NIPA SAHNII, A PALM FRUIT IN THE TERTIARY OF ASSAM

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ABSTRACT

Three fossil fruits collected by Sir Cyril S. Fox 1½ miles south of Kalaichar bungalow (25° 26′; 89° 50′ 30″) near the western extremity of the Garo Hills are described as *Nipa Sahnii*. Their age is regarded as Miocene.

A short history of the genus *Nipadites* is given. The bearing of the occurrence of *Nipa* during Miocene on the palaeogeography of the present locality is discussed.

INTRODUCTION

IN October 1938 the Director of the Geological Survey of India sent Professor Sahni a small collection of fossil plants made by Sir Cyril S. Fox at several localities in and around the Garo Hills, Assam. The major part of the collection consisted of dicotyledonous woods, most of which were too poorly preserved to be studied at all. But with them were the three fruits which have been described in this paper as *Nipa Sahnii*. They were found along with mammalian bones, 1½ miles south of Kalaichar bungalow (25° 26′; 89° 50′ 30″). This locality lies between the western extremity of the Garo Hills and the left bank of the Brahmaputra. The age is regarded as Miocene.

I am deeply indebted to the late Professor B. Sahni, F.R.S., who placed the material at my disposal and gave me invaluable suggestions for its investigation. I also take this opportunity to express my heartfelt gratitude to Professor T. M. Harris, F.R.S., for his criticism and the interest he kindly took in going through the manuscript of this paper. I am grateful to Dr. R. V. Sitholey for the photographs of the material and his general help throughout the preparation of this paper. To Dr. T. S. Mahabalé I owe my thanks for supplying me fruits of *Nipa fruticans* and for his encouraging appreciation of this piece of work.

GENUS *NIPADITES*

The earliest record of *Nipadites* seems to be in 1757 when Parsons described some fossil fruits of this type collected from the island of Sheppey in England. Similar specimens were collected from some other localities also and referred to by various workers as specimens of coconuts, almonds or areca fruits. Brongniart gave the name *Pandanocarpum* to the elongated specimens of *Nipadites* from Sheppey. The genus *Nipadites* was established by Bowerbank in 1840 in his "History of the Fossil Fruits and Seeds of the London Clay", emphasizing the relation of the fossils to the recent genus *Nipa*. In this work he described thirteen species of *Nipadites*. Impressed by the close similarity of the fossils with the recent fruits of *Nipa*, Ettingshausen actually put them as species of *Nipa* itself. A critical *résumé* of all the work on *Nipadites* till 1894 was published in that year by Rendle. In this he resolved the number of species to seven.

He realized the closeness of *Nipadites* with the modern *Nipa* but did not adopt the latter name because of "the uncertainty which must always attach to the specific diagnosis of fossils based, as it often necessarily is, on material which would be deemed quite inadequate in the case of recent plants" (RENDLE, 1894, p. 144).

In 1903 Seward and Arber described samples of *Nipadites Burtini* from the Middle Eocene of Brussels. They also found the resemblance between the fossil *Nipadites* and the fruits of *Nipa* as very striking but felt that it would be better to maintain the name proposed by Bowerbank because the specimens were not recent and it was hard to admit the identity of the fossil and the recent until it was proved. Specimens of *Nipadites* were described from Eocene beds of Egypt, Wilcox (U.S.A.), Borneo, Ukraine and Texas by Bonnet (1904), Berry (1914, 1916, 1930), Kräusel (1923), Kryshtofovich (1927) and Ball (1931) respectively. In 1933 Reid and Chandler published a most comprehensive memoir on the fossil fruits and seeds of the London Clay found on the shore at Sheppey. In this memoir they gave a most complete and critical review of the genus *Nipadites*. They compared the fossil fruits with those of the modern *Nipa fruticans* and found them very closely related though not identical. Considering the degree of variation

seen in the species of the allied genera of Palmae they thought that the little difference that did exist between *Nipadites* and *Nipa* was not of a generic nature. Hence they referred the Sheppey fossils to the genus *Nipa*, under a single species, *Nipa Burtini* (Brongniart).

In 1933 Rode described two new species of *Nipadites*, *N. compressus* and *N. hindi*, from the Deccan Intertrappean beds of Central Provinces in India. This was the first report of *Nipadites* from India, although Hislop, about 1860, had a collection of plant fossils containing some fruits of allied nature from the Central Provinces. But he did not describe them (HISLOP, 1861).

In 1936 Stockmans described *Nipadites Burtini* from the Eocene of Brussels. He studied the sections of the fossils and compared them with those of *Nipa fruticans*. Finding the size and structure of the vascular bundles different in the two, he preferred to keep the fossils under a different generic name because, as he said, the palaeobotanists relied more on the form of the vascular bundles and especially the form of the fibrous zone for the distinction of the fossil palms (STOCKMANS, 1936, p. 34).

In 1937 Sahni, in a joint paper with Rode, re-examined Rode's collection of 1933. He found that it was difficult to decide whether *Nipadites compressus* was definitely a *Nipadites* or some other type of palm fruit. Therefore, he named it as *Palmocarpon compressum*. But the other specimen of *Nipadites hindi* was too much like the fruit of *Nipa* to be placed in a different genus, and hence he called it *Nipa hindi*.

Arnold (1952) reports as *Nipadites burtini* a *Nipa* fruit from the Eocene of Texas.

It appears that the vascular bundles provide the only reason for maintaining *Nipadites* as a separate genus from *Nipa*. I cannot, however, express any opinion on this point as I have not studied specific variation in the bundles of palm fruits. Even if the genus *Nipadites* be distinguished, it is clear that *N. Sahnii* is nearer to the recent *Nipa* than to *N. Burtini*. Unfortunately we know nothing of the vascular bundles of *N. Sahnii*.

NIPA SAHNII SP. NOV.

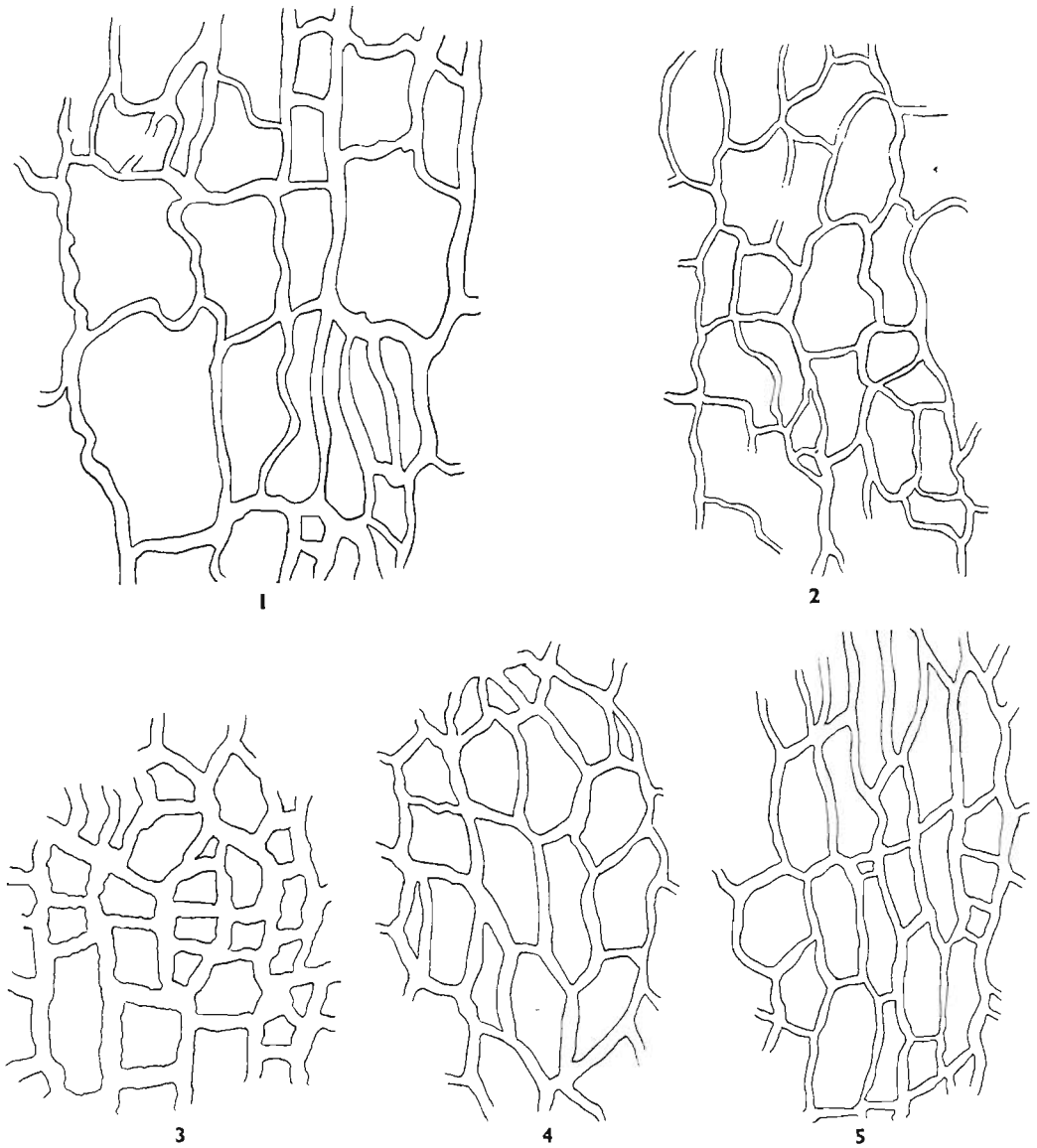
Diagnosis — Fruits, with four or five facets, suggesting a capitulum inflorescence. Average mature fruit a unilocular, one-seeded drupe; obovoid, compressed; about 11 *cm. in length (by inference)*, ca. 6·5 *cm. in breadth, maximum near one-third length from the apex. Apex broad, umbonate. Epicarp thin, smooth, surface cells more or less rectangular with fairly thick, wavy cell walls. Sarcocarp fibrous, fibres visible on the surface. Seed cavity roughly spherical measuring about* 5 *cm. in diameter, with a narrow well-defined longitudinal ridge of the endocarp extending on one side from base to top.*

As a token of respect and affection for my teacher, the late Professor Birbal Sahni, I name this species as *Nipa Sahnii*.

Description — The specimens are preserved as casts composed of ferruginous gritty clay and hence it is not possible to study their internal structures in any great detail. Specimens 1 and 2 (PL. 1, FIGS. 1, 2) are the casts of the fruits themselves while No. 3 (PL. 1, FIG. 3) represents the internal cast of the seed cavity of the fossil fruit.

The form and structure of the fossils are very much like those of the fruits of the living *Nipa* (PL. 1, FIG. 4). They are elongated, obovoid drupes with four or five facets on the surface. The angles formed by the facets are raised into longitudinal ridges as in living *Nipa* and are more prominent near the broad, roundish apex. The size and form vary, as in the modern genus, with the degree of development of the fruits and their position in the fruiting head. No. 1 is 6·75 cm. long and 4 cm. wide near the middle. No. 2, an incomplete specimen in which the basal part is not preserved, has a maximum width of 6·25 cm. The complete fruit might have been about 11 cm. long. It is more compressed than No. 1 and has broader apex. In No. 2 the apex is umbonate while in No. 1 the umbo is fractured. In size and form the specimen No. 2 greatly resembles the mature fruit of *Nipa fruticans* while No. 1 probably represents an immature fruit.

The epicarp is almost destroyed except at a few small patches on the surface in specimen No. 1. It is thin and smooth. A few preparations showing the outer cell layer were made by applying cellulose varnish " Duco " and scraping it off. These scrapings were cleaned with hydrofluoric acid and Schulze's mixture. Two types of cell structure were noted. The one (TEXT-FIGS. 1, 2) obtained from near the base of the fruit shows more or less rectangular



TEXT-FIGS. 1-5 — Camera lucida sketches of the surface cells of fossil and living *Nipa* fruits. 1, 2, *Nipa Sahnii*. Usual type of cells. × 375. 3, *Nipa Sahnii*. Cells with very thick cell walls. × 85. 4, 5, *Nipa fruticans*. × 375.

cells with moderately thick wavy cell walls. Some of the cells are further divided by obliquely vertical walls into cells almost triangular in shape. Stomata are not visible in the preparations made. The other, from a different part of the fruit (TEXT-FIG. 3), shows cells with more or less the same arrangement but with cell walls which are easily five times thicker than those of the first type. Preparations of surface cells of the fruit of *N. fruticans* were made by macerating bits of the epicarp from the base. These show (TEXT-FIGS. 4, 5) cell structure comparable with the first type (TEXT-FIGS. 1, 2) of *N. Sahnii* although appearing a little more regular and with cell walls less wavy.

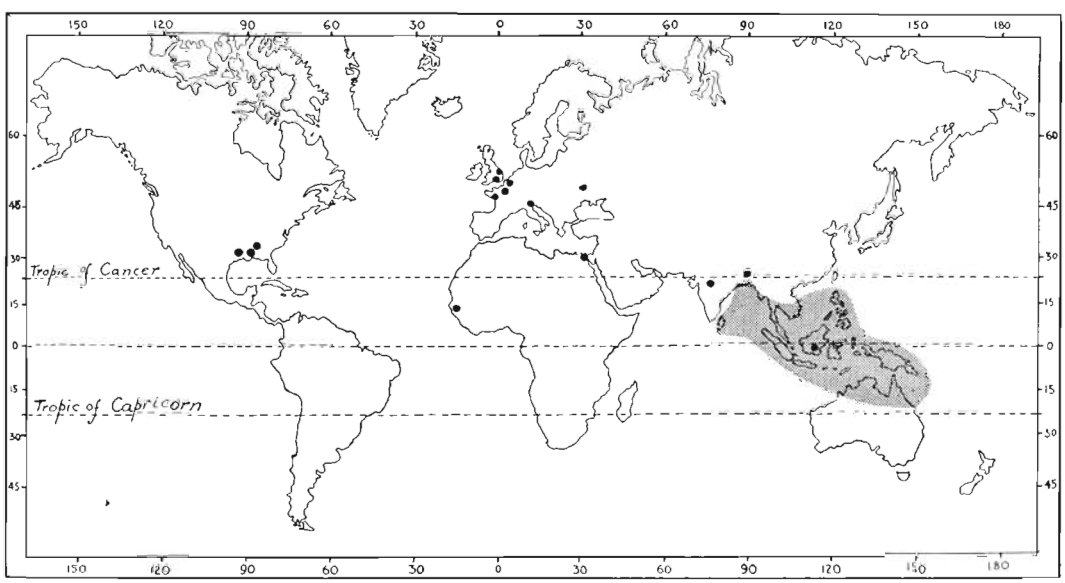
The sarcocarp, as seen on the surface of the fruits, is thick and fibrous, the fibres running longitudinally. There seem to be two types of fibres. The thicker ones which are fewer and more widely spaced; and the thinner ones which are numerous and run in between the former.

Specimen No. 3 (PL. 1, FIG. 3) represents the seed cavity. The cast is not well preserved, being made of coarse gritty material which has now crumbled into a number of pieces. It was irregularly round with bluntly pointed opposite ends representing the top and the base. It measured 5·7 cm. in length and 4·75 cm. in diameter. Comparing the size of the seed cavity with that of the whole fruit it is evident that the pericarp must have been thicker at the ends than near the middle of the fruit. There was on one side a narrow groove running longitudinally from one end to the other. This is a characteristic feature of the living genus *Nipa*. On the surface at places are seen widely spaced longitudinal lines packed with a large number of transverse fibrilae (PL. 1, FIG. 5). This feature is also typical of modern *Nipa*. When the seed is removed from the seed cavity in the living plant, the inner wall of the endocarp shows remnants of the endosperm adhering to it as a network of irregular lines traversing all around.

Comparison — The large number of species of *Nipa* or *Nipadites* described from different localities have been attributed to *N. Burtini* by Reid and Chandler and by Stockmans. *N. hindi* which was described later has not been united with *N. Burtini* but it seems to me that it agrees with it so closely that it should be regarded as identical. It differs less from typical *N. Burtini* than many of the specimens already attributed to it.

N. Sahnii differs from *N. Burtini* in the internal ridge in the endocarp. According to Reid and Chandler, there is either no ridge at all, or else a short one in *N. Burtini*. They discuss this character in detail and point out that it distinguishes *N. Burtini* from *N. fruticans* where the ridge is normally well developed and runs the whole length. In this respect *N. Sahnii* agrees with *N. fruticans* and differs from *N. Burtini*. No other difference is yet known.

The resemblance between *N. Sahnii* and *N. fruticans* is quite close. The cell structure of the surface of the fruit in the two species is more or less the same ; but it must be admitted that the structural details in the fossil are not completely understood and so must be used with caution. The age difference between Miocene and Recent



TEXT-FIG. 6 — Sketch map of the world showing approximately the distribution of fossil (black dots) and living (stippled) Nipa-palm.

is, however, very great and it seems to me preferable not to use a name for an incompletely known fossil which would imply that the recent species has existed unchanged since Miocene period.

DISCUSSION

About the age of the locality of present specimens Sir Cyril S. Fox wrote to Professor Sahni: "The collection from S. of Kalaichar was made in beds which I think are Upper Tertiary (Miocene) and I believe the Burmah Oil Co. agree, but it is an area of monotonous sandstones and blue clays with very low dips over miles, so that one might have anything happening..." The locality lies near the left bank of the Brahmaputra on the western side of the Garo Hills. Oldham (1893, pp. 332, 333), referring to the Upper Tertiaries of Assam, composed of rusty sandstones and grey shales, has described a locality lying near Mahendraganj (or Karibari) as Upper Miocene. Like the present locality the Mahendraganj locality also lies near the left bank of the Brahmaputra. There is another thing common between the above locality and the present one. Amongst the fossils described from the Mahendraganj locality were the teeth of *Anthracotherium*, a mammal of Miocene age. Significantly the present fossil fruits were also found along with mammalian remains. The Karaibari (=Karibari) fauna was later studied by Mukerji (1939) who thinks it to be of a Lower Miocene age, approximately equivalent to Aquitanian-Burdigalian or Burdigalian, identical with the Bagmara and Dalu horizons.

Seeing the geographical location, the composition of the beds and the occurrence of mammalian remains, the present locality is most probably Miocene in age. The *Nipa* described in this paper is the first to be reported from Miocene beds.

Fossil *Nipa* or *Nipadites* has been reported from many places in the world lying far off from one another, as will be clear from Text-fig. 6.

All these fossil localities, except the present one, are of Eocene age. Those of the old world are believed to belong to the Tethys Sea.

The locality of *N. Sahnii*, if correctly assigned to the Miocene, would have nothing to do with the Tethys Sea which had by that time disappeared in Assam. It is more probable that it marked the coastline of a Miocene extension of the Bay of Bengal.

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EXPLANATION OF PLATE 1

1. *Nipa Sahnii*. Fossil specimen No. 1. Cast of the fruit. Slightly smaller than natural size.
2. *Nipa Sahnii*. Fossil specimen No. 2. Cast of the fruit. × 1.
3. *Nipa Sahnii*. Fossil specimen No. 3. Internal cast of the seed cavity. × 1.
4. *Nipa fruticans*. A complete fruit. × ¾.
5. *Nipa Sahnii*. A part of the specimen No. 3 magnified to show the longitudinal and transverse lines on the surface. × 2½.

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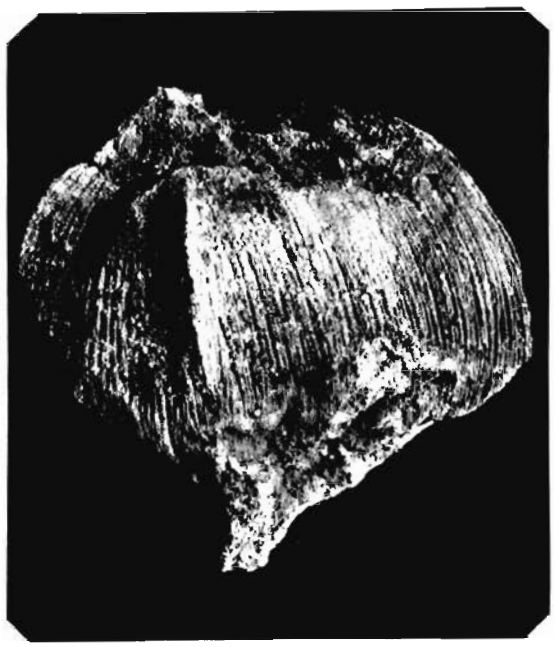

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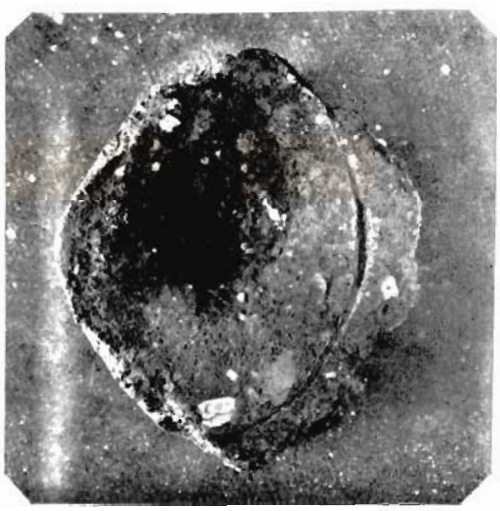

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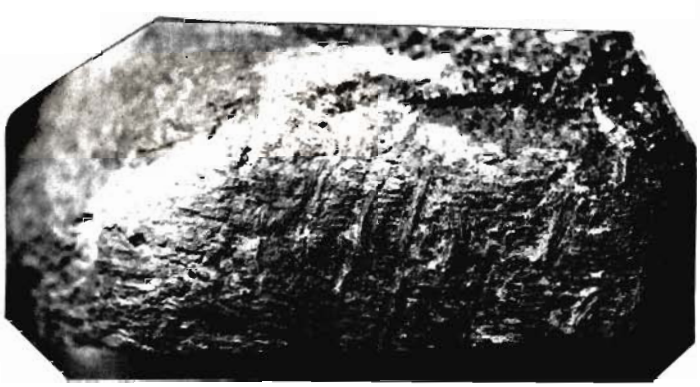

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