeographical problem. Presently, the Mohgaonkalan area is separated from the Narmada Valley by the Satpura Ranges which form the southern boundary of the Valley (Map 1). As the age of the Satpuras is accepted as Lower Permian-Upper Cretaceous, it becomes difficult to explain how the sea could have crossed this barrier to reach Mohgaonkalan area in the Palaeocene-Eocene times.



Map 1—Map showing position of Mohgaonkalan in relation to the Satpura and Vindhyan ranges and the river Narmada.

However, although the Satpuras are considered as early Permian-Upper Cretaceous in age, two totally opposite views have been given by geologists regarding the early Tertiary palaeogeography of this area. AUDEN (1949, p. 333) is of the view that no elevated range or plateau could have existed in the present Satpura trend during the early Tertiary, and the second period of folding, accompanied by elevation which took place after the formation of the Narmada rift, may have been of Miocene age and contemporaneous with the main period of Himalayan overthrusting. KRISHNAN (1961) has gone to the extent of stating that there is a well-marked rift along the valley of the Narmada which has been a marine belt from the Permo-Carboniferous to recent times. Contrary to the above view and based mainly on the evidence of the existence of Palaeozoic and older rocks underlying the alluvium in the Narmada Valley, AHMAD (1966) has opined that this belt was at no stage covered by traps, and, therefore, must have been of considerable elevation when the basalts were being poured out all round

it during the Upper Cretaceous period and later. The area was in the form of a promontary which they failed to envelope. Faulting came later, perhaps in the Pleistocene Period.

Thus, if the first view given by AUDEN (1949)—that no elevated range or plateau could have existed in the present Satpura trend during the Lower Tertiary, is accepted, then the southern margins of the arm of the Palaeogene sea transgressing Central India through the present day Narmada Valley, as shown by LAKHANPAL (1974), can be extended further south up to Mohgaonkalan in the light of occurrence of marine alga from this locality. It also becomes imperative that the Mohgaonkalan area which presently enjoys an elevation of about 685 metres was situated at the sea level during the Palaeocene-Eocene times.

On the other hand, if the view as expressed by AHAMAD (1966), that this region was of considerable elevation when the basalts were being poured out in this area during the Upper Cretaceous Period and later, is accepted then it becomes difficult to explain the existence of marine conditions at Mohgaonkalan and nearby areas during the Palaeogene. We will have to consider the transgression of the sea through an entirely different direction for which, at present, we have no sound hypothesis. Thus, although at present it is difficult to say as to which of the above views is correct, our findings strongly indicate the presence of marine environment at Mohgaonkalan and nearby areas during the Palaeocene-Eocene times. Moreover, the existence of Palaeozoic and older rocks and absence of traps below the alluvium in the Narmada Valley, which forms the main basis for Ahmad's argument, can be explained by the observations made by CROOKSHANK (1936) that, as a result of the denudation which continued over an immense period, the original basalt sheet has been completely removed over a wide tract on the south side of the Narmada Valley. Although this has not affected the courses of the rivers, for they have long occupied their present deep trenches, it has tended to obscure the horizontal nature of the whole country. He further states that the amount of denudation in this region since it took its present form, in the post-Trappean times must have been enormous. It is almost certain that the whole area was covered with a top shroud of basalt at the end of the Cretaceous Period. This has been completely removed over much of the area mapped by him.

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EXPLANATION OF PLATE 1

1. *Peyssonnelia antiqua*—Thallus in sectional view. × 25. BSIP Slide no. 6556.
2. *Peyssonnelia antiqua*—A part of the thallus enlarged to show hypothallus and perithallus. × 130. BSIP Slide no. 6556.
3. *Peyssonnelia antiqua*—A dome like structure at one end of the thallus showing probably the conceptacle. × 45. BSIP Slide no. 6556.
4. *Distichoplax raoi*—Thallus in sectional view showing two rows of cells along a zig-zag central axis. ×250. BSIP Slide no. 6556.
5. *Distichoplax raoi*—A number of thalli lying side by side and exposed in sectional view. × 25. BSIP Slide no. 6556.
6. *Distichoplax raoi*—Thallus in surface view showing thin-walled polygonal cells. × 150. BSIP Slide no. 6556.


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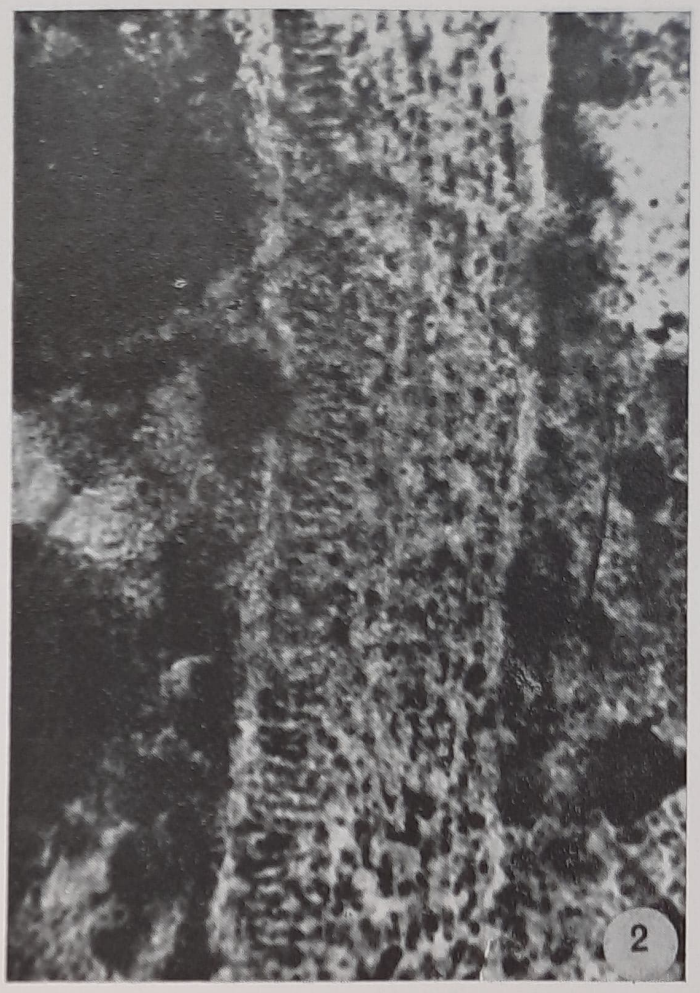
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