EUPHORBIOCARPON DRYPETEOIDES, A NEW EUPHORBIACEOUS FRUIT FROM THE DECCAN INTERTRAPPEAN BEDS OF MANDLA DISTRICT, MADHYA PRADESH

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ABSTRACT

The paper deals with a new euphorbiaceous fruit, *Euphorbiocarpon drypeteoides* gen. *et* sp. nov. from the Deccan intertrappean beds of Ghughua near Shahpura in Mandla District of Madhya Pradesh. It is a small, usually three-seeded drupe and shows some resemblance with the modern fruits of *Drypetes* Vahl.

INTRODUCTION

The Deccan Intertrappean flora is the oldest flora of the Indian Palaeogene and is of special interest because all the major groups of the plant kingdom are known in this flora. The plants are mostly silicified and often very well preserved representing algae, fungi, bryophytes, pteridophytes, gymnosperms and the angiosperms—both monocotyledons and dicotyledons. However, the angiosperms form a dominant group and are represented by all the plant parts, viz. twigs, stems, leaves, flowers and fruits, although flowers and fruits are rarely known (PRAKASH, 1960, 1972). Beside palms, the dicotyledonous fruits so far described are *Enigmocarpon parijai* Sahni (1943) and *Enigmocarpon sahnii* Chitaley & Kate (1977) of Sonneratiaceae (MAHABALE & DESHPANDE, 1959), *Indocarpa intertrappea* Jain (1964) of Guttiferae, *Harrisocarpon sahnii* Chitaley & Nambudiri (1973) and *Daberocarpon gerhardii* Chitaley & Sheikh (1973) probably of Malvaceae, *Sahniocarpon harrisii* Chitaley & Patil (1973) and *Deccanocarpon arnoldii* Paradkar (1975). Recently the authors discovered another dicot fruit from the Deccan Intertrappean beds of Ghughua in Mandla District; this is being described in the present communication. This newly discovered locality of Ghughua (23° 11′: 80°42′) is situated on Niwas-Shahpura road about 80 km north-east of Mandla in Madhya Pradesh and is rich in woods and fossiliferous cherts in which these fruits were found embedded. About a dozen of these fruits were first collected by one of us (M. B. Bande) in December, 1978 which were incomplete without well preserved mesocarp and epicarp. However, in a subsequent trip during 1981 the authors further collected about thirty more specimens of these fruits of which two were complete showing all the layers of pericarp. The better preserved specimens were cut along transverse and longitudinal planes and their thin sections were prepared. The anatomical description of the fruit is based mainly on the slides from these specimens while the external morphological details of the fruit were taken from a number of other specimens also.

Beside the present fossil fruit, a few other fossil plants are known from this locality. These are fossil woods, viz. *Sterculioxylon shahpurensis* of Sterculiaceae, *Calophylloxylon dharmendrae* of Guttiferae, *Burseroxylon preserratum* of Burseraceae, *Heyneoxylon tertiarum* of Meliaceae, *Dracontomelumoxylon mangiferumoides* of Anacardiaceae, *Laurinoxylon deccanensis* of Lauraceae (BANDE & PRAKASH, 1980, 1983) and a palm fruit *Hyphaeneo-*

carpon indicum (BANDE, PRAKASH & AMBWANI, 1982) resembling the modern taxa *Sterculia*, *Calophyllum*, *Bursera*, *Heynea*, *Draconiomelum*, and *Hyphaene*.

SYSTEMATIC DESCRIPTION

Family—EUPHORBIACEAE

Genus—**Euphorbiocarpon** gen. nov.

Euphorbiocarpon drypeteoides sp. nov.

MORPHOLOGY

Gross Features

The fossil fruit is usually a trilocular, three-seeded drupe, oval to elliptical in shape and measures 2.1 cm in length and 1.9 cm in diameter (Pl. 1, Figs. 1, 2, 4, 5; Text-figs. 3, 4). However, rarely one or two carpels become abortive and the mature fruit shows a bilocular or unilocular condition (Pl. 1, Figs. 3, 6; Text-figs. 1, 2). Most of the specimens, where only endocarp is preserved in the fruit wall, are somewhat smaller in size, about 1.3 to 1.8 cm in length and 8 mm to 1.5 cm in diameter (Pl. 1, Fig. 1). The *pericarp* or fruit wall is well preserved measuring about 4.35 mm in thickness and can be differentiated into a badly preserved *epicarp*, a thick and fleshy *mesocarp* and a stony, multilayered *endocarp*. *Seed* is elliptical in shape, one in each locule, 1.2 to 1.5 cm in length and 7-8 mm in diameter (Pl. 1, Figs. 3, 4, 6; Text-figs. 1, 2, 3). Each seed consists of a multi-layered seed coat and a homogeneous endosperm. In some of the seeds an embryo is also seen which is somewhat oval in shape and about 240-360 μm in diameter in cross section (Pl. 2, Fig. 13; Text-fig. 1). Besides, in longitudinal section of one of the seeds a rod-like space is seen where embryo might have been present (Pl. 1, Fig. 5; Text-fig. 4).

Anatomy

Epicarp is the outermost, badly preserved, thin layer of the fruit wall, seen at places and appears to be composed of a single row of thin-walled, horizontally elongated parenchymatous cells. *Mesocarp* is about 2.61 mm in thickness and composed of several layers of thin-walled, parenchymatous cells of variable shape and size in which vascular strands are irregularly distributed. The parenchymatous cells of this region are mostly oval to elliptical in shape measuring 36-160 μm in diameter (Pl. 2, Fig. 7; Text-fig. 5). Sometimes the elliptical parenchyma cells of the ground tissue are arranged in horizontal files. *Endocarp* measures about 1.73 mm in thickness and can be differentiated into a 1.65 mm broad outer zone and discontinuous, narrow strips of inner zone which

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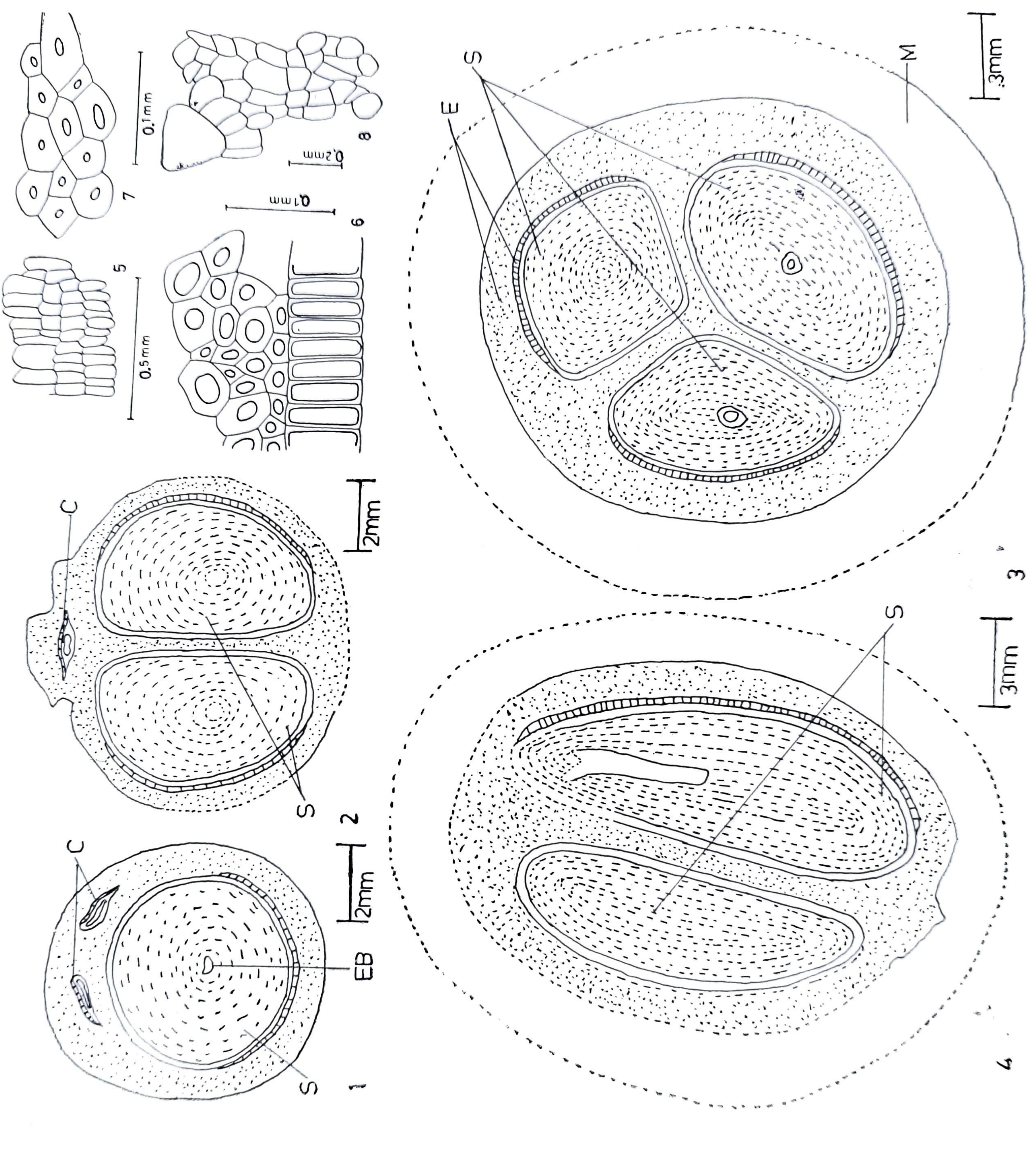
TEXT-FIGS. 1-8

Euphorbiocarpon drypeteoides gen. *et* sp. nov.—1. Transverse section of uniloculer fruit showing a seed (S) with embryo (EB) and two aborted cerpels (C). Slide no. 6833. 2. Transverse section of bilocular fruit showing two seeds (S), one in each locule and one aborted carpel(C). Slide no. 6835. 3. Transverse section of trilocular, three seeded fruit showing mesocarp (M), endocarp (E) and a single seed (S) in each locule, Slide. no. 6832. 4. Longitudinal section of the fruit showing two seeds (S), one in each locule. Slide no. 6834. 5. Thin-walled cells of the mesocarp. Slide no. 6832. 6. Endocarp with two distinct zones, outer zone of thick-walled, polygonal cells and inner zone of thick-walled, radially elongated, rectangular cells. Slide no. 6833. 7. Thick-walled, polygonal cells of the septum. Slide no. 6836. 8. Thin-walled cells of the endosperm. Slide no. 6832.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cover the seeds (Text-fig. 3). The outer zone is made up of several layers of thick-walled, polygonal cells which vary in size from 24 μm to 65 μm (Pl. 2, Fig. 9; Text-fig. 6). Their lumen diameter varies from 12 μm to 24 μm. The strips of the inner zone are made up of a single layer of thick-walled, radially elongated, rectangular cells. Their size varies from 68-76 μm in radial length and 20-22 μm in tangential width. The lumen is about 8 μm in diameter. *Septa* are present separating the chambers in case of bilocular and trilocular fruits (Pl. 1, Figs. 4, 6). Each septum is made up of about 15-20 layers of very thick-walled, polyngonal cells with small lumen and measures about 542.5 μm in thickness (Pl. 2, Fig. 11; Text-fig. 7). The cells are similar to the cells of the outer part of the endocarp except that they are very thick-walled with small lumen of only 2 μm in diameter. Size of these cells varies from 28 μm to 92 μm. *Seed* is covered with a seed coat of 4-6 layers of rectangular cells, 28-60 μm in tangential length and 20-24 μm in radial length (Pl. 2, Fig. 10). These cells are usually thin-walled but there seems to be 1-2 layers of thick-walled cells at some places. *Endosperm* consists of thin-walled, rectangular to oval or elliptical cells which are 24-60 μm in size (Pl. 2, Fig. 12; Text-fig. 8). Some empty spaces are also present in the peripheral part of the endosperm. *Embryo* appears to be made up of thin-walled cells with a single layer of epidermis (Pl. 2, Fig. 13).

DISCUSSION

The structural features of the fossil fruit indicate that it is a drupe which is known to occur in both the monocotyledons and the dicotyledons amongst the angiosperms. In monocotyledons the drupaceous fruits are found only in certain genera of Palmae otherwise the fruits are capsule, berry or caryopsis (Lawrence, 1951; Hutchinson, 1979). However, the fibrous bundles and the fibro-vascular bundles surrounded by a well developed sclerenchymatous sheath, which are characteristic features of a palm fruit, are not seen in the present fossil fruit. Consequently, the fossil fruit cannot be placed among the monocotyledons and its affinities should be traced with the dicotyledons. Amongst the various orders of the dicotyledons the drupaceous fruits with trilocular condition in the ovary are found in 11 orders, viz. Piperales, Santalales, Geraniales, Sapindales, Rhamnales, Malvales, Parietales, Myrtiflorae, Umbelliflorae, Ebenales and Rubiales. However, in six of the above orders, e.g. Santalales, Geraniales, Sapindales, Parietales, Umbelliflorae and Rubiales, a single ovule per locule is present (Lawrence, 1951; Hutchinson, 1979). But in the various families belonging to these orders, only in Euphorbiaceae a multi-seeded drupe is known to occur while in all the other families only one ovule matures and ultimately the drupe is single-seeded (Hooker, 1885; Lawrence, 1951; Hutchinson, 1979). However, in the family Euphorbiaceae a multi-seeded drupe is present only in *Elaeophorbia* Stapf and *Drypetes* Vahl syn. *Cyclostemon* Blume syn. *Putranjiva* Wall. syn. *Hemicyclia* Wight & Arn. (Willis, 1973), whereas in other genera the drupe is only single-seeded. In *Elaeophorbia* although the fruit has a thick flesh enclosing a hard bony, 3-celled endocarp similar to that of the fossil fruit, here the endocarp is marked with a slender groove down the back of each cell unlike the present fossil. Besides, there is a pore on each face near the apex between the grooves which is also not seen in the present fossil fruit (Thiselton-Dyer, 1913, p. 604). On the other hand, fruits of the genus *Drypetes* Vahl (Pl. 2, Fig. 8) show a near similarity with the fossil fruit in most of the features. In *Drypetes* the fruits are 1-4 locular with a single seed in each locule. A study of the modern fruits of four species of *Drypetes* Vahl syn. *Cyclostemon* Blume available to us, viz. *C. macrophyllus* Blume, *C. assamicus* Hook. f., *C. lanci-*

folius Hook. f. and *Cyclostemon* sp. indicates that the fruits of these species are very similar to the fossil fruit in shape, size, number of locules and number of seeds per locule. However, the fossil fruit differs from the modern fruits in the presence of sclereids among the thin-walled cells of the mesocarp. Moreover, the inner zone of endocarp which is made up of a layer of radially elongated, thick-walled cells in the fossil is not observed in the fruits of various species of *Drypetes* so far studied. The modern genus *Drypetes*, with which the fossil fruit shows somewhat near resemblance, grows chiefly in the Old World tropics. Fifteen species of the genus *Drypetes* also grow in India where it is distributed in Andaman and Nicobar Islands, Assam, Sikkim and Central Province (HOOKER, 1885; SANTAPAU & HENRY, 1973).

The earliest record of fossil euphorbiaceous fruits goes back to as early as 1917 when KNOWLTON described *Euphorbocarpum richardsoni* from the Eocene of Raton Formations, Colorado, U. S. A. In 1933, REID AND CHANDLER while describing fossil fruits of Euphorbiaceae from the Eocene of London Clay did not adopt the name *Euphorbocarpum* Knowlton as according to them the fruit of *E. richardsoni* does not belong to the family Euphorbiaceae. They, however, instituted a new genus, *Euphorbiotheca*, to include the dehiscent fossil fruits referable to the family Euphorbiaceae, whose exact affinities are not known (REID & CHANDLER, 1933, p. 284) and described five species, viz. *Euphorbiotheca sheppeyensis, E. obovata, E. minor, E. obscura* and *E. pentalocularis*. Besides, GREGOR (1978) also described fruits of *Mallotus fragilis* Mai, *Omalanthus costatus* Mai and *Sapium germanicum* Kirchheimer from the Miocene, Oberpfalz brown coal of Germany. In all of them, the fruits are capsular and are thus different from the present fossil fruit which is a drupe.

Since the present fruit is different from already known fossil fruits of the family Euphorbiaceae, and is an indehiscent drupe, it cannot be assigned to the genus *Euphorbiotheca* Reid & Chandler (1933) meant for dehiscent euphorbiaceous fruits. Consequently, a new generic name, *Euphorbiocarpon*, is proposed here to include the indehiscent euphorbiaceous fossil fruits. The present fossil fruit is, therefore, described here as *Euphorbiocarpon drypeteoides* gen. *et* sp. nov., the specific name indicating a somewhat near resemblance with the modern fruits of *Drypetes* Vahl.

Euphorbiocarpon gen. nov.

Generic Diagnosis—Indehiscent fossil fruits referable to the family Euphorbiaceae but not assignable to any particular genus.

Type Species—Euphorbiocarpon drypeteoides sp. nov.

Euphorbiocarpon drypeteoides sp. nov.

Specific Diagnosis—Usually trilocular, rarely bi- or unilocular, 3-2-1 seeded drupe, oval to elliptical in shape, about 2.1 cm in length and 1.9 cm in diameter. *Pericarp* 4.35 mm thick with epicarp, mesocarp and endocarp. *Epicarp* of thin-walled, horizontally elongated parenchymatous cells. *Mesocarp* fleshy, 2.61 mm thick, composed of several layers of thin-walled, parenchymatous cells of various shape and size with irregularly arranged vascular strands. *Endocarp* stony, 1.73 mm thick, differentiated into a 1.65 mm thick, outer zone of thick-walled, polygonal cells and inner zone forming one-celled thick, discontinuous strips of rectangular cells. *Septa* 542.5 μm thick, composed of about 15-20 layers of thick-walled polygonal cells. *Seeds* elliptical in shape, 1.2—1.5 cm in length and 7-8 mm in diameter. *Seed coat* of 4-6 layers of rectangular, usually thin-walled cells; cells 28-60 μm in tangential length and 20-24 μm in radial length. *Endosperm* made

up of thin-walled, rectangular and oval to elliptical cells varying from 24-60 μm in size. *Embryo* appears rod-shaped in longitudinal section, composed of thin-walled cells, somewhat oval about 240-360 μm in diameter in cross section.

Holotype—BSIP Slide no. 6832.
Paralypes—BSIP Specimen nos. 35483-35490. BSIP Slide nos. 6833-6836.
Locality—Ghughua near Shahpura
Horizon—Deccan Intertrappean beds
Age—Early Tertiary

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EXPLANATION OF PLATES

PLATE 1

1. *Euphorbiocarpon drypeteoides* gen. *et* sp. nov.—Eight fossil fruits under reflected light showing variation in shape and size. ×1. Speicmen nos. 35483—35490.
2. *Euphorbiocarpon drypeteoides* gen. *et* sp. nov.— A fossil fruit with mesocarp (M) under reflected light. ×5 (The specimen was consumed while preparing the type slide no. 6832).
3. *Euphorbiocarpon drypeteoides* gen. *et* sp. nov.—Cross section of unilocular fruit showing a single seed and two aborted carpels. ×5. Slide no. 6833.
4. *Euphorbiocarpon drypeteoides* gen. *et* sp. nov.—Cross section of the fossil fruit (Fig. 2) showing the fruit wall (mesocarp-M ; endocarp-E) and three seeds (S), one in each locule. ×5. Slide no. 6832.
5. *Euphorbiocarpon drypeteoides* gen. *et* sp. nov.—Longitudinal section of the fossil fruit showing the endocarp and two seeds, one in each locule. ×5. Slide no. 6834.
6. *Euphorbiocarpon drypeteoides* gen. *et* sp. nov.—Transverse section of a bilocular fruit showing an aborted carpel and two seeds one in each locule. ×5. Slide no. 6835.

PLATE 2

7. *Euphorbiocarpon drypeteoides* gen. *et* sp. nov.—Thin-walled parenchymatous cells of the mesocarp. ×75. Slide no. 6832.
8. Modern fruits of *Drypetes* sp. under reflected light. ×1.
9. *Euphorbiocarpon drypeteoides* gen. *et* sp. nov.—Endocarp showing outer zone of thick-walled, polygonal cells and single layered strip of inner zone composed of radially elongated, thick-walled, rectangular cells. ×75. Slide no. 6833.
10. *Euphorbiocarpon drypeteoides* gen. *et* sp. nov.—Transverse section of the fruit showing seed coat (SC) and the endosperm (END). ×200. Slide no. 6832.
11. *Euphorbiocarpon drypeteoides* gen. *et* sp. nov.—Thick-walled, polygonal cells of the septum. ×130. Slide no. 6836.
12. *Euphorbiocarpon drypeteoides* gen. *et* sp. nov.—Thin-walled cells of the endosperm. ×90. Slide no. 6832.
13. *Euphorbiocarpon drypeteoides* gen. *et* sp. nov.—Cross section of a seed showing part of the embryo(EB). ×115. Slide no. 6833.


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2


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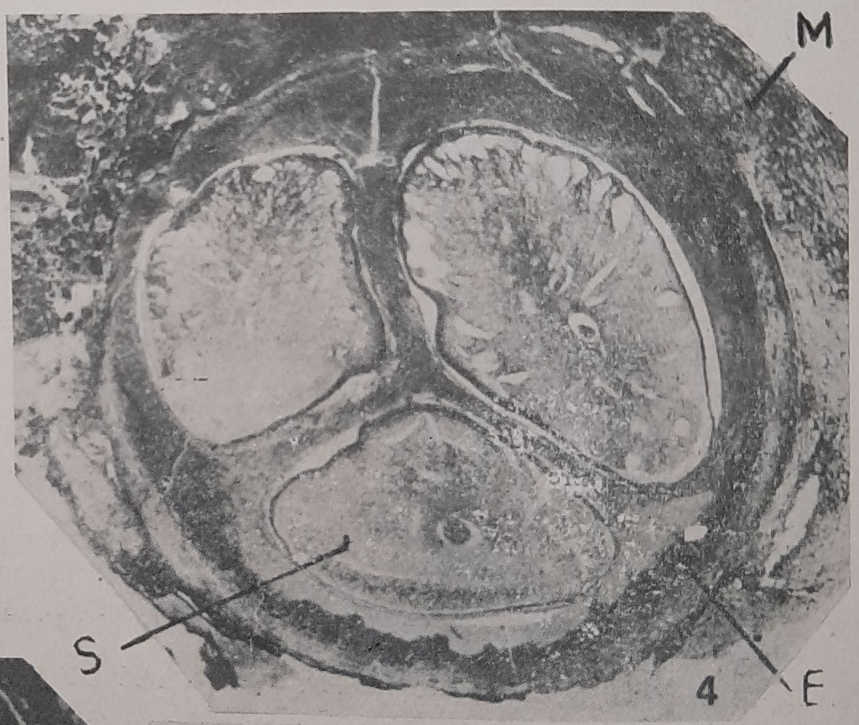
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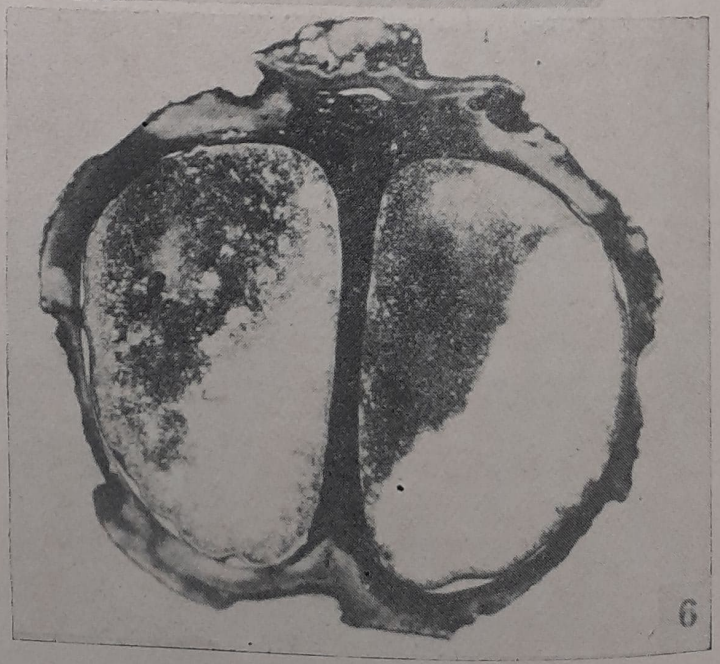
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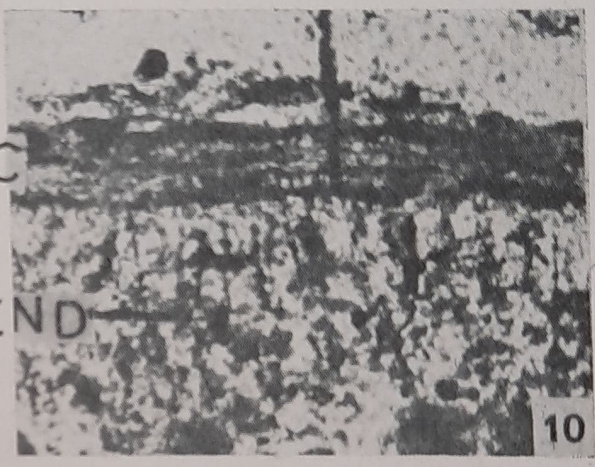
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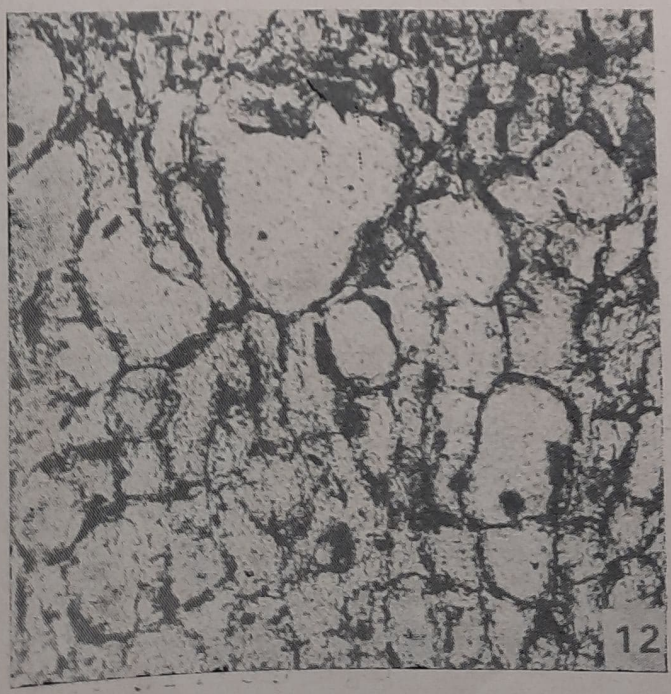
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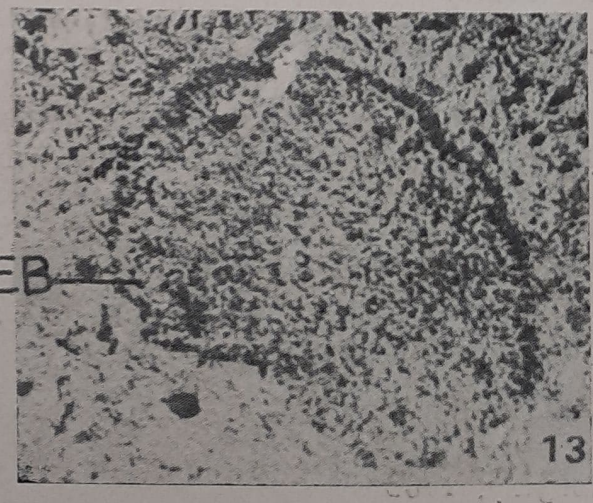
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