TRAPA MOHGAOENSIS—A NEW PETRIFIED DICOTYLEDONOUS FRUIT FROM THE DECCAN INTERTRAPPEAN BEDS OF MOHGAONKALAN, MADHYA PRADESH, INDIA

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Abstract

A well preserved fossil fruit of *Trapa* has been described from Mohgaonkalan, District Chhindwara, Madhya Pradesh. *Trapa* represents an ancient genus known from Cretaceous onwards and was more widely distributed in the Tertiary times in North and Central Europe. The occurrence of *Trapa* from Mohgaonkalan has been reported for the first time and the find is significant enough in determining the age of Deccan traps.

Introduction

The paper describes a well preserved new dicotyledonous fruit from Mohgaonkalan, District Chhindwara, Madhya Pradesh, India. A number of dicotyledonous fruits have been described from the Deccan Intertrappean beds of India. Among these, *Enigmocarpon parijai* Sahni (1943) is exhaustively studied. The different dicot fruits described from this locality are: *Indocarpa intertrappea* Jain (1964), *Harrisocarpon sahnii* Chitaley & Nambudiri (1968), *Sahnicarpon harrisii* Chitaley & Patil (1973), *Daberocarpon gerhardii* Chitaley & Sheikh (1973), *Deccanocarpon arnoldii* Paradkar (1975), *Mohgaoncarpon eydei* Chitaley & Yawale (1977), *Moghaoncarpon dicotylisperma* Barlinge & Paradkar (1980), *Ramanujamocarpon indicum* Sheikh & Kolhe (1980), *Biloculocarpon mohgaoense* Yawale (1977), *Krempocarpon aquatica* Chitaley & Kate (1975), *Krempocarpon indicum* Upadhye (1979), *Leguminocarpon* Yawale (1977), *Erythroxylocarpon intertrappea* Khubalkar (1982), *Wingospermocarpon mohgaoense* Kapgate (1982), *Cremocarpon deccanii* and *Utriculariocarpon chitaleyii* Karanjekar (1982), *Euphorbiocarpon drypeteoides* Mehrotra, Prakash, & Bande (1983), *Grewia mohgaoensis* Paradkar & Dixit (1984) and *Chitaleycarpon deccanii* Kumar (1985).

The fruit under investigation differs from all the known dicot fruits and it is a new addition to the dicot fruits from this locality.

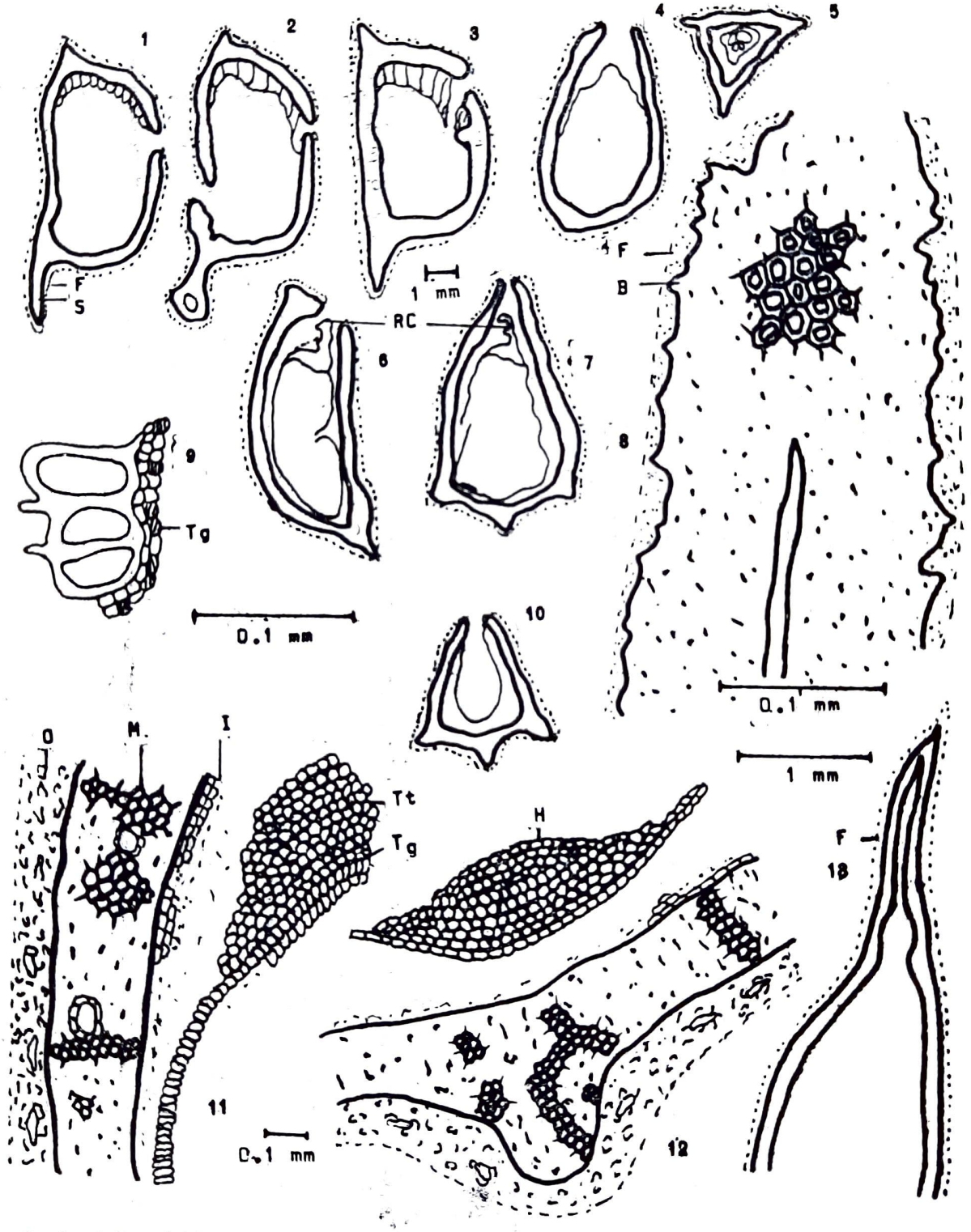
Material and method

A fossiliferous black chert on breaking exposed the fruit in longitudinal plane. After etching the rock with hydrofluoric acid, serial peel sections along different cut planes were taken for the investigation of the fruit. Slides of similar material were made available by Dr G. V. Patil for more detailed study. Sections of fresh *Trapa bispinosa* fruit were prepared for comparative study.

Description

The fossil fruit was exposed in a longitudinal plane (Text-fig. 1; Pl. 1, fig. 1). It is 8.2 to 10.5 mm long and 3 to 4.5 mm broad. Stalk of this fruit was not observed.

It is a compressed, dicotyledonous, turbinate, coriaceous, one seeded, drupaceous and indehiscent fruit. In the beginning it showed two outwardly projected spine-like structures (Text-fig. 1, Pl. 1, fig. 1). On cutting the specimen in another plane, a third elongated spine-like structure was observed (Text-fig. 5). Length of this spine-like structure is 3.5 mm and breadth is 0.2 to 0.5 mm. Spine shows barbs and it is made up of thick walled sclerenchymatous cells (Text-fig. 8, Pl. 1, fig. 3). Fruit consists of a pericarp which is 0.5 to 0.6 mm thick. Fruit wall is smooth and differentiated into 3 zones



Text-fig. 1—1-7 and 10, The fruit exposed in rock in L. S. showing fleshy covering (F), Spine (S), and reduced cotyledon (RC); 8, Spine in L. S., enlarged, showing barbs (B) and fleshy covering (F); 9, Cells of tegmen (Tg) showing spiral thickening; 11, A part of fruit wall and seed coat in details showing outer (O), Middle (M), and inner (I) zones; Testa (Tt) and Tegmen (Tg). 12, A part of the fruit wall and hypostase (H); and 13, Spine in L. S. showing fleshy covering (F).

(Text-fig. 11,Pl.1, figs. 5, 6). The outer zone of the pericarp is 80 to 120 μm thick but it is not well preserved. It consists of oval, parenchymatous cells arranged as aerenchyma. Groups of cells filled with unknown yellowish contents are present. The middle zone is 350 to 430 μm thick. It consists of well developed sclerenchyma and air cavities. The innermost zone is narrow and 20 to 40 μm broad. It is 3 to 4 cells thick in the middle region of fruit and 4 to 6 cells thick in micropylar part. It is parenchymatous and poorly developed. Pericarp shows the vascular supply in its basal region (Pl. 1, fig. 4). The vascular supply is associated with air chambers. Seed is large, oval and non-endospermic. Seed coat is not fused with pericarp but it is free. Seed coat consists of outer testa and inner tegmen (Text-fig. 11; Pl. 1, figs. 5,6). Testa is 2-18 cells thick and consists of thick walled cells. It is 2 cells thick at the apex and 16 to 18 cells thick at the chalazal end (Text-fig. 11; Pl. 1, figs. 6, 7). Inner tegmen is 2 celled thick and the cells are narrow, elongated, irregular, smaller, filled with yellowish substance. Cells of tegmen show spiral thickening in sectional view (Text-fig. 9; Pl. 1 figs. 5, 6) and reticulate thickening in surface view (Pl. 1, fig. 8).

Embryo is of a pseudomonocotyledonous type consisting of one large cotyledon and a small extremely unequal one, which was not very well seen. Large cotyledon is well developed and the other is scale-like or reduced (Text-figs. 6, 7; Pl. 1, fig. 7). Reduced cotyledon is found in the extended neck like micropylar portion of the median longitudinal section of the fruit (Text-fig. 7; Pl. 1, fig. 7). Hypostase is observed. It comprises thick-walled lignified and suberised cells (Text-fig. 12; Pl. 1, fig. 9) at the chalazal end of the seed.

Discussion

Shape and size of the present fruit specimen; structure of its wall, spines with barbs, its single seed, cotyledon single with large size and presence of hypostase are characters much different from the known fossil fruits from the same locality. While discussing the arrangement of families into orders, Corner (1976) has rightly pointed out the importance of seed structure specially the seed coat. The fossil seed falls under group 1, i. e. exotestal seeds. The exotestal seeds suggest the primitive construction in which the exposed surface is a protective layer. The seeds where the embryo completely fills the cavity, the inner integument and other tissues are crushed by embryo. Such seeds are described by Corner (1976) as exotestal seeds. Also undifferentiated seed coats occur in indehiscent fruits. All these features are expressed in the fossil seed with fruit described.

Comparison with other fossil fruits from same locality—Enigmocarpon parijai Sahni is 2-3 cms long and 1.5-2 cm broad and with clear loculicidal dehiscence. It is 6-12 locular with a thick spongy wall and each loculus shows two rows of seeds. It is large in size. The fruit *Indocarpa intertrappea* Jain is tetralocular, septifragal capsule with a columella and a fleshy testa. It is 3.0 x 2.3 cm in size and much larger than the present fossil. *Harrisocarpon sahnii* Chitaley & Nambudiri and *Sahniocarpon harrisii* Patil both show pentalocular condition. *Harrisocarpon* has 2 seeds in each loculus and *Sahniocarpon* has only one in each loculus. Both loculicidal capsules clearly show dehiscence. *Daberocarpon gerhardii* Sheikh is 10 locular and each loculus shows only one seed. It shows ridges and furrows which are not seen in the present fossil. *Deccanocarpon arnoldii* Paradkar shows 8 locular capsule with one seed-row in each loculus. The present fossil fruit was also compared with fossil berries like *Krempocarpon aquitica* Chitaley & Kate, *Krempocarpon indicum* Upadhye & Patil, *Mohgaoncarpon eydei* Yawale, *Biloculocarpon mohgaoense* Yawale,

Ramanujamocarpon indicum Kolhe, which are all unilocular with parietal placentation. *Leguminocarpon* Yawale is a unilocular lomentaceous legume with marginal placentation. *Erythroxylocarpon intertrappea* Khubalkar is stalked, 3-locular, 2 locules are basal and fertile, 3rd is sterile and superior in position; there is marginal placentation; seed anatropous bitegmic and with straight embryo; endosperm present. *Wingospermocarpon mohgaoense* Kapgate is oval, unilocular, fibrous fruit, seeds 7, winged and endospermic. *Cremocarpon deccanii* Karanjekar is a two chambered cremocarp; two mericarps attached to the biforked carpophore on commisural sides, mericarp unilocular, smooth, elongated pericarp with 2 zones, seed solitary, unitegmic, anatropous, pendulosus. *Utriculariocarpon chitaleyii* Karanjekar is a simple fruit, dry dehiscent, unilocular, free central placenta, seeds anatropous, unitegmic, nonendospermic, seed coat with ridges and furrows. *Euphorbiocarpon drypeteoides* Mehrotra, Prakash & Bande is trilocular rarely bi-or unilocular, 3-2-1 seeded drupe. The fruit wall is differentiated into thick epicarp, fleshy mesocarp and a stony endocarp, seed is elliptical, one in each locule with multilayered seed coat and homogeneous endosperm. *Grewia mohgaoensis* Paradkar & Dixit is small, round, five lobed, two pyrened, two seeded, drupaceous and indehiscent fruit with albuminous seeds. Embryo straight with 2 foliaceous cotyledons. *Piperocarpon mohgaoense* Kumar is baccate, indediscent, one seeded, exotegmic or endotegmic, anacampylotropous, embryo minute, straight and undifferentiated, *Chitaleycarpon deccanii* Kumar is small, stalked, unilocular, baccate, indehiscent with undifferentiated seed coat and embryo is not seen.

From the above comparison, it is clear that fossil fruit under investigation is totally different from the previously described fossil fruits from the Deccan Intertrappean Series.

After a detailed study of all characters of the fossil fruit it has been found resembling more Trapaceae than any other dicotyledonous family. For comparison with modern *Trapa* the embryological study by Manasi Ram (1956) has been very helpful in tracing each and every tissue; the testa, tegmen, hypostase and the large single cotyledon. It was observed that fossil fruit is identical with the fruit of *Trapa*. Sections of fresh specimen of *Trapa bispinosa* were cut along different planes for comparison with the fossil specimen and the following similarities are observed.

Trapa bispinosa	*Fossil fruit*
(1) Fruit is one seeded drupe.	(1) Fruit is one seeded drupe.
(2) Fruit surrounded by calyx limb with 2-4 spines	(2) Fruit surrounded by calyx limb with 3-4 spines.
(3) Barbs present on spine	(3) Barbs seen on spine.
(4) Fruit surrounded by a fleshy covering (aerenchyma).	(4) A covering is seen in the form of a layer surrounding the fruit wall.
(5) Fruit is coriaceous and indehiscent.	(5) Fruit is coriaceous and indehiscent.
(6) Seed is nonendospermic and dicot type.	(6) Seed is nonendospermic and dicot type.

Trapa bispinosa	*Fossil fruit*
(7) Tegmen is not multiplicative and shows spiral thickening.	(7) Tegmen is not multiplicative and shows spiral thickening.
(8) Hypostase is present.	(8) Hypostase is present.
(9) Embryo with one well developed cotyledon and other cotyledon is vestigeal.	(9) Embryo with one well developed cotyledon and other cotyledon is vestigeal.

From the adove comparison it seems that the fossil fruit is more or less identical with the fruit of *Trapa* of the family Trapaceae. Therefore, the present fossil dicot fruit is named as *Trapa mohgaoensis* sp. nov. The specific name is after the locality from where the fossil fruit was collected.

The gymnosperm ovule *Podocarpoovulites triwingatous* (Singh, 1977) from the Deccan Intertrappean beds of Mohgaonkalan, Madhya Pradesh is also compared with the present fruit. After careful odservations and comparison it is concluded that it is not a gymnosperm ovule but a fruit of Trapaceae. The fruit is confused as an ovule. Three wing like projections are not the outgrowths of ovule but are modified persistent seeds of *Trapa* fruit. Fruit wall is interpreted as an integument of ovule. Pollen chamber and endosperm which are shown present are not observed in a fruit. Testa and tegmen which are the characteristic layers are not taken into consideration and also nothing has been mentioned about the hypostase which is so prominent in the specimen.

Diagnosis

Trapa mohgaoensis sp. nov.

Fruit is dicotyledonous, compressed, turbinate, coriaceous, on eseeded, drupaceous and indehiscent, 2-3 spines with barbs, fruit wall shows 3 zones. Outer zone cells oval, parenchymatous arranged as aerenchyma, middle zone consists of sclerenchyma and inner zone parenchymatous, seed large, oval, nonendospermic, hypostase present, Embryo pseudomonocotyledonous with one large cotyledon and other scale-like or reduced.

Holotype — TRA/PAT 1.
Horizon — Deccan Intertrappean Series.
Locality — Mohgaonkalan, District Chhindwara, Madhya Pradesh.
Age — Upper Cretaceous?

Trapa represents an ancient genus known from Cretaceous onwards. It was recorded from the Cretaceous of North America by Berry (1914) who reported two species. Several species are known from the Eocene onwards in Oligocene, Miocene, Pliocene and Pleistocene. From Pleistocene of Kashmir Puri (1951) has described fossil *Trapa* fruits. It seems that *Trapa natans* flourished during the Tertiary when it was widely distributed. It was also widespread at very high latitudes during preglacial times and its absence from these regions today is variously interpreted. The present *Trapa* specimen having three spines and perhaps a smaller 4th one is the most primitive type being rather smaller in size than present day *bispinosa* one. It formed part of an aquatic floating shallow water plant community consisting of *Azolla*, *Salvinia*, *Eichhornia* and *Rodeites;* a rooted aquatic fern and many other aerenchyma containing plants like *Aerorhizos* des-

cribed from Deccan Intertrappean Series. However, this is the first record of fossil *Trapa* from Mohgaonkalan locality of Deccan Intertrappean Series.

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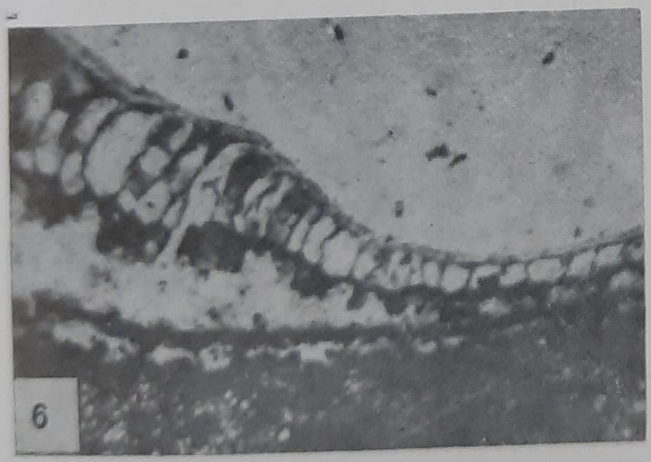
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Explanation of Plate

PLATE 1

Trapa mohgaoensis sp. nov.

1. The fruit exposed in the rock in L. S. × 4
2. L. S. of fruit with spine like projection. × 16
3. Spine in L. S., enlarged, showing barbs and fleshy layer. × 180.
4. Pericarp of the fruit showing vascular supply. × 60
5 & 6. Pericarp and seed coat in L. S.; tegmen shows spiral thickening. × 450.
7. Embryo in L. S., showing scale like cotyledon in the extended neck like micropylar part of the fruit. × 50.
8. Cells of the tegmen in surface view showing reticulate thickening. × 450
9. Hypostase in L. S. at the chalazal end of seed. × 80