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EPIDERMAL STUDIES OF NEPALESE PTERIDOPHYTES-FAMILY-ADIANTACEAE

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ABSTRACT

The occurrence of *Adiantum* species belonging to the family Adiantaceae is reported from Pokhara, Nepal. The present paper deals with the anatomical details like structure of pinnae, structure of stomata, guard cells, other epidermal cells etc. although several workers has reported about the pteridophytic plants from Nepal but it is the first time to work about the epidermal details of Nepalese fern.

KEYWORDS : Nepal, Epidermal Details, Ferns, Pinnules.

The pteridophytes of Nepal Himalayas are well represented by nearly 70genera and 400 species (Gurung 2002).Nepal is represented by the rich pteridophytic vegetation and it is constituted as one of the most important group of plants in this country. Nepal is also famous for its richness of pteridophytic plants among the botanists. In 1950's when Nepal is opened to the botanist from abroad, a new era of research on Nepalese ferns began. Many Japanese expeditions were planned to this country and explored thus a large number of plants of pteridophytes were collected. Nakao, Namikawa, Kawakita and others made exhaustive survey of these plants from Nepal and collected them. These are kept now in KYO. The enumerations of some important collections such as those of Kihara's Fauna and Flora of Nepal Himalaya (1955), Hara's Flora of Eastern Himalayas (1966-71) and Ohashi's Flora of Eastern Himalaya (1975) has given valuable knowledge about several species.

The term Adiantum is derived from Greek word 'Adiantos' which means “unwetted”(see Beddome 1883,1892). The plants of this genus are grown in moist shady places are as well as crevices of rocks. Other several species grow frequently in terrestrial places of hillocks and hills, clay or humus, soil near ravines or near water streams or water falls or banks, rhizomes small, erect or suberect, stout or short creeping or slender, long creeping to hard, roots fibrous and long, scale variable in size, ovate to lanceolate or lenear-lanceolate, non peltate, non clatharate, yellowish brown to dark brown, margin entire, smooth to dentate, stipe small to large, erect to suberect, wiry to stout, brown to blackish, often polished, grooved or smooth, nacked or hairy, scaly at base, fronds small to large, monomorphic or nearly so, born in cluster or close to widely spaced, lamina 1-4 pinnate; pinnules small, unilateral, cuneate, flabellate, sessile or petiolate, margin smooth or serrate, hairs small to large, yellowish brown to dark brown,veins distinct or indistinct , free flabelately forked, sori close to the margin, born on orbiscular to very long , strongly recurverd modified margin lobes, the sporangia confined to the veins or sometimes also on the tissue, indusium false, spores with tetrahedral trilete, light brown to dark brown, exine withscrabrate smooth granulate or reticulate ,size quite variable.

Pinnules have open dichotomous type of venation. Trichomes are generally absent from pinnae. Epidermal cells on both surfaces of pinnae are sinuous walled, Pinnae are hypostomatic, guard cells of the stomata may be slightly sunken. Sometimes stomata are arranged in longitudinal rows along the vein. Epidermal cells are sinuous walled, more prominent on both the surfaces, hairs sometimes present or absent.

MATERIALS AND METHODS

The material of *Adiantum* has been collected from Pokhara. Total three species *Adiantum capillus* - veneris L., *A. caudatum* L., and *A. philippense* L., are collected .

The collected specimens were dried and treated with mercuric chloride. The specimens were duly numbered. For the identification help has been taken from BSI (Central circle Allahabad) and thanks are due to Late Dr. R. D. Dixit for identified these plants.

For the study of cuticle, stomata and epidermal details, small pieces of mature pinnules were fixed in FAA. The usual technique employed by Pant school, has been

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employed. Epidermal peels were taken out by treating the material with Shulze's techniques of maceration. Venation pattern has been studied by making preparations of transparency using Foster's technique (Foster, 1966). Lastly it is mounted in euparol.

Spores were studied by procedure. Several microchemical tests of Lignin, Cutin were made by techniques.

RESULTS AND DISCUSSION

Adiantum capillus-veneris L. (Figure-1, Plates-1A, 2A, 2B, 2C, 2D, 2M)

Common name-'HANSRAJ'

Plants are 40-50cm long, usually terrestrial and herbaceous in nature, rhizomes are 0.3-0.5cm, short, creeping or erect, suberrect densely covered with the scales are narrower or acicular, some cells on lower side are thick walled, cells are longer than broader, roots are 1-2cm long, fibrous, stipe is slender and shiny dark brown in colour. Fronds are usually bi or tripinnate. Pinnules are 1-1.6cm x 1-1.2cm, green papery, laminar, surface smooth. Pinnae are dissected in the upper margin, blunt and convex. Lower margin is smooth and more or less concave. Shape of pinnae is more or less triangular. Distal margin of fertile pinnae extended and inwardly turned forming distinct soral flaps, sporangia large and attached to the margin of pinnules.

Venation of pinnules is open dichotomous and they are dichotomously branched two to three times, leaves hypostomatic, stomata are present on the lower side of the epidermis and more or less parallel to the vein. Epidermal cells of both the surfaces are slightly wavy and sinuous. Upper epidermal cells are longer than broader but irregular in shape. The amplitude of sinuosity of upper epidermal cells is 17.5µm and wavelength of sinuosity is 103µm.Lower epidermal cells are irregular in shape and sinuous walled . The amplitude of sinuosity is 11µm and wavelength of sinuosity is 91µm. Stomata are confined only on lower side of the leaf. So the pinnules are hypostomatic. Trichomes are absent in pinnae. Stomata are surrounded by 3 to 5 neighbouring cells and cells are longer than broad.

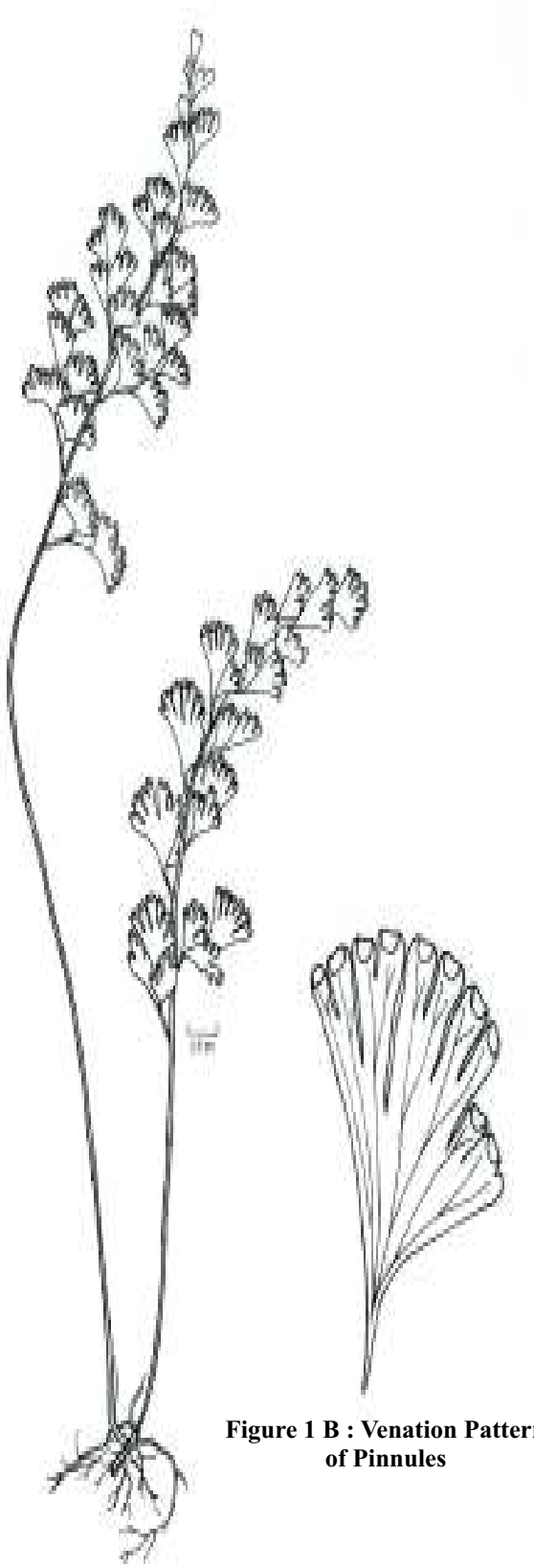

Figure 1 B : Venation Pattern of Pinnules

Figure 1 A : Complete Diagram of *Adiantum capillus-veneris*

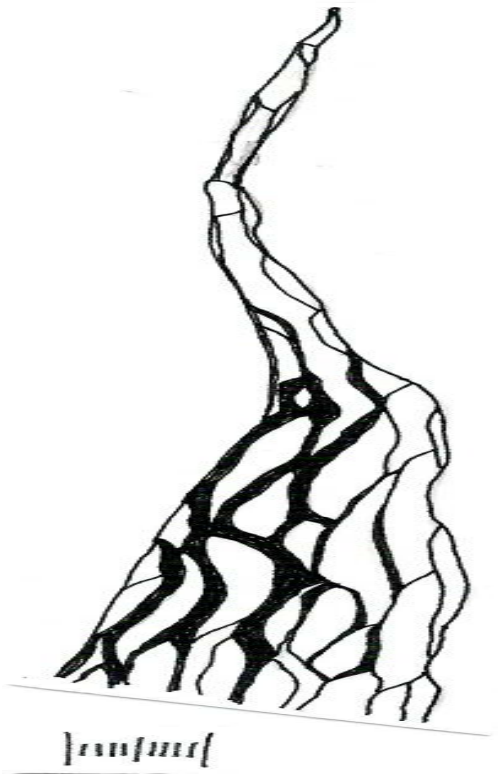

Figure 1 C : Scale

Figure 1 : Diagram of *Adiantum capillus-veneris* L.

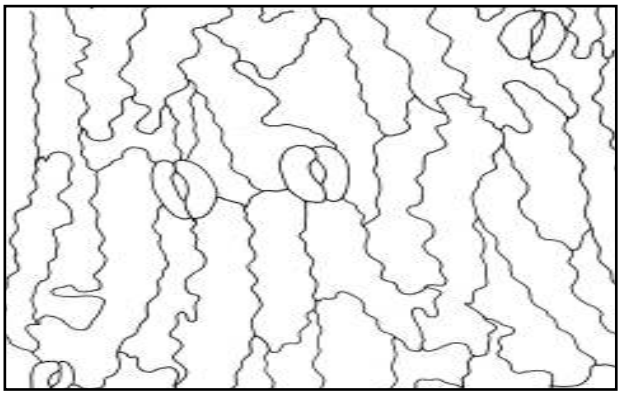

Figure 1 D : Lower Epidermal Cells With Stomata

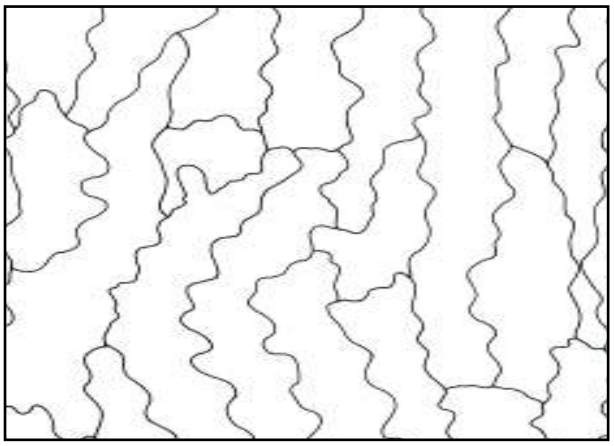

Figure 1 E : Upper Epidermal Cells

Plate 1 A : Photograph of Plant *Adiantum caudatum* L.

Plate 1 B : Photograph of plant *A. caudatum* L.

Plate 1 C : Photograph of Plant *A. philippense* L

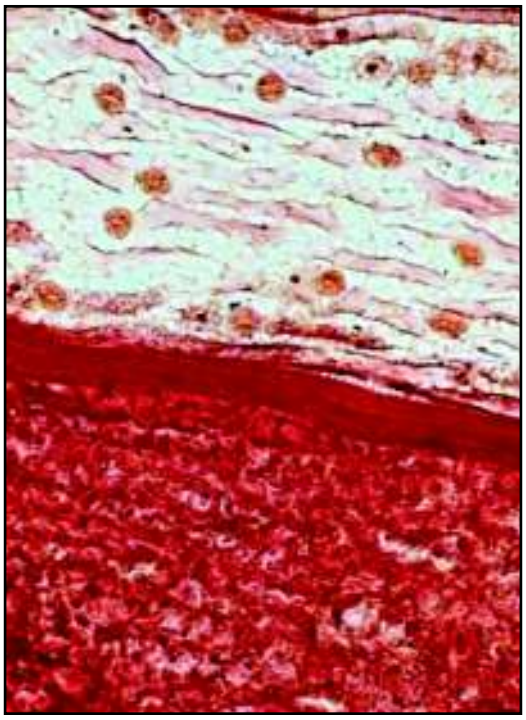

Plate 2 A : Photograph of Lower Epidermis of Plant *Adiantum capillus-veneris* L.(10X)

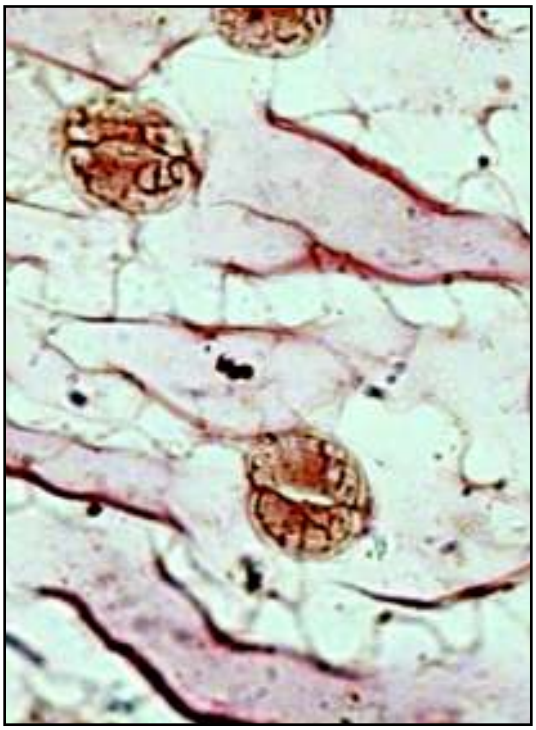

Plate 2 B : Photograph of Lower Epidermis of Plant *Adiantum capillus-veneris* L.(40X)

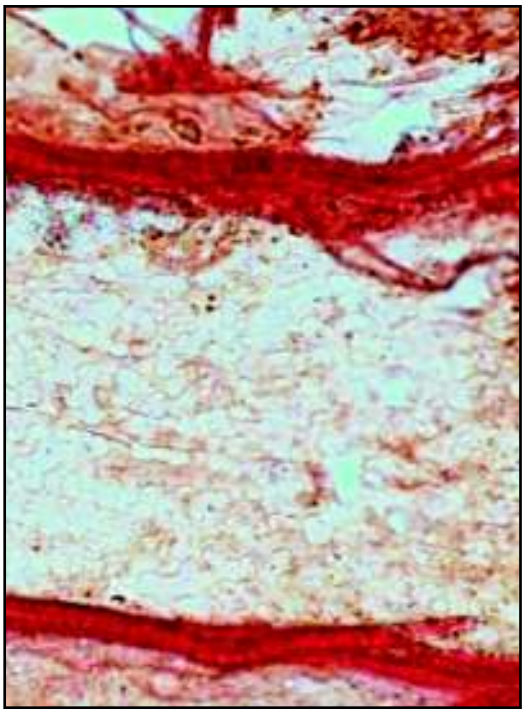

Plate 2 C : Photograph of Upper Epidermis of Plant *Adiantum capillus-veneris* L.(10X)

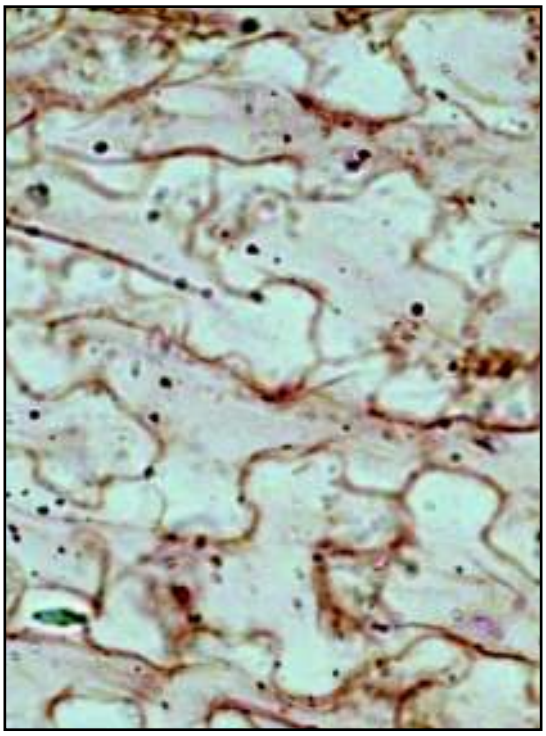

Plate 2 D : Photograph of Upper Epidermis of Plant *Adiantum capillus-veneris* L. (40X)

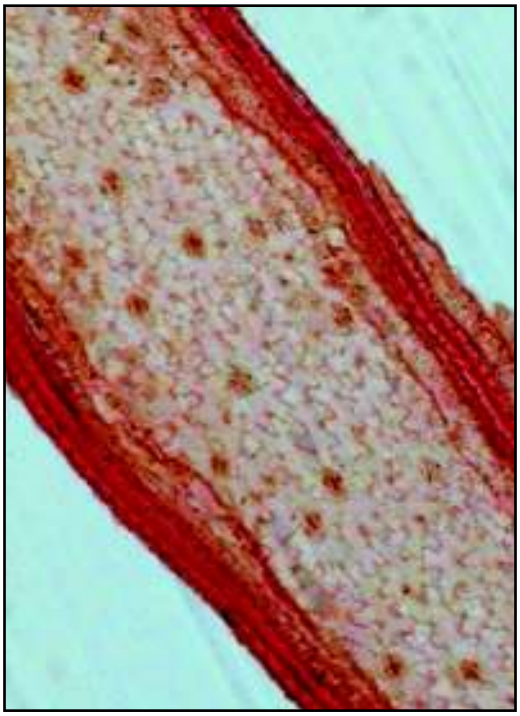

Plate 2 E : Photograph of Lower Epidermis of Plant *Adiantum caudatum* L.10X)

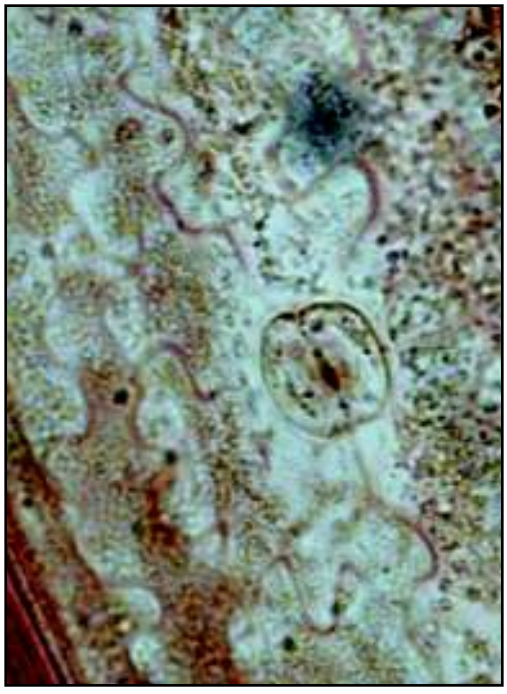

Plate 2 F : Photograph of Lower Epidermis of Plant *Adiantum caudatum* L.(40X)

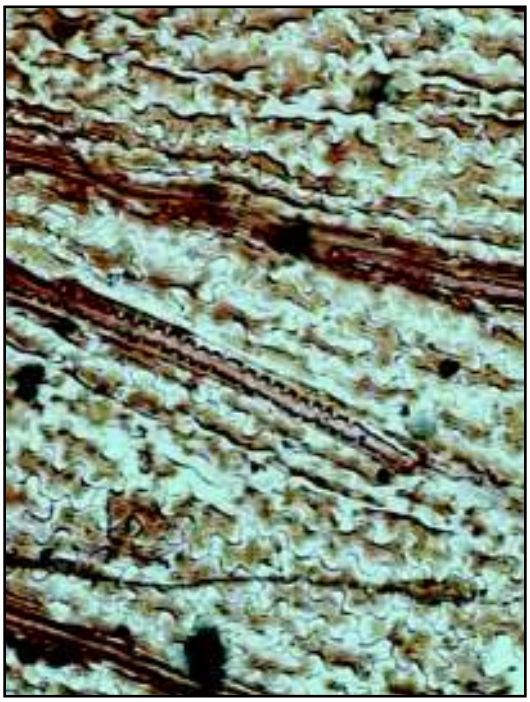

Plate 2 G : Photograph of Upper Epidermis of Plant *Adiantum caudatum* L.(10X)

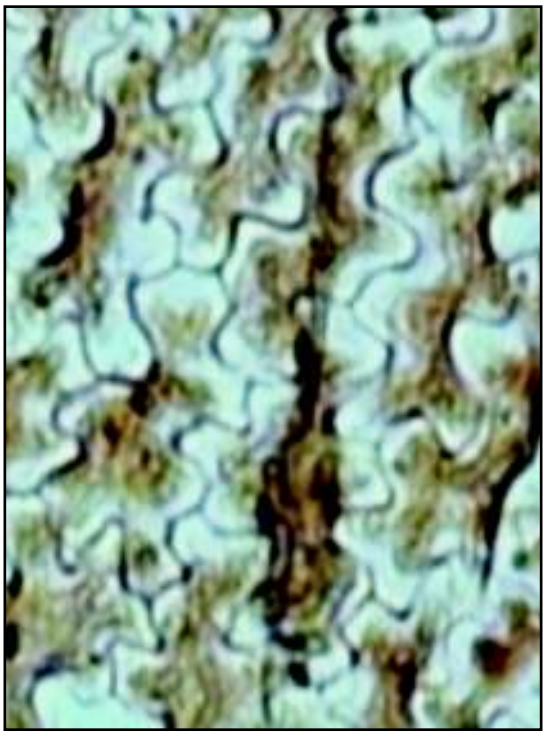

Plate 2 H : Photograph of Upper Epidermis of Plant *Adiantum caudatum* L.(40X)

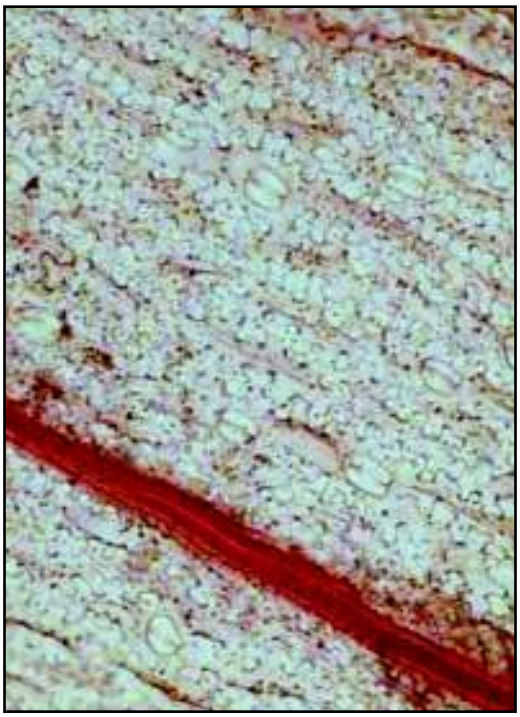

Plate 2 I : Photograph of Lower Epidermis of *Adiantum philippens* L.(10X)

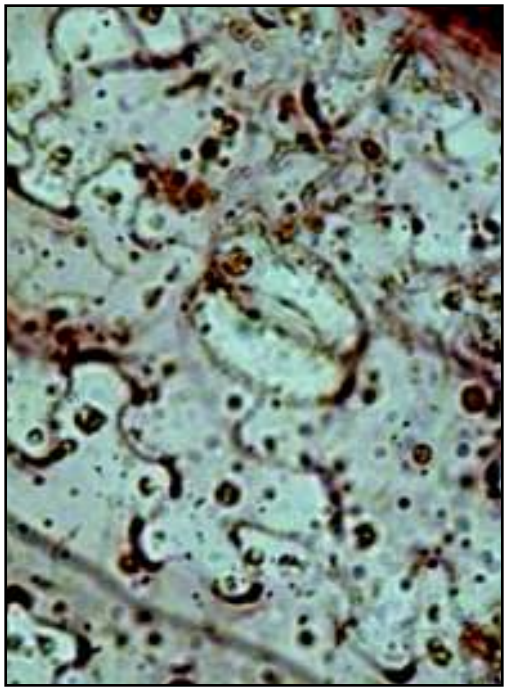

Plate 2 J : Photograph of Lower Epidermis of Plant *Adiantum philippens* L. (40X)

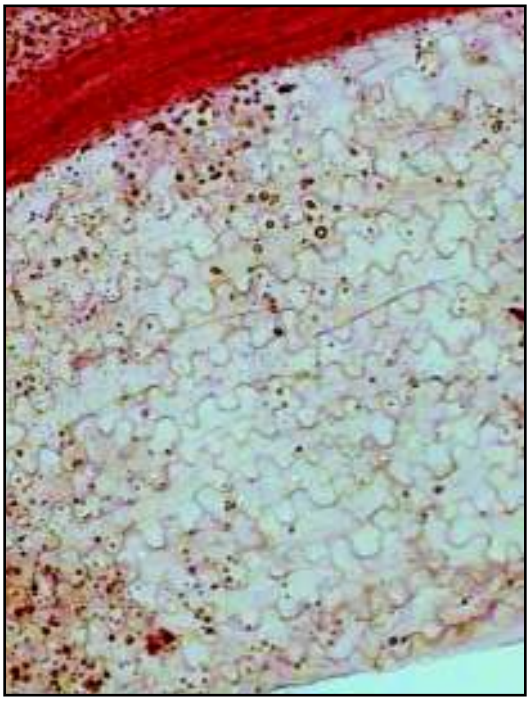

Plate 2 K : Photograph of Upper Epidermis of Plant *Adiantum philippens* L.(10X)

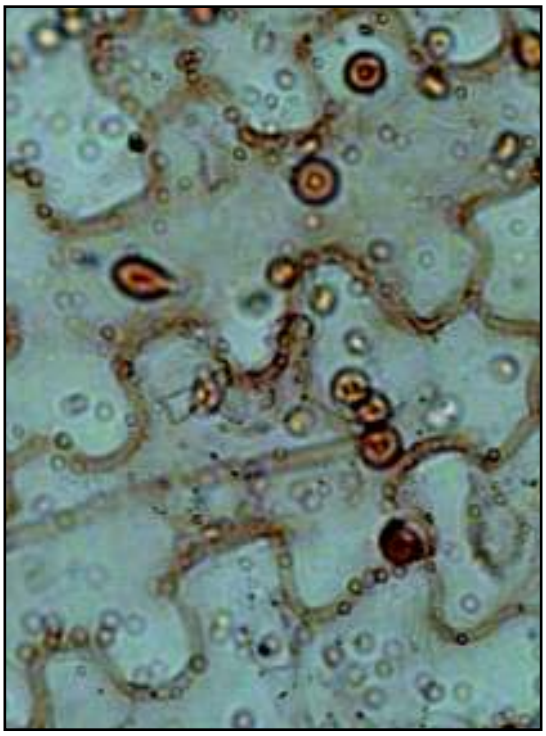

Plate 2 L : Photograph of Upper Epidermis of Plant *Adiantum philippens* L.(40X)

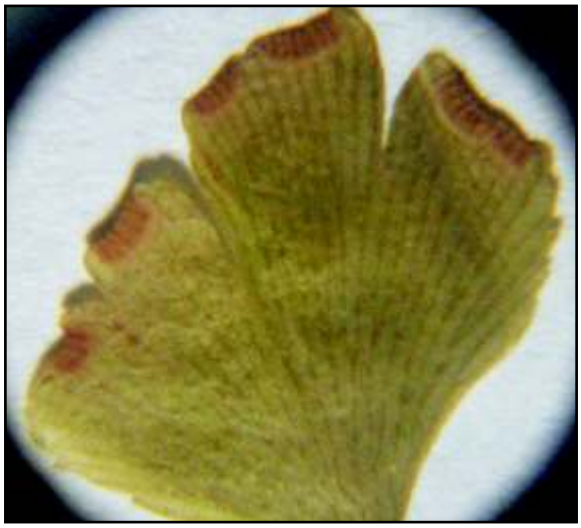

Plate 2 M : Photograph of Pinnule of Plant *Adiantum capillus-veneris* L

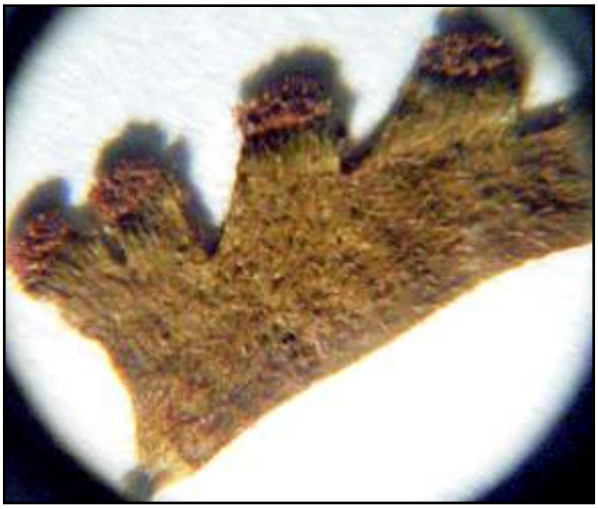

Plate 2 N : Photograph of Pinnule of Plant *Adiantum caudatum* L

Plate 2 O : Photograph of Pinnule of Plant *Adiantum philippens* L

Adiantum caudatum L. (Figure -2, Plates-1B, 2E, 2F, 2G, 2H, 2N)

Common name-'MAYURSHIKHA'

Plant length are 35-40.5cm and found in moist shady places, mesophytic, terrestrial, rhizome are 0.3-0.5cm thick, short, erect, densely covered with scales, varying much in size, roots are 4 to 16.50cm long fibrous, scale leaves are copious, lanceolate, narrow usually broad at base and pointed at tip, dark brown and cells are longer than

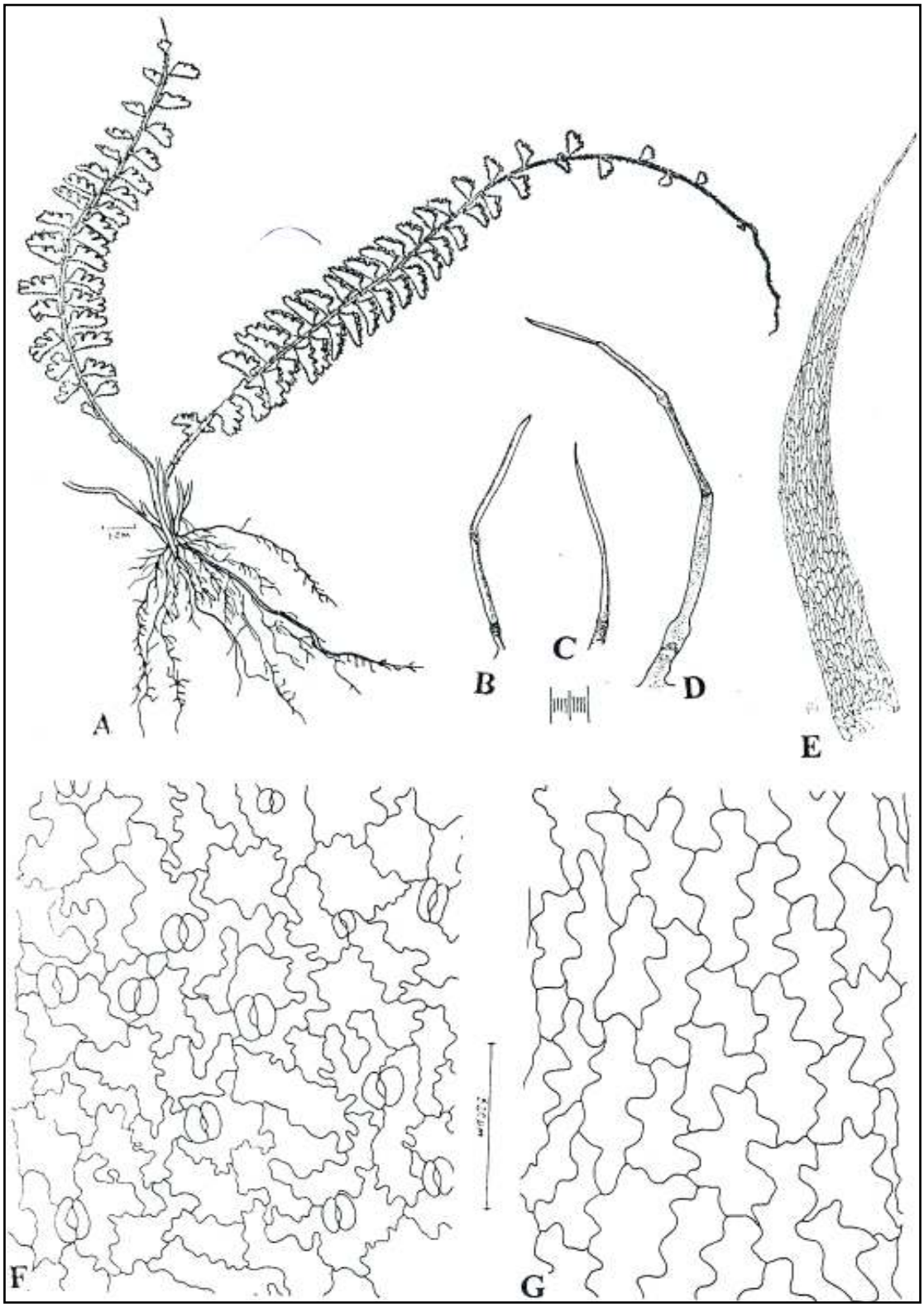

Figure 2 : Diagram of *Adiantum caudatum* L.
A : Complete diagram of *Adiantum caudatum* L.
B, C, D : Hairs
E : Scale
F : Lower epidermal cells with stomata
G : Upper epidermal cells

broader, stipe tufted, wiry dark chestnut brown with multicellular hairs, lamina simply pinnate bearing sub-sessile pinnae on each side of rachis attached by pointed base. Pinnae are 0.5-1cm x 0.3-0.4cm and deeply cut into several narrow spreading lobes, shape more or less trapiziform in outline, apex blunt or rounded, lower margin is slightly concave and smooth. Upper margin is convex and dissected, texture coriaous. Fertile pinnae posses a lot of sporangia on the tip of pinnae, they appears cap like on the pinnae. Both surfaces are hairy, hairs multicellular, hairs base are broad and tip is pointed, veins quite prominent on abaxial side but not on adaxial side. Sori on apices of lobes, hairy, sporangia small, and annulus is generally 14-18 cells long. Spores are 32 x 30 µm. Spores are more or less triangular in shape with trilete mark, exine shows reticulate form.

Pinnules have open dichotomous venation pattern, generally two to three times dichotomously branched before ending to the tip. Lower surface consist of elongated, multicellular hairs with tapering ends along the veins. Epidermal cells of both faces are sinuous walled. Upper epidermal cells are longer than broader but irregular in shape. The amplitude of sinuosity of upper epidermal cells is 29µm and wavelength of sinuosity is 136µm. lower epidermal cells are irregular in shape and sinuous walled . The amplitude of sinuosity is 21µm and wavelength of sinuosity is 50µm. Stomata are generally present on lower side of the leaf and the leaves are hypostomatic in nature. The stomata are surrounded by 2-5 neighbouring cells. Stomata are more or less parallel to the vein.

Adiantum philippens L.(=*A. lunulatum*). (Figure 3, Plates-1C, 2I, 2J, 2K, 2L, 2O)

Common name- 'HANSAPADI'

Plants are 15-17cm long, occurs in moist shady places, mesophytic, terrestrial, rhizome 0.3 - 0.5cm, short, erect or suberrect, bearing a dense tuft of fronds as well as of fibrous roots, scale leaves narrow, lanceolate, dark, stipe dark brown or black, polished, grooved, glabrous, leaf simply pinnae, pinnae present on each side of the rachis and a terminal leaflet of irregular shape, pinnae articulated to the rachis and stalked. Pinnae are1-1.5cm x 0.5-0.7cm, dissected on the outer margin and convex, lower margin is

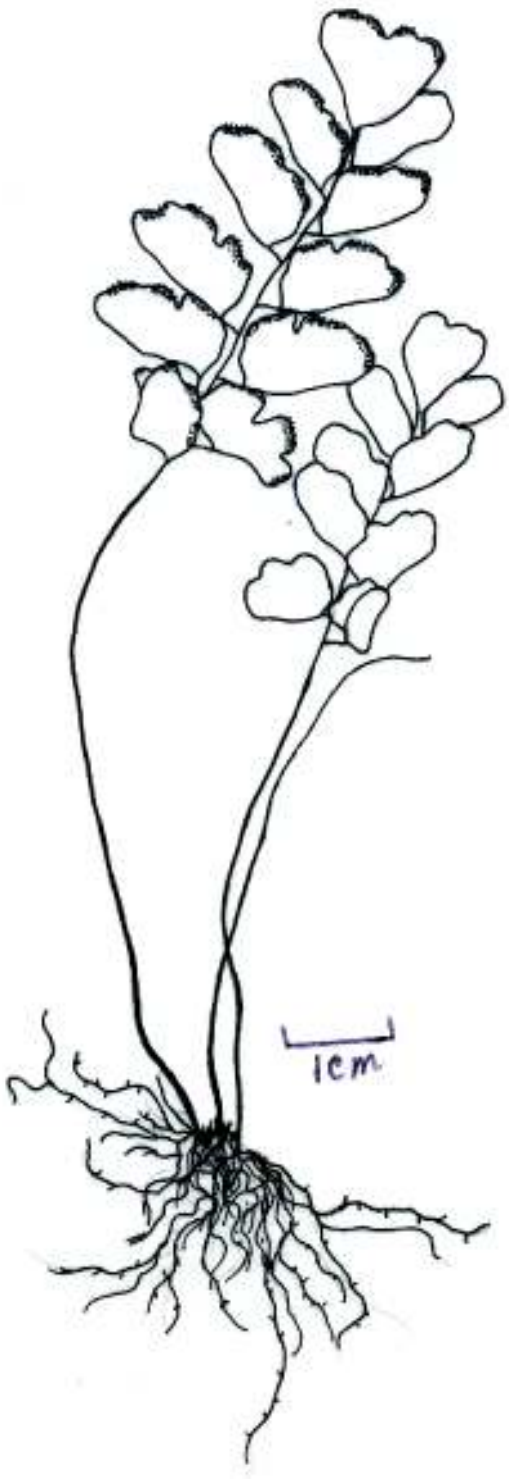

Figure A : Complete diagram of *Adiantum philippens* L

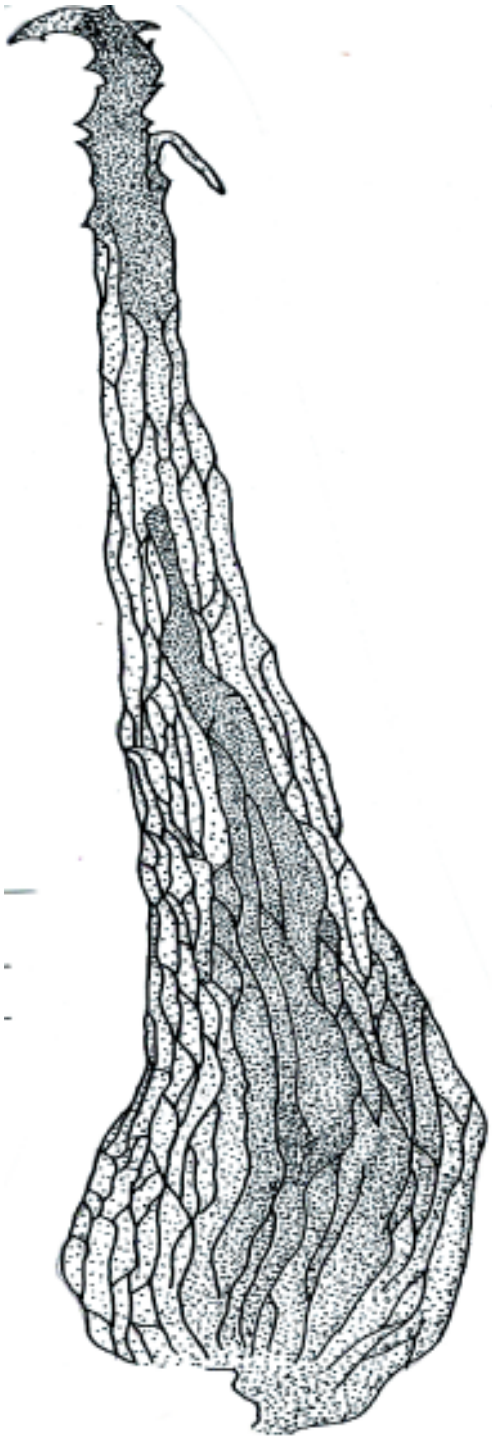

Figure 3 B : Scale

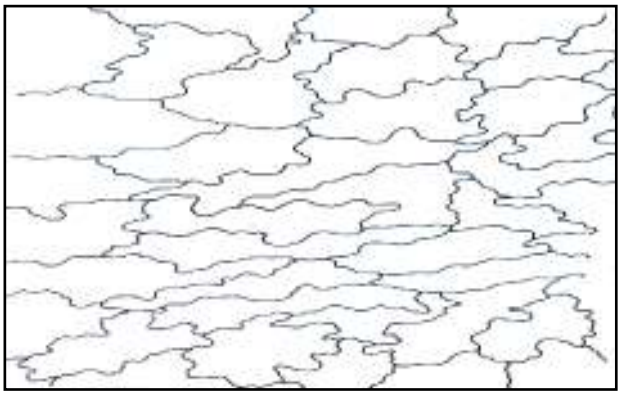

Figure 3 C : Lower Epidermal Cells With Stomata

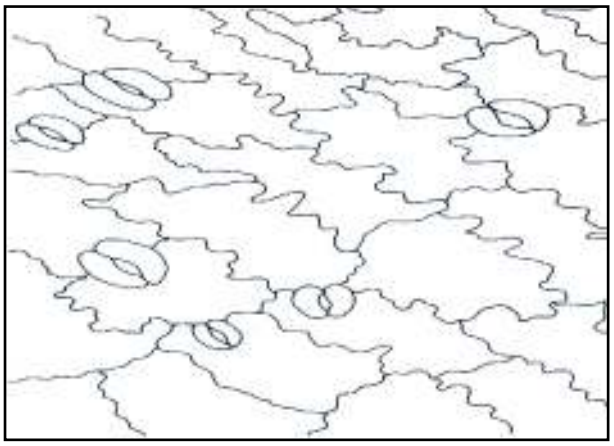

Figure 3 D : Upper Epidermal Cells

Figure 3 : Diagram of *Adiantum philippens* L.

smooth and more or less convex, fertile pinnae with outer margin smooth and sori are present on the margin of pinnae, veins radiate from the attachment of the petiole. Sporangia small and annulus is generally 16-19 cells long. Spores are 40 x 43 µm. Spores are more or less triangular in shape with trilete mark, exine shows reticulate ornamentation.

Pinnae have open dichotomous venation pattern .they dichotomise two to three times. on the lower side a main vein appears and rest of veins originated from there, trichomes absent in the pinnae , epidermal cells on both sides of pinnules are deeply sinuous walled and are arranged longitudinal rows along with the veins. Upper epidermal cells are longer than broad but are irregular in shape. The amplitude of sinuosity of upper epidermal cells is 16µm and wavelength of sinuosity is 79µm.Lower epidermal cells are irregular in shape and sinuous walled. The amplitude of

sinuosity is 17.5µm and wavelength of sinuosity is 75µm. stomata are usually confined to the lower surface i.e. hypostomatic, these are parallel to the vein, cells of lower side are longer than broad and sinuous walled.

In the present study three out of five species of Adiantum have been studied from different localities of Nepal viz; *Adiantum caudatum, A. capillus - veneris, A. philippens.* (see *A. caudatum, A. capillus - veneris, A. philippens, A. indicum, A. edgeworthii*, Sinha and Gurung 1985) Nayar in 1961 reported about 200 species of Adiantum from the world. As for as the author knows this is the first illustrated account of these Adiantum from the Nepal. In the present study the morphology of leaf, venation, epidermal and cuticular along with spore morphology has been undertaken for the first time. Although Pant 1965 have carried out such studies. However in majority of the Adiantum such studies are imperfectely known in India. However many details are still needed in such studies.

All the three species in the present study show striking differences in their epidermal, cuticular, venation as well as in their spores. In all the three species of Adiantum venation is dichotomous type. Epidermal cells in all the three species (both upper and lower) are sinuous walled but the amplitude and wavelength of sinuosity is different in different species varies greatly. Stomata as a rule are hypostomatic in all the three investigated species. Stomata are generally surrounded by 2-5 neighbouring or epidermal cells.

ACKNOWLEDGEMENTS

We express our deep sense of gratitude to the respective Late dr. R.D.Dixit from B.S.I., Allahabad and Late Prof. P.K.Khare from University of Allahabad, Allahabad. For helping us in identification of species. We are grateful to Prof.D.R.Misra, University of Allahabad who has given me support at every step.

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