Leaf cuticles from the Neyveli lignite of India

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The paper reports some leaf remains from the Neyveli lignite of South Arcot District, Tamil Nadu. The fossil cuticles resemble cuticles of extant *Shorea* (Dipterocarpaceae), *Cryptostegia* (Asclepiadaceae) and *Lagerstroemia* (Lythraceae).

Key-words—Morphology, Cuticles, *Shorea, Cryptostegia, Lagerstroemia,* Neyveli Lignite (India).

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सारांश

भारत के निवेली लगुडाँगार से अश्मित पत्तीयों की उपचर्म

छेदीलाल वर्मा, निर्मला उपाध्याय एवं राजीव कुमार श्रीवास्तव

तमिल नाड्डु में दक्षिण आरकोट जनपद के निवेली लगुडाँगार से कुछ पत्तीयों के अवशेष अभिलिखित किये गये हैं। उपलब्ध उपचर्म वर्तमान **शोरिआ** (डिप्टेरोकार्पेसी), **क्रिप्टोस्टीजिआ** (एँस्क्लीपियेडेसी) एवं **लेगरस्ट्रोयमिया** (लाइथ्रेसी) नामक वर्गकों की उपचर्मों से समानता व्यक्त करती हैं।

NEYVELI lignite has been extensively worked out for the microfossils, such as spores and pollen grains, fungal and algal remains and wood tissues. The megafossils, however, have received little attention, though they are common in the lignite deposits (Singh & Mathew, 1954; Lakshmanan & Levey, 1956; Chatterjee & Bhattacharya, 1965; Ambwani, 1982; Awasthi, 1984).

The cuticles of these fossils have not received the attention they deserved. The only known reports are cuticles of Oleaceae (Jacob & Jacob, 1953), *Litsea* (Lauraceae, Srivastava, 1984) and *Phoenix* (Palmae, Upadhyay & Verma, 1986). Kulkarni and Phadtare (1980) and Dalvi and Kulkarni (1982) have reported few fossil cuticles from the Ratnagiri lignite, Maharashtra. In the present paper leaf cuticles resembling *Shorea* (Dipterocarpaceae), *Cryptostegia* (Asclepiadaceae) and *Lagerstroemia* (Lythraceae) have been described.

MATERIAL AND METHODS

Some of the specimens contained well-preserved leaves from which the cuticles were obtained by usual maceration method. They were mounted in canada balsam. The numerical data are based on an average of 20 random counts. The terminology as suggested by Dilcher (1974) has been adopted.

DESCRIPTION

Family—Dipterocarpaceae

Genus—*Shorea* Roxb.

Fossil cuticle type-1

Pl. 1, figs 1-4; Text-fig. 1A-L

Description—Leaf hypostomatic, upper epidermal cells penta-or hexagonal, small, thick and smooth-walled, elongated on the veins (Text-fig. 1

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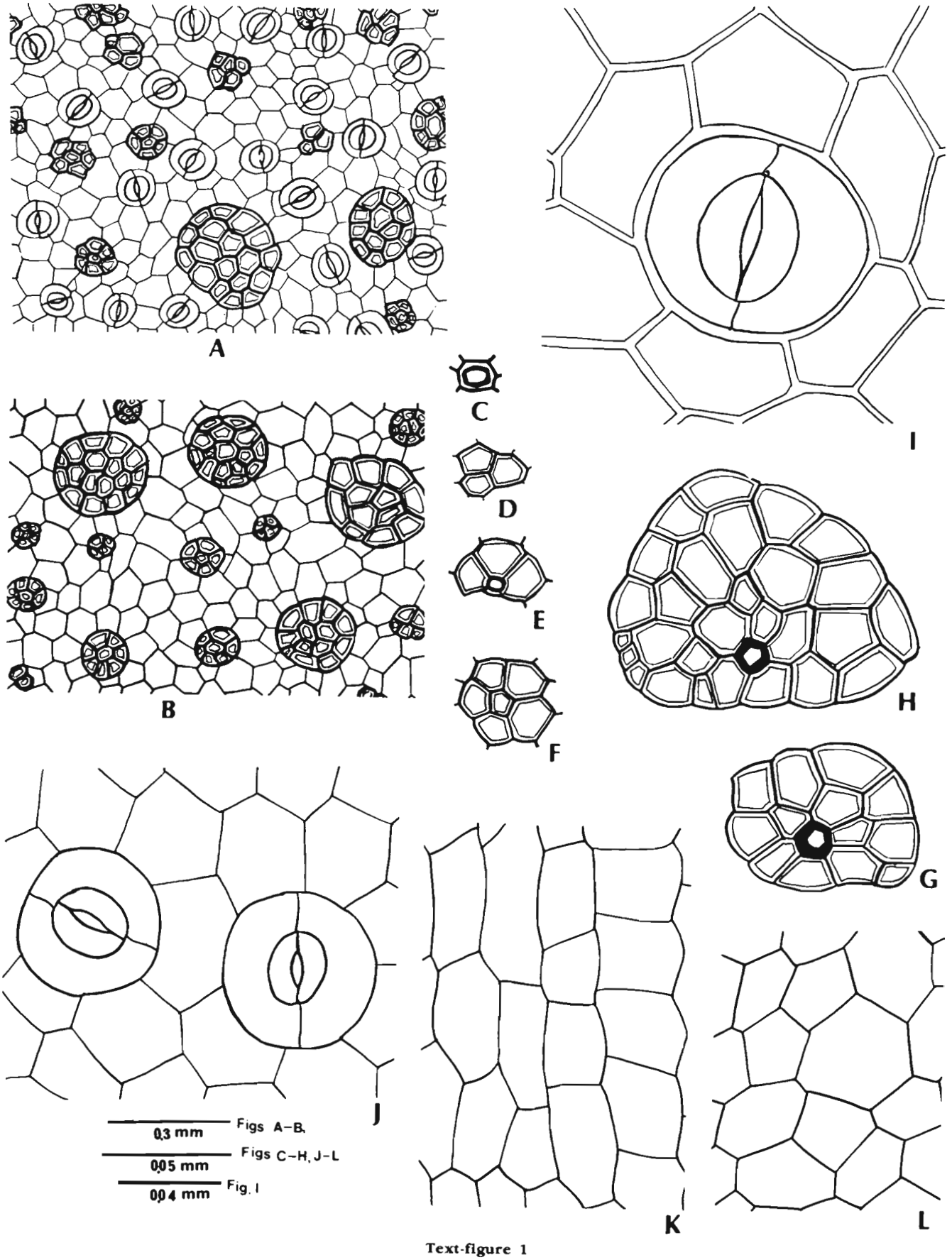
Text-figure 1—Fossil cuticle of *Shorea* type 1: **A,** Lower epidermis showing distribution of stomata and trichomes; **B,** Upper epidermis showing distribution of trichomes; **C-H,** One to many-celled peltate trichomes; **I,** A stoma enlarged to show guard cells and subsidiary cells; **J,** An enlarged portion of lower epidermis showing stomata and epidermal cells; **K,** Cells of veinal region; **L,** Cells of the upper epidermis.



Text-figure 1

K-L); multicellular disc-like trichomes present all over the surface (Text-fig. 1B), smaller ones having only few cells, larger ones with 50 or more cells (Pl 1, fig. 1; Text-fig. 1C-H).

Lower epidermal cells penta-or hexagonal with slightly thickened walls, elongated round the trichomes, much elongated on the larger veins (Pl. 1, fig. 3); stomata irregular, distinct round the peltate trichomes, paracytic, frequency 110-120/mm², size 50-70 × 35-45 μm (Text-fig. 1A, I-J), trichomes all over the surface, similar to those occurring on the upper surface (Pl. 1, fig. 3; Text-fig. 1A).

Affinities with modern taxa—The important features of the fossil cuticle are : presence of peltate trichomes on both the surfaces, paracytic stomata and thick-walled, smooth epidermal cells.

Both paracytic stomata and peltate trichomes occur in 16 families of Angiosperms. However, the fossil cuticle comes closest to the cuticles of extant members of Dipterocarpaceae which have varied cuticular characters but genera like *Shorea* and *Vateria* have almost identical epidermal features. Both the genera have peltate trichomes which are distributed all over the foliar surface and paracytic stomata that are confined to the lower surface. Fossil cuticle shows maximum resemblance with *Shorea robusta* Gaertn. f in structure and distribution of stomata, epidermal cells and structure and distribution of trichomes. A comparative account has been given in Table 1. However, in the fossil, frequency of stomata is slightly low, size is bigger and trichomes are much crowded and have varied number of cells.

Present day distribution—Of the 12 species of the genus *Shorea*, five are endemic to Sri Lanka, three are confined to Burma, two grow in south India and one in Assam. *S. robusta* (Sal) grows now-a-days in the foot-hills of Himalaya, south India and Orissa.

Family—Asclepiadaceae

Genus—*Cryptostegia* Br.

Fossil cuticle type-2

Pl. 1, figs 5-8; Text-fig. 2 A-H

Description—Leaf hypostomatic, upper epidermal cells penta-or hexagonal, small, smooth-walled (Pl. 1, fig. 6; Text-fig. 2B), marginal and venal cells thickened (Text-fig. 2C); trichomes absent. Lower epidermal cells polygonal or elongated on the veins, smooth-walled, cells round the stomatal groups thick-walled (Text-fig. 2 D-F); stomata in groups, small, paracytic, bound by thick-walled cells, number of stomata in a group from 30 to 60, frequency 160-170/mm², size 20-26 × 13-20 μm (Pl. 1, figs 5, 8; Text-fig. 2A, D, G-H), trichomes absent.

Affinities with modern taxa—Amongst the important features, such as paracytic stomata in groups bound by thick-walled cells and thick- and smooth-walled epidermal cells, the fossil cuticle shows close affinity with the cuticle of modern *Cryptostegia grandiflora* R. Br. of Asclepiadaceae. Detailed comparison of the two is given in Table 1. In the fossil, frequency of the stomata is high and size smaller. In addition, the modern taxon has uniseriate hairs on the midrib, but such hairs have not been observed in the fossil.

Present day distribution—Genus *Cryptostegia* is a native of Madagascar (Gamble, 1912). *Cryptostegia grandiflora*, the only species, is a large climbing shrub which is now cultivated in gardens or grows wild all over India.

Family—Lythraceae

Genus—*Lagerstroemia* Linn.

Fossil cuticle type-3

Pl. 1, figs 9-11; Text-fig. 2 I-M

Description—Leaf hypostomatic; upper epidermal cells, penta-to-polygonal with slightly

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PLATE 1 →

Fossil cuticle type 1

1. Upper epidermis of fossil showing epidermal cells and pelted trichomes. × 100.
2. Upper epidermis of *Shorea robusta* showing epidermal cells, veinal cells and pelted trichomes. × 100.
3. Lower epidermis of fossil showing paracytic type of stomata and pelted trichomes. × 150.
4. Lower epidermis of *S. robusta* showing paracytic stomata and pelted trichomes. × 150.

Fossil cuticle type-2

5. Lower epidermis of fossil showing distribution of stomata. × 80.
6. Upper epidermis of fossil showing marginal cells. × 150.
7. Lower epidermis of *C. grandiflora* showing paracytic stomata arranged in groups. × 250.
8. Lower epidermis of fossil showing paracytic stomata arranged in group. × 250.

Fossil cuticle type-3

9. Lower epidermis of *Lagerstroemia indica* showing anomocytic type of stomata. × 300.
10. Lower epidermis of fossil showing anomocytic stomata. × 300.
11. Upper epidermis of fossil showing cells. × 200.

sinuate walls (Text-fig. 2K), trichomes absent. Lower epidermal cells larger than the upper ones, penta-to polygonal walls, slightly sinuate, elongated and thick-walled on the larger veins (Pl 1, fig. 11, Text fig. 2J), stomata irregular, 3 to 6 cells apart, anomocytic, frequency 80-90/mm², size 40-50 × 26 33 μm (Pl 1, fig. 10; Text-fig. 2I, L), trichomes bases rounded on the midrib only (Text-fig. 2M).

Affinities with modern taxa—Fossil cuticle is characterised by the presence of anomocytic stomata

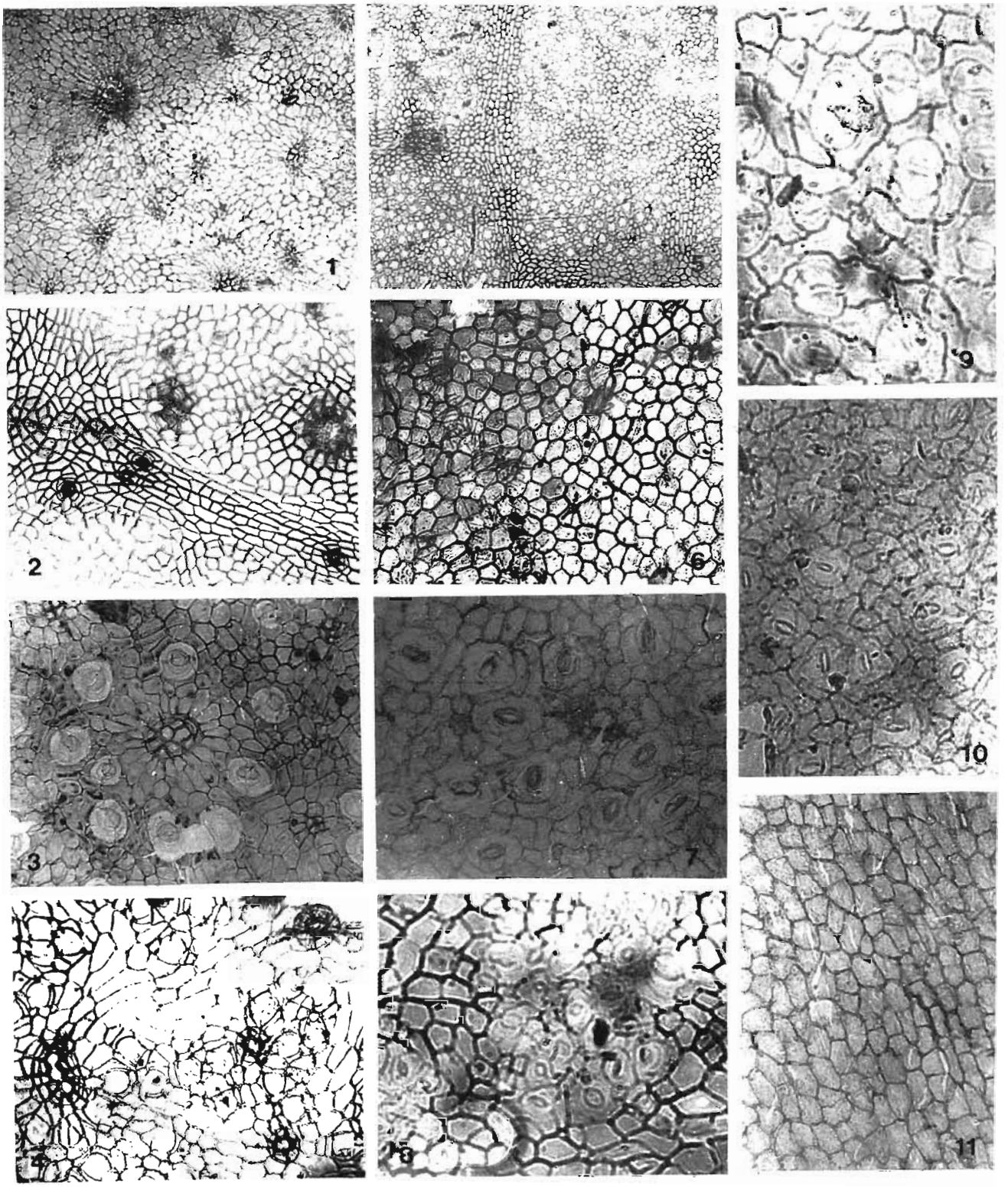
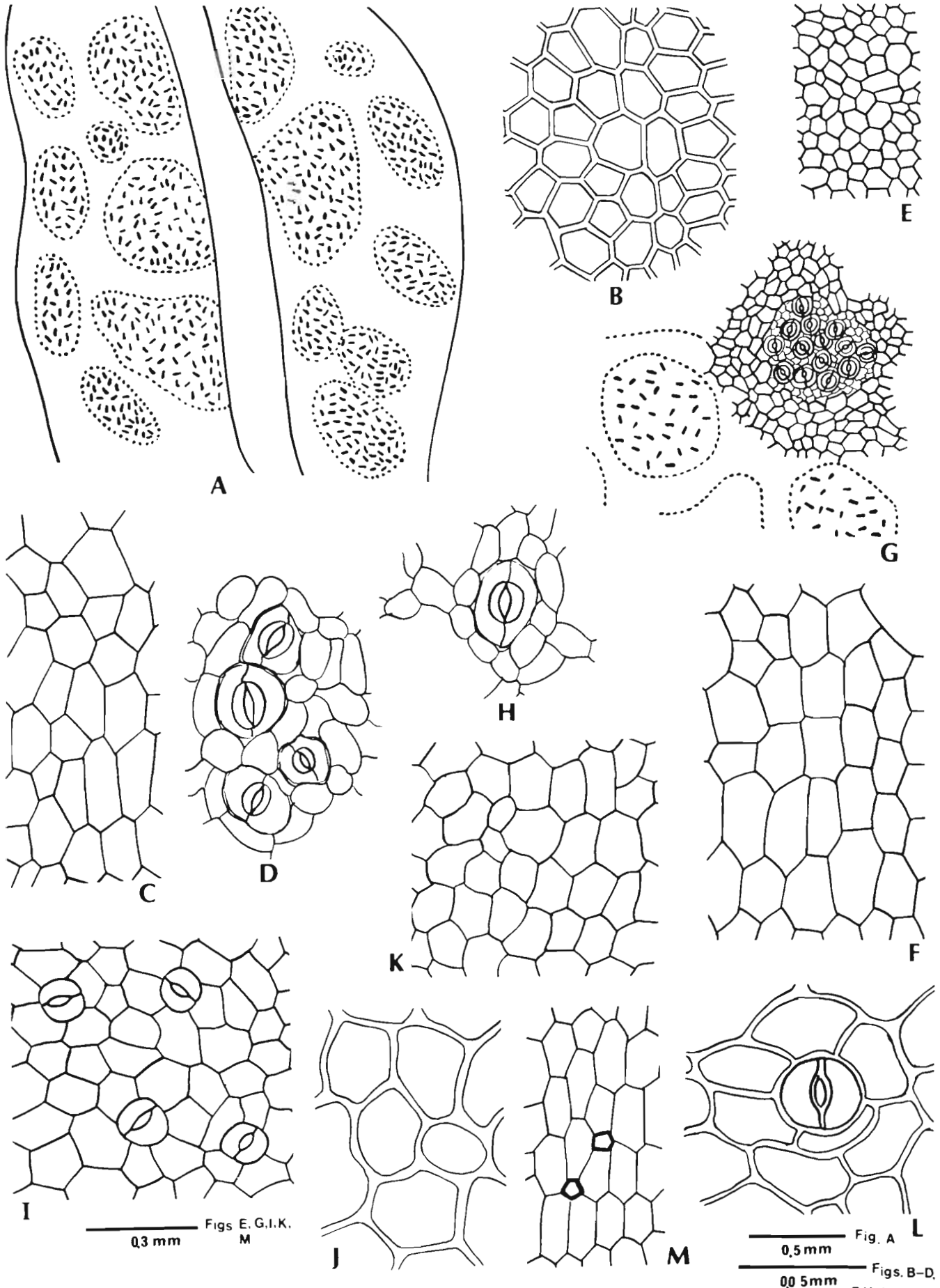


PLATE 1



Text-figure 2

Table 1

NAME OF SPECIES	LEAF	EPIDERMAL CELLS		STOMATA		FREQUENCY PER mm²	SIZE IN μm	TRICHOMES
		UPPER	LOWER	DISTRIBUTION	TYPE			
Fossil cuticle type 1	Hypostomatic	Penta or hexagonal	Penta-polygonal, smooth walled	Irregular	Paracytic	110-120	50-70 × 35-45	Peltate, irregular on both the surfaces 4 to many celled
Living *Shorea robusta*	Hypostomatic	Penta-or hexagonal, small	Penta-polygonal, smooth-walled	Irregular all over the surface between the smaller veins	Paracytic	160-170	40-50 × 26-33	4-25 celled irregular, on both the surfaces
Fossil cuticle type-2	Hypostomatic	Penta hexagonal small, smooth walled	Polygonal or elongated on veins, thick-walled round stomatal groups	In groups between veins, crowded	Paracytic	160-170	20-26 × 13-20	Not observed
Living *Cryptostegia grandiflora*	Hypostomatic	Penta hexagonal, small	Polygonal, thin walled, thick walled round stomata	In groups between veins	Paracytic	140-150	23-26 × 16-20	Uniseriate hairs on the midrib
Fossil cuticle type-3	Hypostomatic	Penta to polygonal, slightly sinuate walls	Polygonal, sinuate walls	Irregular	Anomocytic	80-90	40-50 × 26-33	Trichome bases at the midrib region
Living *Lagerstroemia indica*	Hypostomatic	Penta polygonal sinuate walls	Polygonal sinuate walls	Irregular	Anomocytic	115-125	33-42 × 23-26	Uniseriate trichomes on the midrib

on the lower foliar surface and epidermal cells with slightly sinuate walls. It shows similarity with the cuticle of extant genus *Lagerstroemia indica* L. of the family Lythraceae.

Considerable variation is found in the epidermal features of Lythraceae with respect to the nature of trichomes (Metcalfe & Chalk, 1950). The genus *Lagerstroemia* has also varied types of trichomes. A detailed comparison is given in Table 1 In the fossil, the frequency of stomata is low and size is bigger On the midrib region of fossil cuticle a few hexagonal, thick-walled areas have been observed and most probably they represent hair bases. There are striations on the upper epidermis.

Present day distribution—The genus *Lagerstroemia* with about 50 species is confined to the old world (Pearson & Brown, 1932). Seven species, viz., *L. indica, L. parviflora, L. lanceolata, L. flos-reginae, L. hypoleuca, L. villosa* and *L. tomentosa* are found in India. *L. indica* with which the fossil cuticle resembles is a small deciduous tree indigenous to China. It is cultivated through out India in the gardens (Gamble, 1912).

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Text-figure 2—Fossil cuticle of *Cryptostegia* type-2: **A,** A portion of leaf cuticle showing distribution of stomata; **B,** Upper epidermal cells; **C,** Cells of the veinal region; **D,** Stomata in groups between the smaller veins; **E,** Thick-walled cells round the stomata; **F,** Cells of the midrib region; **G,** A portion of non-veinal region enlarged to show the stomata in groups; and **H,** A stomata enlarged to show the guard cells and subsidiary cells.

Fossil cuticle of *Lagerstroemia* type-3: **I,** Lower epidermis showing distribution of stomata and epidermal cells; **J,** Lower epidermal cells enlarged to show the sinuate walls; **K,** Upper epidermal cells; **L,** A stomata enlarged to show vertical aperture and guard cells; and **M,** Epidermal cells showing trichome bases.

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