

# First occurrence of fossil paraphyses resembling *Acrostichum* Linn. from the Lalitpur Intertrappean sediments (Palaeocene), Uttar Pradesh, India

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## ABSTRACT

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A new microfossil of paraphyses viz., *Lithoparaphysis paproensis* gen. et sp. nov. recovered from the Lalitpur Intertrappean bed (Palaeocene) is described here. This fossil species closely resembles the paraphyses of *Acrostichum aureum* Linn., a mangrove fern, and is found in association with the Palaeocene marker spore-pollen taxa.

**Key-words**—Paraphyses, *Acrostichum*, Deccan Intertrappean, Palaeocene, Lalitpur and Uttar Pradesh.

भारत के उत्तर प्रदेश प्रान्त के ललितपुर अन्तर्द्वीपीय अवसादों (पेलियोसीन) से प्राप्त एक्रोस्टिकम लिन के सदृश अशिमित सहसूत्रों की प्रथम प्राप्ति

रतन कर एवं रमाशंकर सिंह

सारांश

प्रस्तुत शोध पत्र में ललितपुर अन्तर्द्वीपीय संस्तर से खोजे गए सहसूत्रों के एक नवीनतम सूक्ष्म पादपाशम लिथोपैराफ्राइसिस पापरोएन्सिस वंश नव प्रजाति का वर्णन अभिप्रेत है। यह अशिमित प्रजाति एक्रोस्टिकम ऑरियम लिन नामक मैंग्रोव फर्न के सहसूत्रों के निकटस्थ सदृश है तथा यह पेलियोसीन सूचक बीजाणु परागकण वर्गकों के साथ साहचर्य में पाई गई है।

**संकेत शब्द**—सहसूत्र, एक्रोस्टिकम, दक्खिनी अन्तर्द्वीपीय, पेलियोसीन, ललितपुर तथा उत्तर प्रदेश।

## INTRODUCTION

**P**ARAPHYSES are sterile hairs growing mostly around the reproductive structures in some algae, fungi, bryophytes and pteridophytes often of very characteristic forms (Usher, 1966; Brown, 1966). In *Funaria* (Bryales, Bryophyta) they are

very conspicuous and comprises row of cells tapering at the base and swollen at the apex (Campbell, 1918). *Cibotium chamiss* of Cyatheaceae exhibits numerous long hair like paraphyses in the sporangium (Bower, 1963). In Ascomycetes (Fungi), vegetative hyphae grow among the ascogonium as slender paraphyses during the development of asci (Cook,

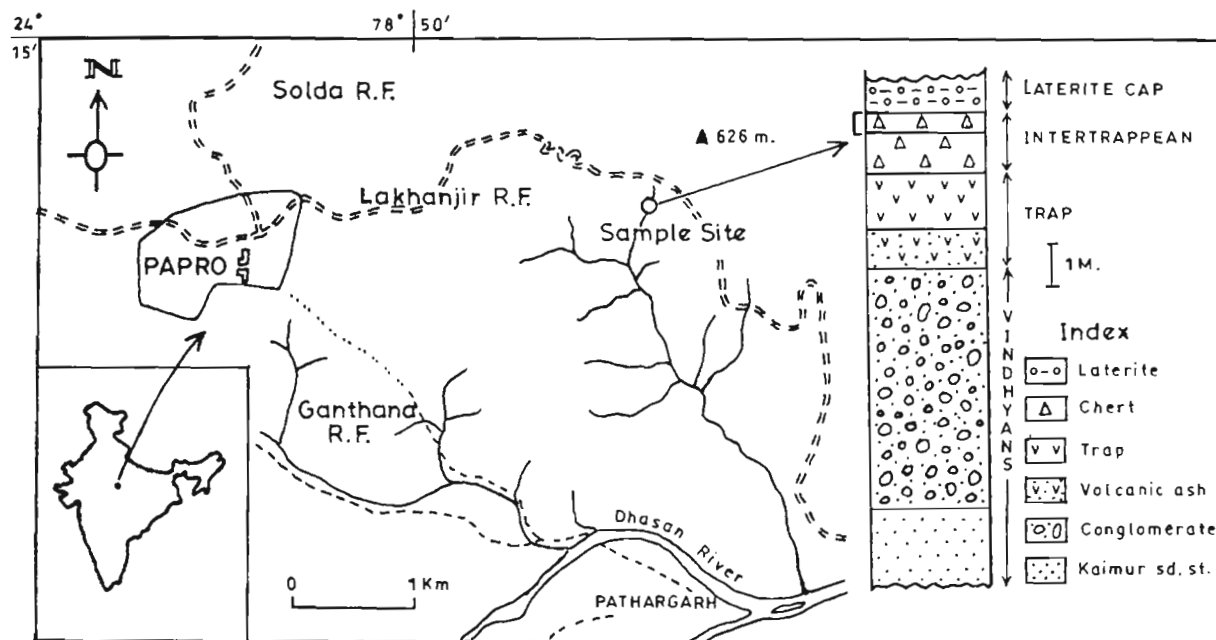


Fig. 1—Map showing the locality and lithology of the Intertrappean exposures near the village Papro, Lalitpur District, U.P.

1966). *Acrostichum aureum* Linn. has somewhat globose, irregularly lobed paraphyses while *Acrostichum danaeifolium* Long. & Fisch. possesses less lobed ones—these characters of paraphyses are considered as one of the distinguishing parameters of the above two species (Tryon & Tryon, 1982).

### GEOLOGY OF THE AREA

The Lalitpur Intertrappean beds are exposed on two *nalas* 3 km north-east of Papro Village (Long. 78°48'20": Lat. 24°14'; Toposheet No. 54L/16; Fig. 1). The basal most part of the section consists of Kaimur Sandstone of Vindhyan age, which is overlain by approximately six meters of loosely cemented conglomerates with volcanic ash. It is overlain by about one meter of white, loose, volcanic ash. One to one and half meters of Deccan Trap lies on the ash bed and is overlain by one

meter of grey and half meter of black chert respectively, containing organic detritus, ostracodes and gastropods. The sequence is capped by a laterite cover. Kumar *et al.* (1980) recorded *Lymnaea*, *Physa* and different species of *Chara* from the black chert and advocated an Eocene age for this bed. Recently, Singh and Kar (2002) recovered a spore-pollen assemblage from these Intertrappean beds and assigned it a Palaeocene age on the basis of marker species.

### MATERIAL AND METHODS

The black and grey chert along with embedded organic detritus were macerated in hydrofluoric acid (40%) and then washed in potassium hydroxide solution (5%). The slides were made by smearing a drop of maceral and polyvinyl alcohol on a cover-slip and mounted in Canada balsam. The slides are

### PLATE 1

1. *Lithoparaphysis paproensis* gen. et sp. nov. (Holotype) recovered from the Lalitpur Intertrappean bed, ca. x 500. Slide No. BSIP 12594, E.F. no. G-37/3.
2. Isotype, ca x 500, Slide No. BSIP 12594, E.F. No. F-18/3.
3. Showing morphological variation ca x 500, Slide No. BSIP 12594 E.F. No. D-12/2.
4. A part of the holotype ca x 1000, showing the nature and ornamentation of lobes.
5. Specimen showing weak striation in the lobes. ca x 500. Slide No. BSIP 12596, E.F. No. N-20.
6. A part of the above, ca x 1000. Note the grana in the lobes.
- 7, 8. Comparatively smaller sized specimens, ca x 500. Slide Nos BSIP 12595 E.F. No. L-17/2 and BSIP 12596, E.F. No. X-38 respectively.
- 9-12. Extant paraphyses of *Acrostichum aureum* Linn. ca. x 500, observed in the pollen preparations from specimen growing in Sunderban delta, West Bengal, India.

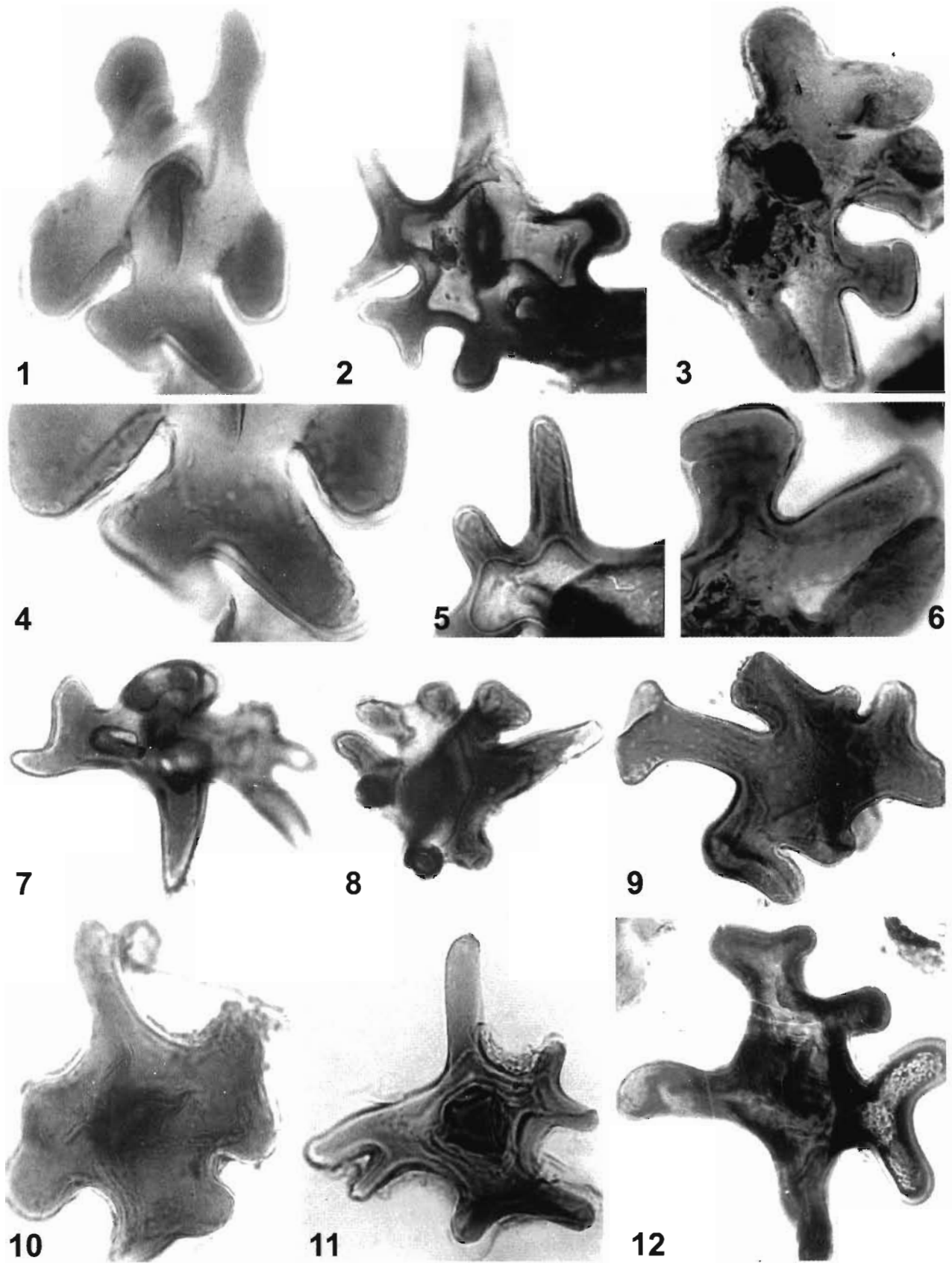


PLATE 1

deposited at the repository of Birbal Sahni Institute of Palaeobotany, Lucknow, India.

## PALYNOLOGICAL ASSEMBLAGE

An assemblage comprising *Phragmothyrites eocenica*, *Inapertusporites kedvesii*, *Cyathidites minor*, *Todisporites major*, *Dandotiaspora dilata*, *Dandotiaspora pseudoauriculata*, *Spinizonocolpites echinatus* and *Lakiapollis ovatus* was recorded. A Palaeocene age was ascribed to this assemblage by Singh and Kar (2002) due to the presence of *Dandotiaspora dilata*, *D. pseudoauriculata*, *Spinizonocolpites echinatus* and *Lakiapollis ovatus*. Besides, numerous paraphyses were also observed in the slides along with these taxa, which is the subject matter of this paper.

## SYSTEMATICS

### Genus—LITHOPARAPHYSIS gen. nov.

(Pl. 1·1-8)

*Generic Diagnosis*—Paraphyses unicellular, 60-120 µm in size; possessing 5-8 robustly built, finger-like, sometimes bifurcating projections, 20-60 µm in size. Surface of the paraphyses mostly smooth but sometimes weakly ornamented, with a few grana or weakly striated.

*Remarks*—The new genus instituted here closely resembles the paraphyses of the genus *Acrostichum* Linn. in its gross morphology and more particularly to those of *Acrostichum aureum* Linn.

*Type Locality, Horizon & Age*—Papra Village, Lalitpur District, U.P., Deccan Intertrappean, Palaeocene.

*Genotype*—*Lithoparaphysis paproensis* sp. nov. Pl. 1·1, 4; Slide no. BSIP 12594, E.F. no. G-37/3.

*Derivation of name*—The generic name is derived from the terms 'litho' and 'paraphyses'. Litho indicates rock whereas paraphyses refers to the sterile body associated with the reproductive structure.

### LITHOPARAPHYSIS PAPROENSIS sp. nov.

(Pl. 1·1-8)

*Specific Diagnosis*—Paraphyses 60-120 µm, strongly built, star-shaped due to 5-8 finger-like projections radiating from all sides, projections robust, not of same size, one particularly bigger than rest, broad at base, tapering at tip, mostly smooth, sometimes a few grana or striations present.

*Comparison*—*Lithoparaphysis paproensis* sp. nov. was compared with the fossil and living forms of various plant groups. It was observed that these are remarkably similar to the paraphyses of extant *Acrostichum aureum* Linn. (Pl. 1·9-12) in its morphology, in size range (60-120 µm), number (5-8) and length of projections (20-60 µm). In addition, the

bifurcating habit of projections is also similar in both the population. These observations led to the assumption that the fossil paraphyses reported here belong to *Acrostichum aureum* Linn.

*Type Locality, Horizon & Age*—Papra Village, Lalitpur District, U.P., Deccan Intertrappean, Palaeocene.

*Holotype*—Pl. 1·1, 4; Slide no. BSIP 12594, E.F. no. G-37/3.

*Derivation of name*—The species is named after the village Papra, Lalitpur District, Uttar Pradesh, India, from where the fossils were collected.

## DISCUSSION

*Acrostichum aureum* Linn. is placed in the family Pteridaceae and has the unique distinction of being the only pteridophyte which has pan tropical distribution in mangrove swamps (Blasco, 1975; Chapman, 1975). It is a rhizomatous, erect, pinnate plant growing up to the height of two meters. The upper pinnae of this plant are fertile and smaller in size than the lower, sterile pinnae. This plant is known to grow luxuriantly in the tidal brackish water of India and Bangladesh (Rao & Sastry, 1974; Rao *et al.*, 1973). The fossil spores resembling the modern *Acrostichum* are described as *Acrostichumsporites* Kar and are known from the Early Palaeocene sediments of India and Late Palaeocene of Senegal, West Africa (Kar, 1992; Caratini *et al.*, 1991).

The Intertrappean beds were deposited during the quiescence phase of successive Deccan volcanic eruptions (Late Cretaceous-Early Palaeocene) under lacustrine conditions. The occurrence of paraphyses resembling those of *Acrostichum aureum* in the Lalitpur Intertrappean bed indicates that there was some sort of salinity associated with the lake around which this plant was growing. Megafossil and microfossil remains of *Nypa*, (a mangrove palm) and marine algae are also known from the other intertrappean localities in Madhya Pradesh (Sahni & Rode, 1937; Bande *et al.*, 1981; Kar *et al.*, 1998) strengthening the supposition that brackish water conditions were prevalent in at least some lakes of the Deccan Trappean province. Recently Bonde & Kumaran (2002) described a megafossil, bearing stem, petioles and roots from the Deccan Intertrappean beds of Nawargaon, Wardha District, Maharashtra, as *Acrostichum intertrappeum*. Occurrence of this *Acrostichum* corroborates our study indicating existence of back water conditions during Intertrappean depositional times.

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## REFERENCES

- Bande MB, Prakash U & Bonde SD 1981. Occurrence of *Peyssonnela* and *Distichoplax* in the Deccan Intertrappean, with remarks on the age of Chhindwara Traps and Palaeogeography. *Geophytology* 11 : 182-188.
- Blasco F 1975. The mangroves of India. Institute Francais de Pondicherry. *Travaux de la Section Scientifique et Technique* 14 : 1-175.
- Bonde SD & Kumaran KPN 2002. A permineralized species of mangrove fern *Acrostichum* L. from Deccan Intertrappean beds of India. *Review of Palaeobotany and Palynology* 120 : 285-299.
- Bower FO 1963. The Ferns (Filicales) Vol. I. Today & Tomorrow's Book Agency, New Delhi : 238-239.
- Brown WH 1966. The Plant Kingdom. Vakils, Feffer and Simmons Pvt. Ltd., Bombay : 543.
- Campbell DH 1918. The structure and development of Mosses and Ferns. Macmillan Company, New York : 11.
- Caratini C, Kar RK, Sarr R, Tissot C & Venkatachala BS 1991. Palaeocene palynoflora from Walalane boreholes, Senegal. *Palaeoecology Africa* 22 : 123-133.
- Chapman V 1975. Mangrove biogeography, Proceeding International Symposium Biology of Mangrove (Walsh G *et al.* editors). Institute of Food and Agricultural Science University of Florida 1 : 3-22.
- Cook CDK 1966. Aquatic and wetland plants of India. Oxford University Press, Oxford : 27.
- Kar RK 1992. Occurrence of *Acrostichum* spores from the Langpar Formation, Early Palaeocene of Meghalaya. *Geophytology* 21 : 33-35.
- Kar RK, Sahni A, Ambwani K & Singh RS 1998. Palynology of Indian onshore-offshore Maestrichtian sequences in India: implication for correlation and palaeogeography. *Indian Journal of Petroleum Geology* 7 : 39-49.
- Kumar S, Singh MP & Singh SN 1980. Lithostratigraphy, age and palaeogeography of the newly discovered Intertrappeans, Lalitpur District, Uttar Pradesh. *Geophytology* 10 : 72-80.
- Rao TA, Mukherjee AK & Banerjee LK 1973. Is *Acrostichum aureum* L., truly a mangrove fern. *Current Science* 42 : 456-457.
- Rao TA & Sastry ARK 1974. An ecological approach towards classification of coastal vegetation of India II. Estuarine border vegetation. *Indian Forestry* 100 : 438-452.
- Sahni B & Rode K 1937. Fossil plants from the Intertrappean beds of Mohgaon Kalan, in the Deccan, with a sketch of the Chhindwara District. *Proceeding of National Academy of Sciences, India* 7 : 165-174.
- Singh RS & Kar RK 2002. Paleocene palynofossils from the Lalitpur Intertrappean beds, Uttar Pradesh, India. *Journal of the Geological Society of India* 60 : 213-216.
- Tryon RM & Tryon AF 1982. Fern and allied Plants. Springer-Verlag, New York : 348-354.
- Usher G 1966. A Dictionary of Botany. Constable & Company Ltd., London : 265.