CONTRIBUTION TO OUR KNOWLEDGE OF THE PHYSIOLOGICAL ANATOMY OF SOME INDIAN HYDROPHYTES

I. The Stem of Caesulia axillaris, Roxb.

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Caesulia axillaris, R., a member of the family Compositae, is the only species of the genus Caesulia, Roxb. occurring in India. It is a common marsh herb found throughout the greater part of this country in swamps, on the margins of lakes and streams and in rice fields.

The stem of this amphibious species is stout, prostrate or suberect and succulent. The surface is glabrous and striate.

Anatomical investigation of the stem reveals the following features:

1. Epidermis.—A single layer of small thick-walled cells. Cuticle thin and finely papillose. Stomata in level with the ordinary epidermal cells, or slightly raised (Fig. 1).

Another feature of the epidermis is the presence of anthocyanin. The pigment is generally restricted to a few epidermal cells here and there, appearing as red streaks on the external surface of the stem. Occasionally, however, the entire epidermis may come to possess anthocyanin so that externally the stem appears red.

2. Cortex.—This shows three concentric zones. The outer cortex consists of two to three layers of collenchyma. In the middle cortex there are well-defined schizogenous lacunae bounded by thickwalled parenchymatous cells. The cells of the outer and middle cortex contain chloroplasts (Figs. 1 & 2).

The inner cortex, which is thinwalled and parenchymatous, shows the presence of resin-ducts placed at regular intervals. The endodermis is wavy and contains small starch-grains (Fig. 3).

Some of the cortical cells show the presence of anthocyanin which may extend even to the inner cortex.

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TEXT-FIGS. 1–2. *Cesulia axillaris*, R. Fig. 1. Part of the T.S. of the stem showing the thin papillose, cuticle (*c*), stoma (*st*), thickwalled epidermis (*ep*), and collenchymatous outer cortex (*o*), ×225. Fig. 2. Part of the T.S. of the stem showing the chlorenchymatous lacunar middle cortex, ×100.

3. Pericycle.—Heterogeneous; radially alternating zones of thin-walled parenchyma and sclerenchymatous fibres, the latter forming crescent-shaped stereid bundles on the outer periphery of the phloem groups of the vascular bundles.

4. Vascular system.—This is of the *Helianthus annuus* type. A single ring of vascular bundles separated by medullary rays. Secondary growth conforms to the sunflower type.

5. Pith.—Extensive; thinwalled parenchymatous cells containing druses of calcium salts (Fig. 4).

**Discussion**

1. The stem of *Cesulia axillaris*, R. is constructed on a fundamental plan typical for the herbaceous species of the Compositae. It shows, at the same time, marked adaptation to the marshy habitat.
2. The cortex is the most characteristic region of the stem. The outer cortex forms a firm peripheral shell of collenchyma. The lacunar middle cortex, so typical of the helophytes, functions as the aerating tissue.

3. The typical combination of semi-xerophytic or mesophytic characters with the hydrophytic ones found in the anatomy of marsh plants is evinced here by the presence of the thickwalled epidermis and cuticle, the development of an assimilatory tissue in the form of the chlorenchymatous...
outer and middle cortex and the general thickness of the walls of the cortical cells. This thickness is found to increase with the decrease of moisture in the soil.

4. The presence of anthocyanin in the epidermis and cortical cells is open to various interpretations. At the present stage of investigation, the author is inclined to believe that the pigment offers protection to the plant against too strong light and high temperature. It may be mentioned here that during his investigation of the hydrophytes of Nagpur, the author has noticed several hydrophytes which develop anthocyanin on the onset of drier and warmer conditions of the summer season.

5. The foregoing account of the anatomy of the stem shows that it has efficient mechanical and conducting systems.

6. As far as the author is aware, this is the first account of the physiological anatomy of a marsh plant belonging to the Compositæ from India. Arber (1920) has drawn attention to the fact that the existence of hydrophytic members in the Compositæ is itself significant, in view of the history of Angiosperms. How far these hydrophytes have adapted themselves to their comparatively recent watery habitat is worth investigation. The present contribution is intended to be a step in that direction.

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