## 2.3 *PSILOTUM*

*Psilotum* belongs to the family Psilotaceae, order Psilotales, class Psilophytinae, division Psilophyta of Pteridophyta (Smith, 1955). Eames (1936) has placed the genus *Psilotun* under the same order (i.e. Psilophytales) of the group Psilopsida. Bold (1957), Benson (1957), Pichi-Sermolli (1958) and others placed the genus under the same family and order of their class Psilotopsida.

**Habitat**—*Psilotum* with two species e.g., *P. nudum* (Syn. *P. triquetrum*)

and *P. flaccidum* is widely distributed in tropical and sub-tropical regions of both hemispheres. The plant is xerophytic in nature but grows in various habitats from very dry to moist places. *P. nudum* is found to grow in India and hence it is the only Indian species.

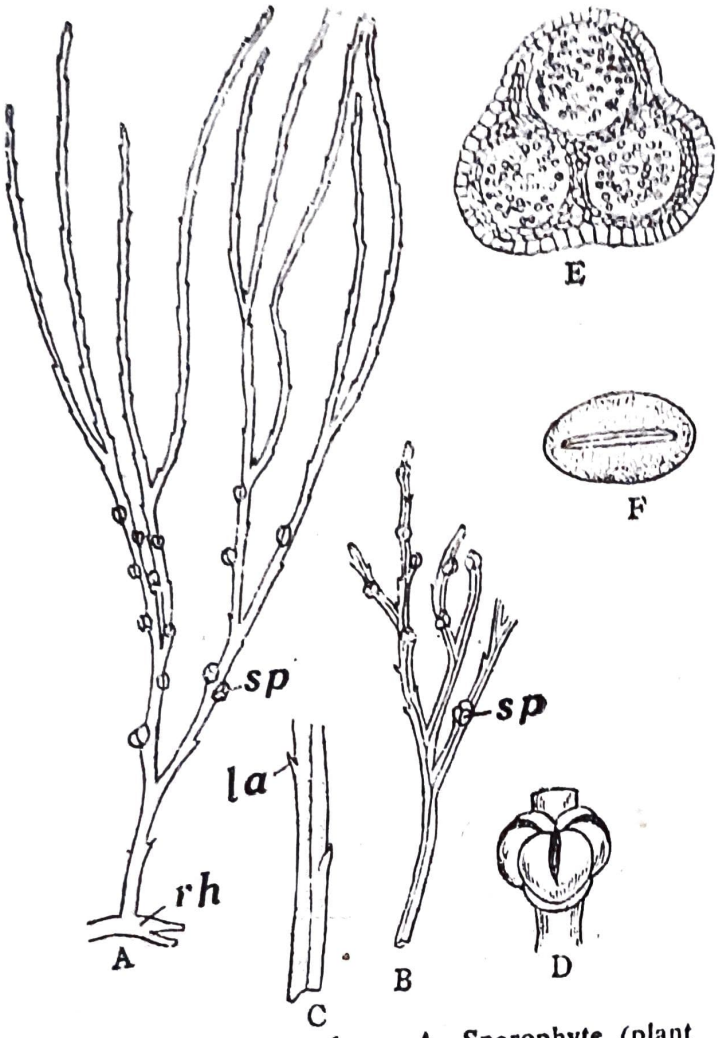


Fig. 2.4—*Psilotum nudum.* A—Sporophyte (plant body.) B—A fertile twig bearing sporangia (*sp.*). C—A portion of stem showing leafy appendages (*la*). D—Sporangia showing dehiscence. E—Sporangial structure in t.s. F—Single spore. *rh*—rhizome.

**Habit**—*Psilotum* is a slender often densely tufted shrubby plant—20 to 100 cm in height. Both the species are generally epiphytic in habit and grow upon tree ferns and palms, but they may also grow terrestrially in soil or in the crevices of rocks.

**A. Structure of the Sporophyte :**

1. EXTERNAL MORPHOLOGY OF THE VEGETATIVE ORGANS—

(*a*) The sporophyte i.e., plant body is differentiated into a slender rootless subterranean rhizome and an aerial shoot.

(*b*) The rhizome contains a mycorrhizal fungus and is covered with hair-like absorbing structures called *rhizoids*. The rhizome branches dichotomously, the tip of any branch i.e. dichotomy may become erect and develop into a green aerial 'leafy' shoot.

(*c*) Aerial shoots are either pendent (in case of epiphytic condition) or erect (in case of terrestrial condition). The branching of aerial shoot is strictly dichotomous. The basal part of the stem is cylindrical but the distal green portion may be longitudinally ribbed (*P. nudum*) or may be flattened (*P. flaccidium*).

(*d*) The aerial branches i.e. stems bear on the upper part small, scale-like appendages i.e. *'leaves'* arranged irregularly, or more or less definitely in 2 or 3 rows. Aerial branches are green and perennial, they serve as photosynthetic organs.

The growth of the rhizome and aerial branches takes place by the activity of a single, large and wedge-shaped apical cell with three cutting faces.

2. INTERNAL MORPHOLOGY—

(*i*) The epidermis of aerial branches is one-cell in thickness with heavily cutinised outer walls—the epidermis is interrupted by stomata, chiefly in the grooves between the longitudinal ridges.

Epidermis of rhizome is indistinct and thin-walled—outer cells are without cuticle ; stomata are absent.

(*ii*) Cortex of acrial branches is massive and differentiated into three regions e.g., (1) hypodermal *outer cortex*, 2-5 layered, composed of chlorenchymatous cells with intercellular spaces; (2) *middle cortex*—this zone lies internally next to outer cortex and is composed of 4-5 layers of vertically elongated sclerenchymatous cells with little or no intercellular spaces—and (3) *inner cortex* lying internal to middle cortex—this zone is composed of thin-walled parenchymatous cells without intercellular spaces but containing abundant starch grains. The cortex is internally delimited by an endodermis with distinct Casparian strips.

In the rhizome, cortex is composed of only thin-walled parenchymatous cells containing mycorrhizal fungus, the cells are without intercellular spaces.

(*iii*) Stele of aerial branches is actinostelic protostele with 5-6 xylem rays; the xylem is exarch. Phloem lies between the endodermis and the xylem, it is composed of elongated thin-walled cell-elements—typical sieve tubes have been demonstrated. The stele of rhizome is haplostelic or actinostelic type of protostele.

(*b*) The 'leaf' has single-layered epidermis without stomata. The interior of leaf is composed of parenchyma cells without a vein.

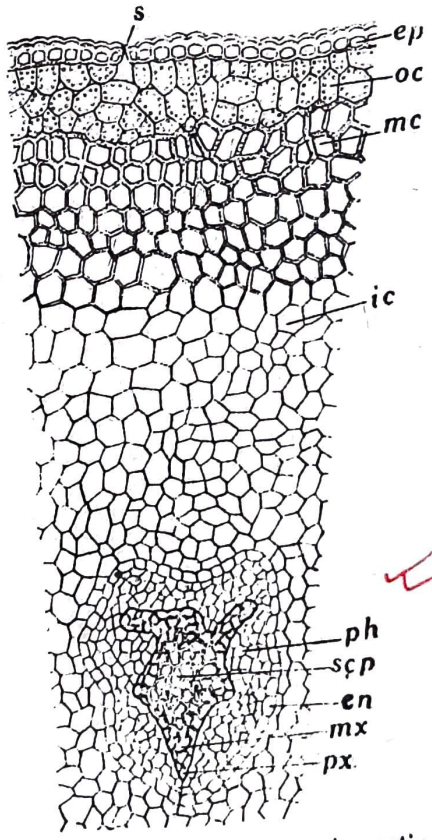


Fig. 2.5—*Psilotum nudum*. A portion of the stem in t. s. *s*—stoma; *cp*—epidermis; *oc*—outer cortex; *mc*—middle cortex; *ic*—inner cortex; *ph*—phloem; *scp*—sclerotic pith; *en*—endodermis; *mx*—metaxylem; *px*—protoxylem.

3. VEGETATIVE REPRODUCTION—In *Psilotum*, vegetative reproduction takes place by the formation of *gemmae*, which develop freely and in large numbers on the rhizomes. These gemmae are small, oval bodies, one-cell in thickness. The gemmae may germinate into new sporophyte while still attached to the parent plant or when they fall on suitable substratum.

4. ASEXUAL REPRODUCTIVE ORGANS

*Psilotum* bears large and conspicuous sporangia at the distal ends of the dichotomously branched shoots. In *Psilotum* the sporangia are borne in *triads* on the adaxial (ventral) side of the appendag (i.e. 'leaf') at the point of dichotomy and they (i.e. sporangia) are slightly raised on broad but short stalks. As the sporangia are fused with one another so the group is often referred to as 'synangium'. Each mature sporangium or sporangial complex is 2-3 mm wide, 3-lobed (Fig. 2.4, E), and each lobe contains a spore sac with numerous spores of one kind. The sporangial wall is multilayered. The mature sporangium dehisces by a vertical slit.

The morphological nature of the sporangial complex has long been in great dispute. According to Solms-Laubach (1884), Velenovsky and Seward (1910), Bower (1908), and Schoute (1938) it is a foliar structure and the forked leaves are bifid sporophylls bearing a 3 lobed fructification (sporangium). But Juranyi (1871), Strasburger and Gobel (1915) and Bierhorst (1956) consider it as a short lateral shoot. According to them the short fertile branch i.e. axis bears two sterile appendages i.e. leaves and terminates in a trilobed fructification.

**B. Structure of the Gametophyte :**

Spore is the first cell of the gametophyte. Each spore is bilaterally symmetrical with outer delicate and finely thin reticulate wall. A spore

germinates after about four months and develops into a gametophytic plant body. The gametophytic plant body is small (±18 mm long), brown in colour, sub-terranean and saprophytic in existence. The mature gametophyte is a dichotomously or irregularly branched, subterranean, cylindrical elongated structure and covered densely with brownish hair-like rhizoids ; cells of the gametophyte are filled with mycorrhizal fungus. Gametophytes are monoecious *i.e.* homothallic, there is no differentiation into vegetative (sterile) and reproductive (fertile) regions—antheridia and archegonia are borne in large numbers all over the gametophyte.

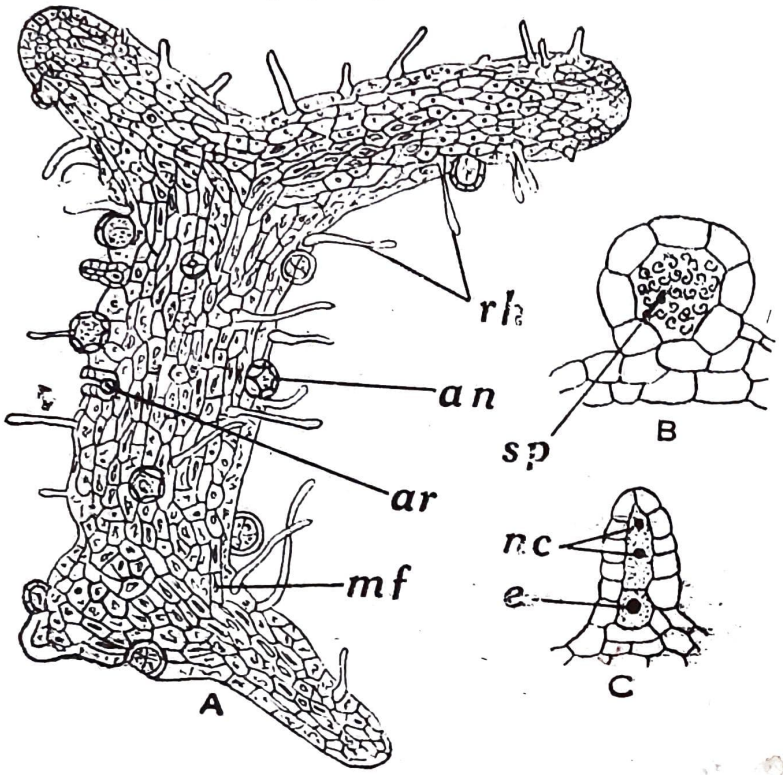


Fig. 2.6—*Psilotum nudum*. A—Gametophyte. B—Antheridium containing sperms (*sp*). C—Mature archegonium. *nc*—neck canal cells, *e*—egg, *rh*—rhizoids, *an*—antheridium, *ar*—archegonium, *mf*—mycorrhizal fungus.

*Antheridia*—Antheridia begin to develop on the gametophyte earlier than archegonia. Each antheridium is a projected spherical body with a jacket of single-layer of cells. Within the jacket of the antheridium, there lie numerous spiral and multiflagellate sperms.

*Archegonia*—The archegonia are sunken with short projecting neck which breaks away at maturity. The neck of the archegonium is 4-5 cells in height, with possibly two neck canal cells ; the venter contains one ventral canal cell and an egg. The neck canal cells or merely nuclei and the ventral canal cell gradually begin to disintegrate.

5. *Fertilization*—As the archegonia approach maturity there is sloughing off of all neck cells above them, next disintegration of neck canal cells and ventral canal cell takes place which leaves a passageway for entrance of antherozoids into the venter of the archegonium. Fertilization has not been observed, probably it takes place as usual.

**C. The young Sporophyte (Embryo)**—After fertilization, the diploid zygote enlarges and fills up the cavity of the venter ; then the zygote cell divides transversely into an upper i.e., *epibasal cell* and a lower i.e., *hypobasal cell.* The epibasal cell gives rise to the *axis* i.e. shoot while the hypobasal cell develops into the *foot* of the embryo. With the development of embryo, a cushion-like gametophytic tissue is also formed above the embryo forming the so-called *calyptra*—this cushion of gametophytic tissue is lifted and finally ruptured by the growing axis of the embryo. In the mean time, the foot enlarges downwards sending a number of haustorium-like processes deep in the gametophytic tissue. The foot attaches the young sporophyte and absorbs the nutrients from the gametophytes until the young sporophyte becomes physiologically independent. Ultimately youug sporophyte breaks off from the foot but still remains with the gametophyte. As soon as the sporophyte gets an mycorrhizal fungus infection, it becomes independent.