LEAF EPIDERMIS OF *NYPA* FROM LIGNITIC BEDS OF RATNAGIRI DISTRICT, MAHARASHTRA

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ABSTRACT

A well preserved leaf epidermis recovered from the lignitic beds of Ratnagiri District, Maharashtra resembling that of an estuarine palm, *Nypa fruticans* is described.

INTRODUCTION

Occurrence of lignitic beds in Ratnagiri District was reported as early as 1871 by WILKINSON. Since then a few other geologists have also found peaty lignite at various localities in the district, mainly in well sections. Though it is generally presumed that they are northern extensions of Neyveli lignites no detailed survey of these has so far been attempted and hence botanical investigation of these exposures has been undertaken by us.

MATERIAL AND METHODS

This contribution is mainly based upon the analysis of lignite collected in two well sections on Ratnagiri—Pawas Road near Third Dharmashala Stop, 10 km south of Ratnagiri. The maceration of the lignite yielded a rich variety of leaf cuticles along with pollen, spores, fungal fructifications, etc. Cuticles could be recovered in a most satisfactory condition by treating the samples with concentrated nitric acid followed by 10 per cent potassium hydroxide for ten minutes each. The recovered cuticles were washed in water and mounted in acetogelatin. A well preserved leaf epidermis recovered from these beds resembling that of estuarine plam, *Nypa* has been described here.

For comparison, freshly fixed leaflets of *Nypa fruticans* were obtained through Botanical Survey of India, Calcutta. Epidermal peels from the middle portion of the leaflets were prepared following the technique mentioned above for the recovery of fossil cuticles.

The numerical figures given in Table 1 represent averages of ten random counts.

OBSERVATIONS

Epidermis hypostomatic (Pl. 1, Figs. 1, 3) ; hair bases characteristic, stomata like, frequent on both the surfaces, but more common on the abaxial epidermis than on the adaxial; each with a pair of heavily cutinised sunken cells (Pl. 1, Fig. 11). Adaxial epidermis (Pl. 1, Fig. 3) uniform, not differentiated into costal and intercostal regions ; the cells (Pl. 1, Fig. 7) rectangular, transversely extended, arranged in longiutdinal files ; the cells surrounding hair bases irregularly arranged. The abaxial epidermis (Pl. 1, Fig. 1) differentiated into narrow costal and very wide intercostal regions ; costal cells rectangular, longitudinally oriented ; intercostal cells (Pl. 1, Fig. 6) squarish to rectangular, somewhat transversley extended, arranged in wavy longitudinal rows ; the

cells surrounding the stomata and hairs irregularly arranged (Pl. 1, Fig. 11). Stomata (Pl. 1, Fig. 9) restricted to abaxial intercostal regions, paratetracytic (DILCHER, 1974) ; the terminal subsidiary cells rectangular, transversely oriented, short and wide, partially overarching the guard cells ; the lateral subsidiary cells oval, thin-walled, as long as guard cells. Guard cells much larger than other epidermal cells, very characteristic ; each with many small cutinised horizontal ledges seen as fine transverse lines in the surface view on many stomata ; outer walls cutinised, inner walls surrounding the pore thin.

COMPARISON

The diagnostic features exhibited by this epidermis are : (1) hypostomatic nature; (2) presence of peculiar stomata like sunken hair bases on both the surfaces ; (3) adaxial epidermis with transversely extended cells, arranged in longitudinal rows ; (4) abaxial epidermis with narrow costal and very wide intercostal bands ; (5) intercostal cells arranged in somewhat wavy longitudinal files ; (6) stomata paratetracytic, restricted to intercostal bands, in many indistinct longitudinal files ; (7) the terminal subsidiary cells short, wide and slightly overarching the guard cells and lateral subsidiary cells as long as the guard cells, thin walled and (8) the guard cells much larger than other epidermal cells with many horizontal ledges.

These details show that this epidermis belongs to palms. Within palms, the characteristic transverse bands on guard cells are seen in Caryotoid palms and in *Nypa*, though in the latter case they are most evident in sectional than in surface views. However, the Caryotoid palms have cylindrical hair base composed of several sclerotic cells surrounding one or more thin walled cells as against peculiar stomata like hair bases consisting of only two cutinised cells present in this specimen.

The features enumerated to be diagnostic for *Nypa* epidermis by TOMLINSON (1961) and MOORE (1973) are : (1) The presence of characteristic stomata like sunken hair bases consisting of two cutinised cells resembling guard cells ; (2) transversely extended adaxial epidermal cells and (3) guard cells of stomata sunken, much larger than other epidermal cells, each with many horizontal ledges between the large inner and outer ledges. All these characters are shared by the present epidermis also.

In addition to these, the hypostomatic nature, the arrangement of adaxial epidermal cells in longitudinal rows, the differentiation of abaxial epidermis into narrow costal and very wide intercostal areas, the arrangement of intercostal epidermal cells in somewhat wavy longitudinal rows, the paratetracytic stomata restricted to intercostal bands arranged indistinct longitudinal rows, the short wide terminal subsidiary cells slightly arching over guard cells and the thin-walled lateral subsidiary cells equalling the guard cells in their length are other features common to the fossil leaf epidermis and that of *Nypa* (Pl. 1, Figs. 2, 4, 5, 8, 10 & 12).

Further comparison in the numerical details of epidermal features of *Nypa fruticans* and the fossil are tabulated in Table 1.

The table shows that the fossil leaf epidermis differs to certain extent in some of its features from that of *Nypa fruticans*. Namely, its stomatal apparatus appears to be slightly smaller in size than that of *Nypa* and its adaxial epidermal cells are more cutinised. Such differences could exist even in different leaves of a same plant or might be a result of changes in volumes during preservation.

This exhaustive comparison therefore clearly reveals that the fossil leaf epidermis belongs to *Nypa*.

Table 1—Cuticular characters of fossil epidermis and that of *Nypa fruticans* Wurmb.

Serial number	Characters	Epidermis of fossil		Epidermis of *Nypa fruticans*	
1	Stomatal frequency/mm²	Range 138—165	Average 140	Range 124—154	Average 142
		Length μm	Breadth μm	Length μm	Breadth μm
2	Stomatal apparatus	56.62	34.01	61.94	47.50
3	Guard cells	47.50	5.75	50.54	10.83
4	Polar subsidiary cells	9.50	22.23	12.54	28.50
5	Lateral subsidiary cells	40.85	8.73	38.00	9.50
6	Costal epidermal cells size	33.63	8.13	33.25	9.50
	Common wall thickness	0.83		0.83	
7	Intercostal epidermal cells size	13.45	17.18	17.86	15.20
	Common wall thickness	1.18		1.25	
8	Upper epidermal cells size	9.50	22.80	9.50	22.60
	Common wall thickness	2.50		1.66	
9	Hair base	20.90	25.27	22.45	23.84

Since the differences between the fossil epidermis and that of *Nypa fruticans* are only of a quantitative nature and of the order which could exist within a same species, the epidermis is described as that of *Nypa fruticans* instead of creating a form species.

Monotypic genus *Nypa* represented by *N. fruticans* Wurmb. is distributed today in estuarine situations from Ceylon and the Ganges delta to Australia, the Solomon and the Ryukyu islands. However, the fossil remains of the genus are known from Paleocene of Brazil, the Eocene and Miocene of Europe, Africa, India and parts of Borneo (Tralau, 1964), suggesting a much wider past distribution. In fossils the genus is mostly represented by its peculiar fruits described under form genus *Nipadites* or genus *Nypa* in addition to its pollen grains.

Existence of *Nipadites* in early Tertiary exposures of India was first reported by Hislop from the Deccan Intertrappean beds of Nagpur area (Carter, 1857). Since then, Rode (1933), Sahni and Rode (1937), Chitaley (1960) and Nambudari (1966) have further contributed to *Nypa* fruits from these beds. Lakhanpal (1952) has also described *Nipa sahnii* from Tertiary of Assam. Apart from these, Verma (1974) has described well preserved petrified roots referable to this genus from Deccan Intertrappean Series of India. Leaf remains of the genus are being described in this communication for the first time from the lignitic beds of Ratnagiri attributed to Miocene Period.

Occurrence of leaf remains of *Nypa* along the Arabian sea coast when it is restricted today to eastern Gangetic delta suggests that either the species was spread along the entire coast of India during the past or that the leaves represented here may belong to the ones drifted by sea currents and deposited at the present site.

The fact that pollen grains closely resembling those of *Nypa* have been described under the form genus *Spinizonocolpites* from Miocene beds of Warkalli and Quilon exposed along the west coast of India (RAO & RAMANUJAM, 1975, 1976 and RAMANUJAM & RAO, 1977) suggests that former probability appears to be more likely.

Type : Slide Nos.—R/ST-6 ; R-EP-10.
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Locality : Third Dharmashala Stop, Ratnagiri—Pawas Road.

Age : Miocene ?

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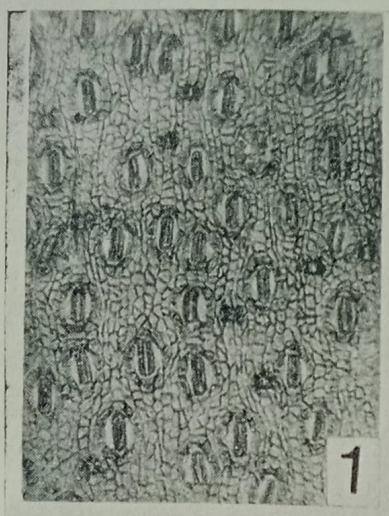
EXPLANATION OF PLATE 1

Fig. 1 Abaxial epidermis of fossil ×247. Fig. 2. Abaxial epidermis of *Nypa fruticans* ×247. Fig. 3. Adaxial epidermis of fossil ×247. Fig. 4. Adaxial epidermis of *N. fruticans* ×247. Fig. 5. Abaxial epidermis of *N. fruticans* enlarged ×1110. Fig. 6. Abaxial epidermis of fossil enlarged ×1110. Fig. 7. Adaxial epidermis of fossil enlarged ×1110. Fig. 8. Abaxial epidermis of *N. fruticans* enlarged ×1110. Fig. 9. Stomata of fossil ×2470. Fig. 10. Stomata of *N. fruticans* ×2470. Fig. 11. Hair base of fossil ×2470. Fig. 12. Hair base of *N. fruticans* ×2470.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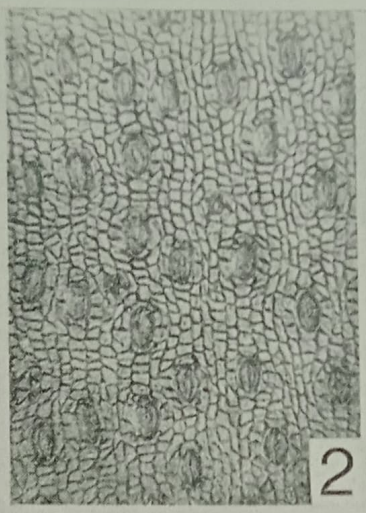
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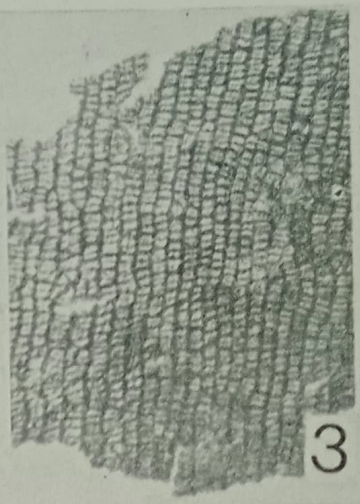
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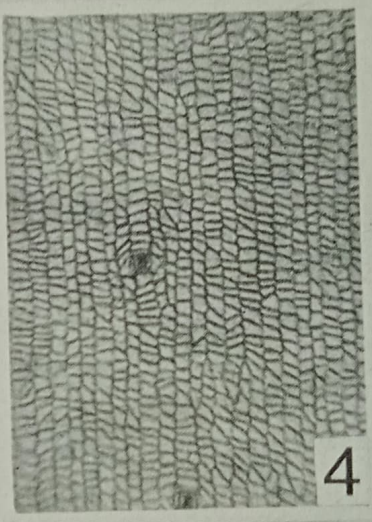
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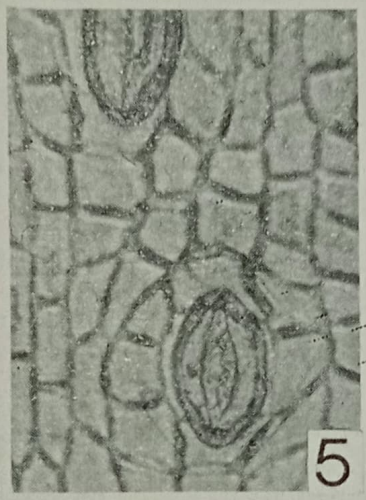
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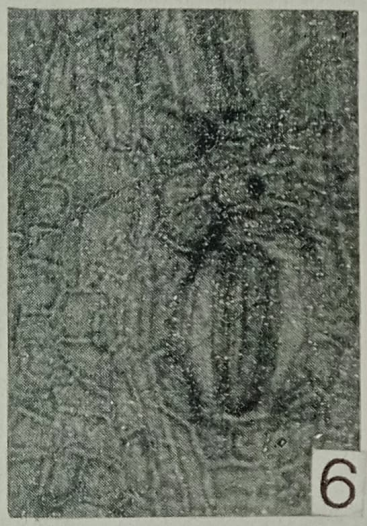
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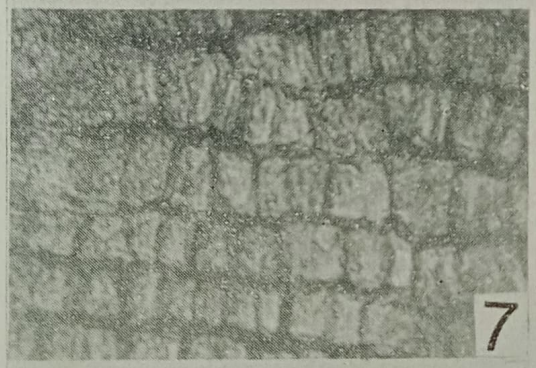
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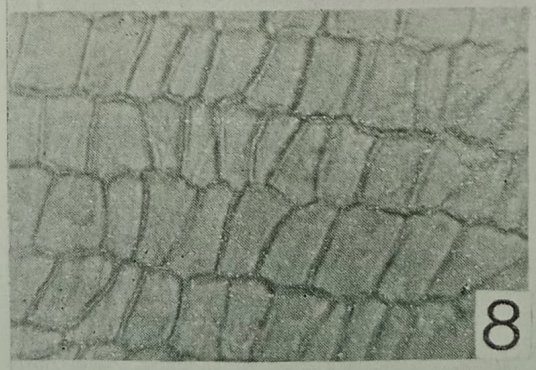
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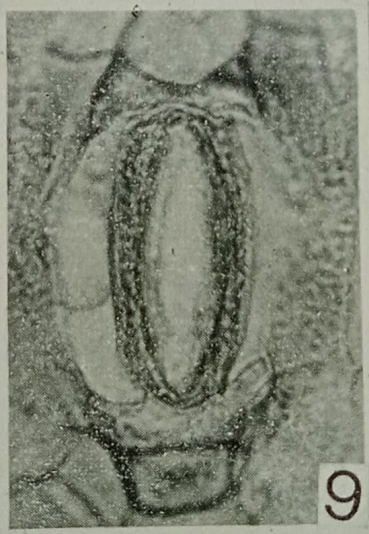
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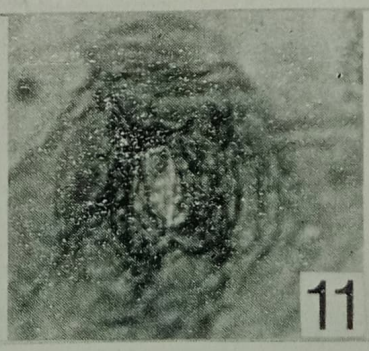
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