Telome Theory

It is now widely accepted that the present day plants with green leaves and branches have evolved from the axial sporophyte of the earliest and most primitive land plants. Devonian Psilophytales (e.g., *Rhynia*, *Horneophyton*, *Psilophyton*, *Asteroxylon*), which are considered to be the earliest vascular land plants, had a simple dichotomously branched axis with leaves and roots. Some of their terminal branches bore sporangia while others were sterile. Discovery of these primitive plants prompted many workers to believe that from these simple vascular plants, by the process of elaboration, branches with green leaves developed. One such view that has attracted maximum attention is the **telome theory** put forward by Zimmermann (1930).

What are Telomes ?

The name **telome** has been given to the simple ultimate terminal portions of a dichotomously branched axis. These axes are undifferentiated and single nerved. Two telomes of a dichotomizing axis are united below the point of dichotomy to form a fused structure, called **mesome** (Fig. 1 A). In fact each mesome is basically a telome but during ontogeny its apex was formed and it was transformed into a mesome. The following two types of telomes have been recognised on the basis of their function.

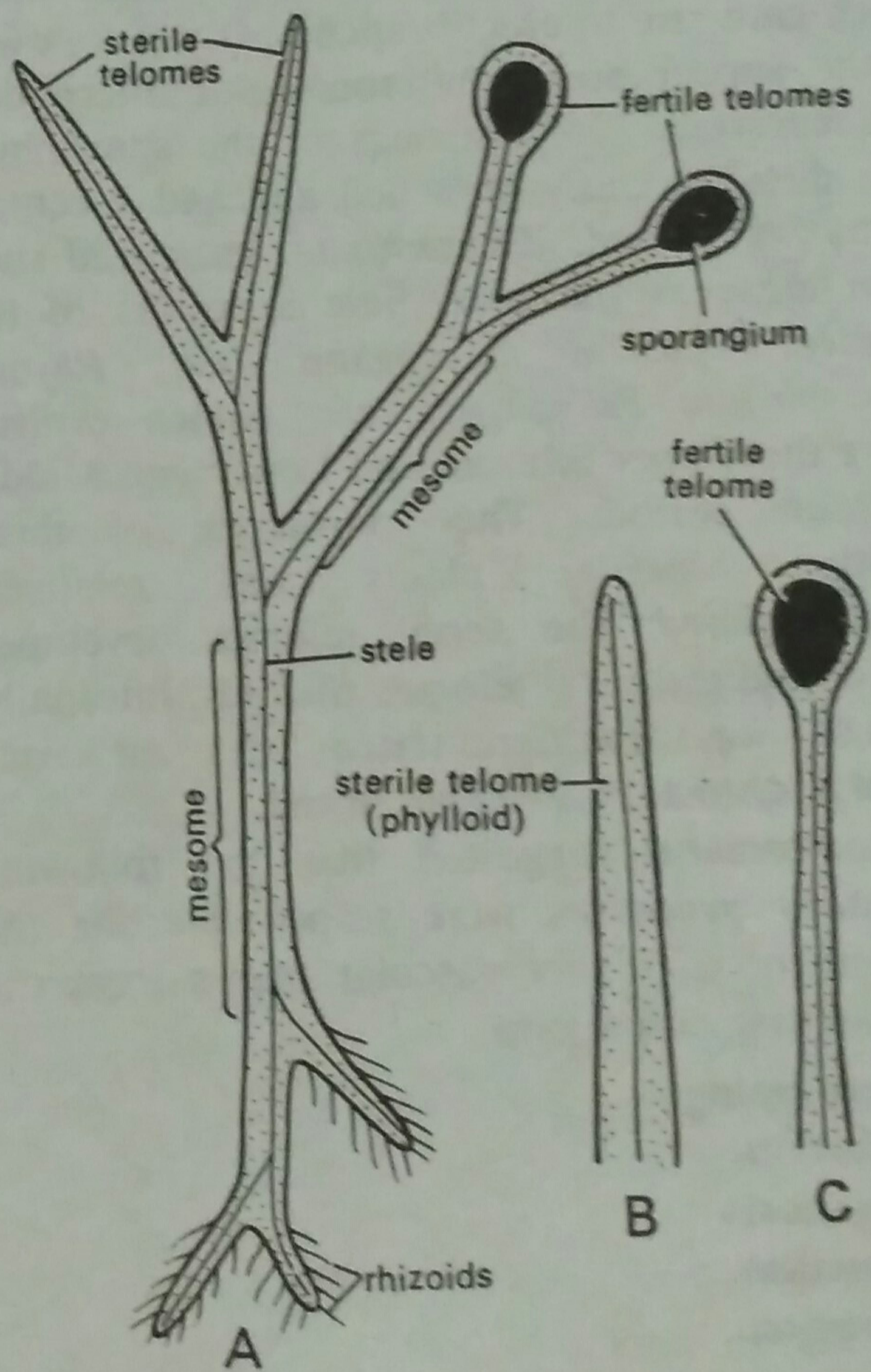

Fig. 1 **A-C.** Telome : **A.** Diagrammatic representation of a hypothetical primitive vascular plant, **B.** A sterile telome, **C.** A fertile telome.

1. **Vegetative or sterile telomes.** These telomes are without sporangia and they are also called **phylloids** (Fig. 1 B).

2. **Fertile telomes.** Those telomes which bore terminal sporangia are called **fertile telomes** (Fig. 1 C).

During the course of evolutionary development, telomes became grouped together to form a more complex structure, called **syntelome** or **telome truss.** A syntelome is called **phylloid truss** if it consisted of only sterile telomes, a **fertile truss** if it consisted only fertile telomes and a **mixed telome truss** or **mixed syntelome** when it consisted of both sterile and fertile telomes.

Telome and the Origin of Higher Land Plants

According to Zimmermann, the primitive vascular land plants have originated from unicellular green algae. Repeated divisions in unicellular forms resulted in the development of large undifferentiated forms with parenchymatous thalli. Further development and differentiation led to the establishment of meristematic tissue which gave rise to erect branches. It was followed by the appearance of heteromorphic alternation of generation. The branches of the sporophyte were dichotomously branched and had a central mechanical strand. Zimmermann visualized such green algae as the immediate ancestors of the primitive vascular cryptogams (e.g., *Rhynia, Horneophyton, Psilophyton,* etc.) which evolved during the Upper Silurian and Lower and Middle Devonian periods. The sporophyte of these primitive vascular plants was relatively undifferentiated; the aerial telomes developed stomata and the basal telomes rhizoids. Internally, the axis was undifferentiated with an axial, typically protostelic vascular strand.

Zimmermann suggested that the following **elementary processes** were responsible for the development of higher vascular plants from the early vascular cryptogams.

(1) **Overtopping**
(2) **Planation**
(3) **Syngenesis**
(4) **Reduction**
(5) **Curvation**

[I] Overtopping

In this process one of the two dichotomizing branches of an axis became larger, stronger and grew vertically upward as the main axis. The shorter dichotomy was displaced laterally and it served as precursor of megaphylls (Fig. 2 A, B).

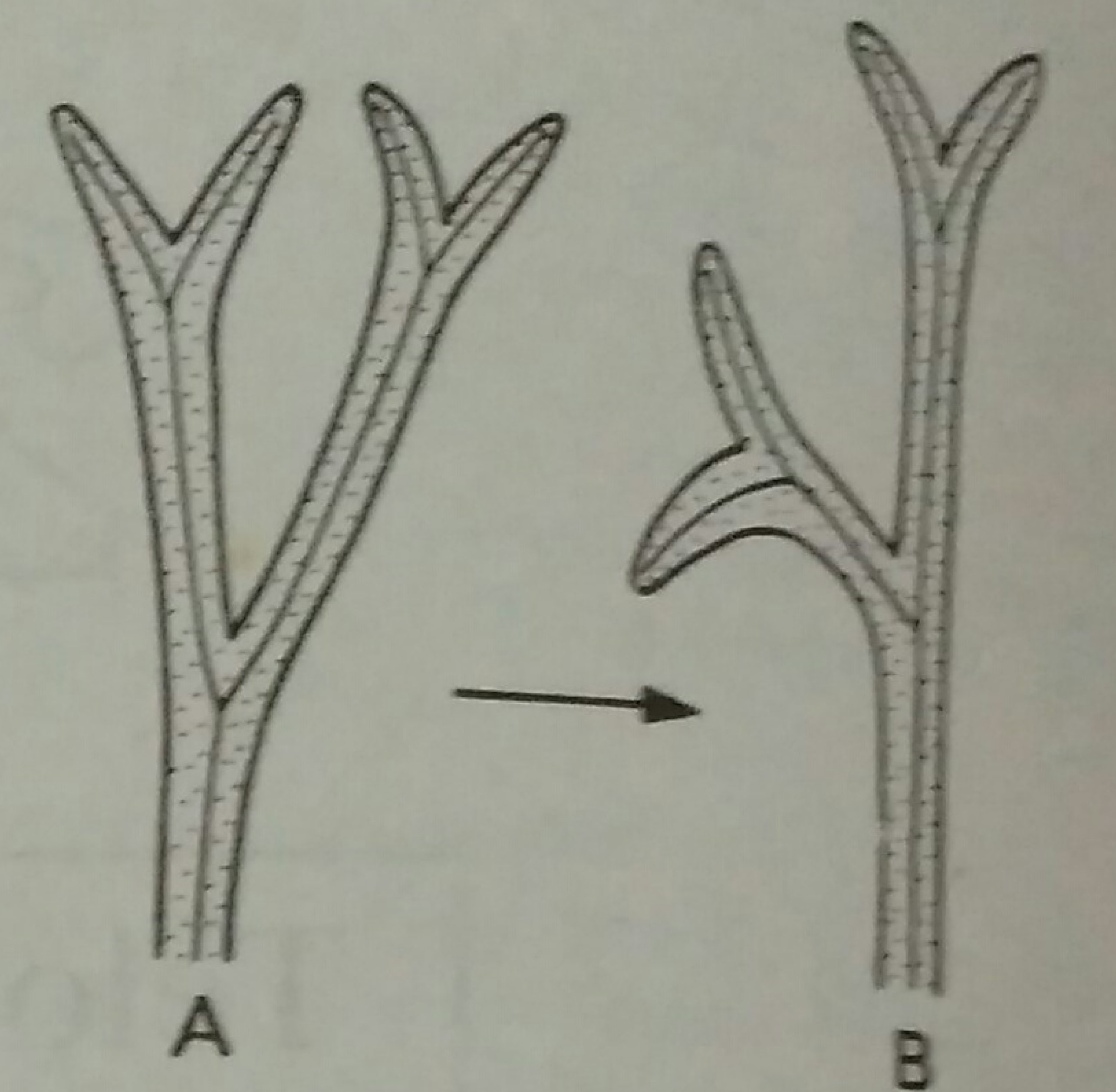

Fig. 2 **A-B.** Overtopping of telomes.

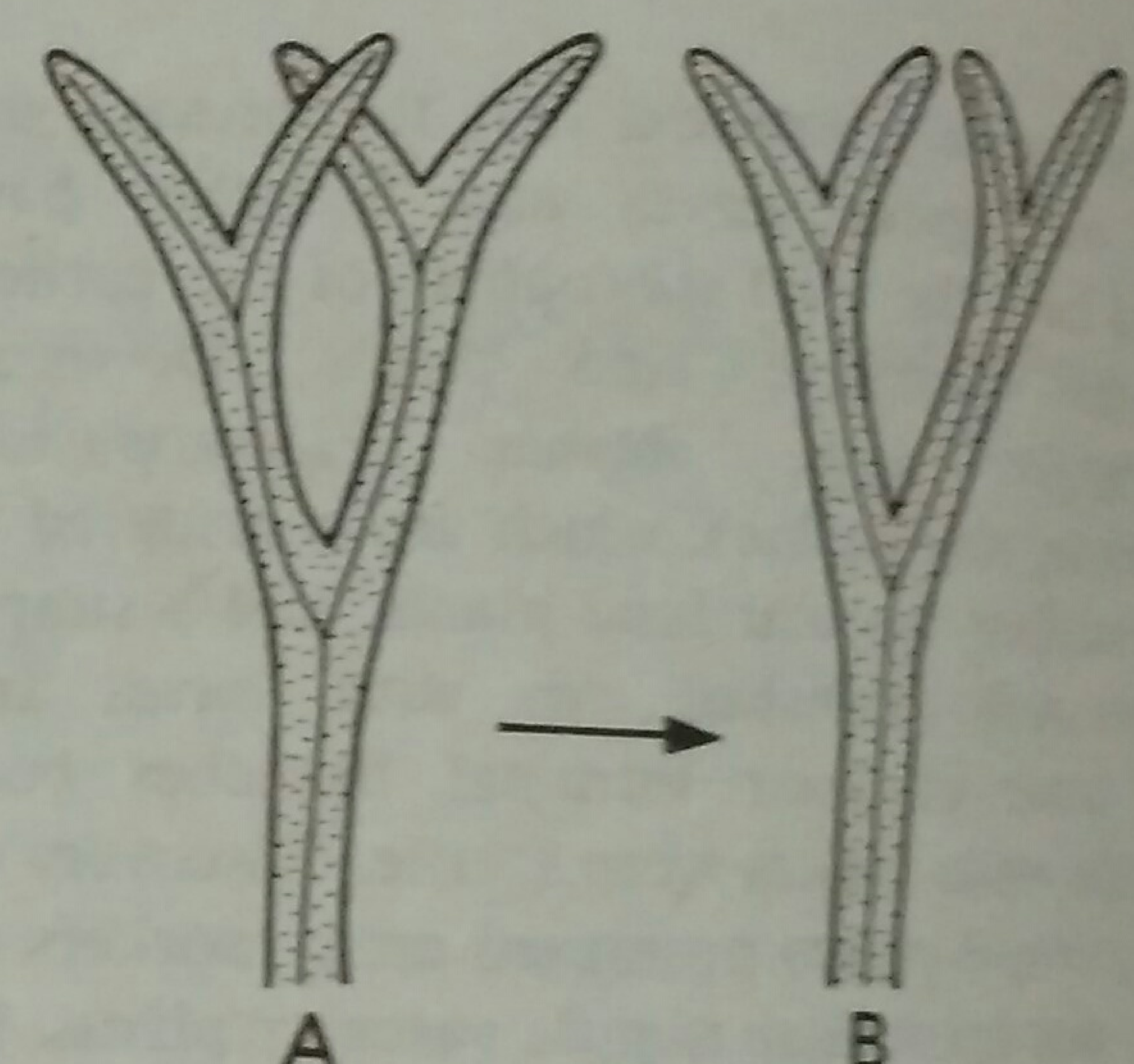

Fig. 3 **A-B.** Planation of telomes.

Thus in this process the weaker branch was overtopped by the stronger branch. It resulted in the development of monopodial branches from equal dichotomies. Evolutionary studies have also shown that dichotomous branching is frequent in primitive pteridophytes and monopodial in advanced forms.

[II] Planation

The equal dichotomies of a system, which were in more than one plane (called cruciate dichotomy), come to lie in a single plane, (fan-shaped dichotomy; Fig. 3 A, B). This process, known as **planation,** helps in the interpretation of the development of organs of bilateral symmetry from those of radial symmetry. Thus, planation may have led to the evolution of leaf.

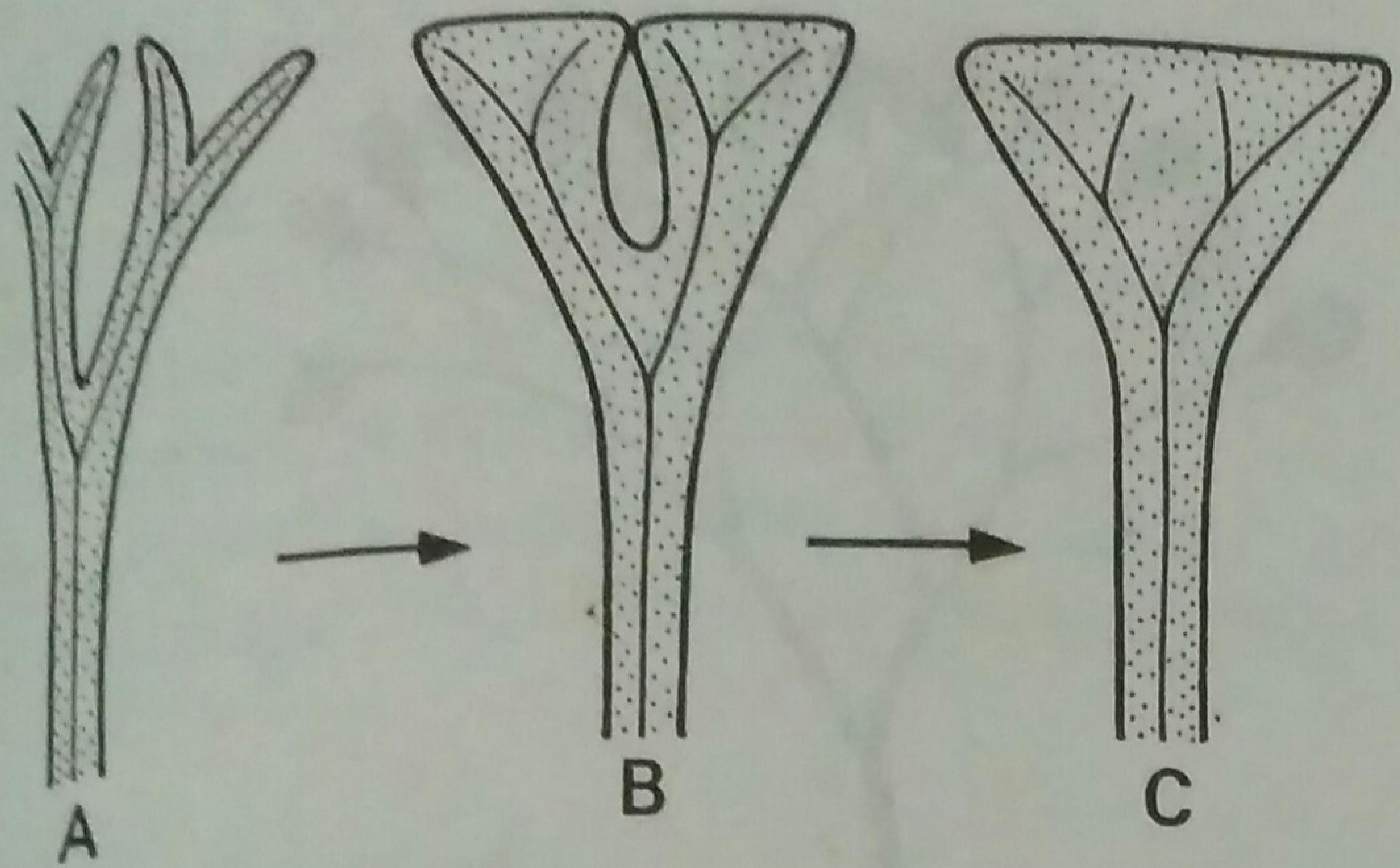

Fig. 4 **A-C.** Webbing of telomes.

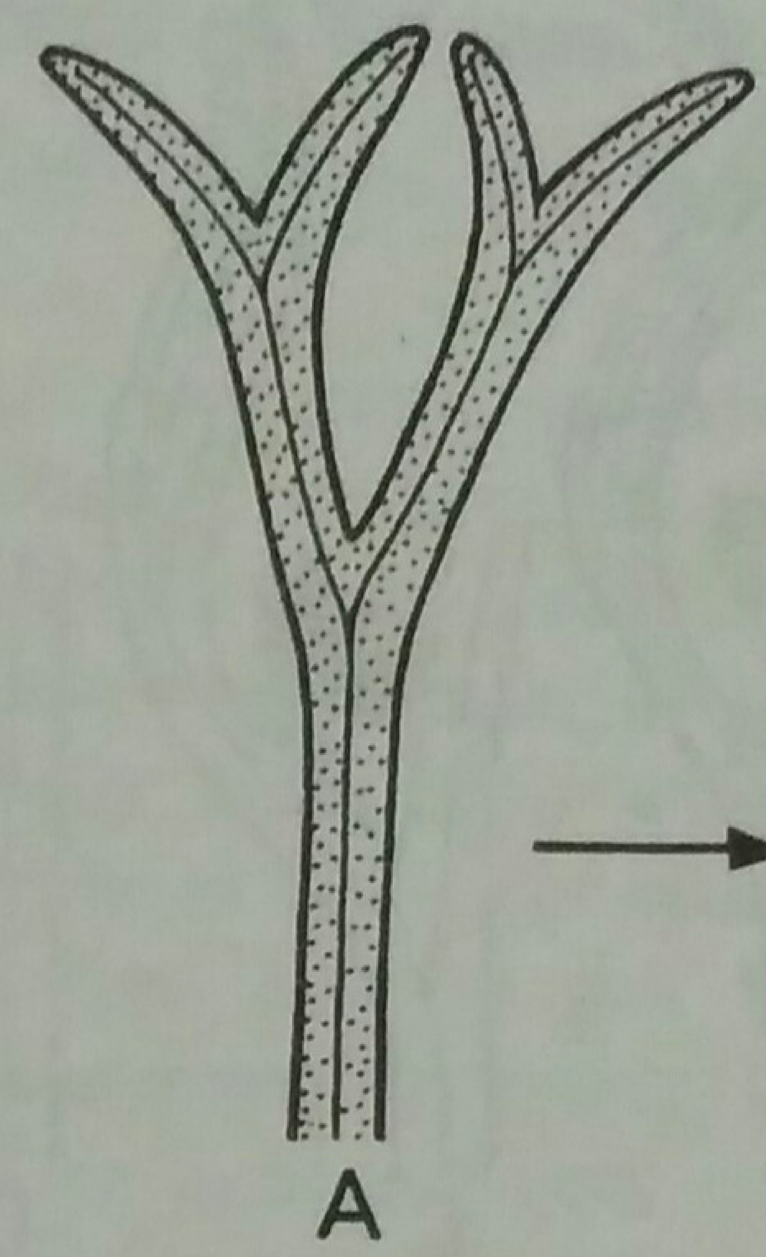

Fig. 5 **A-B.** Reduction of telomes.

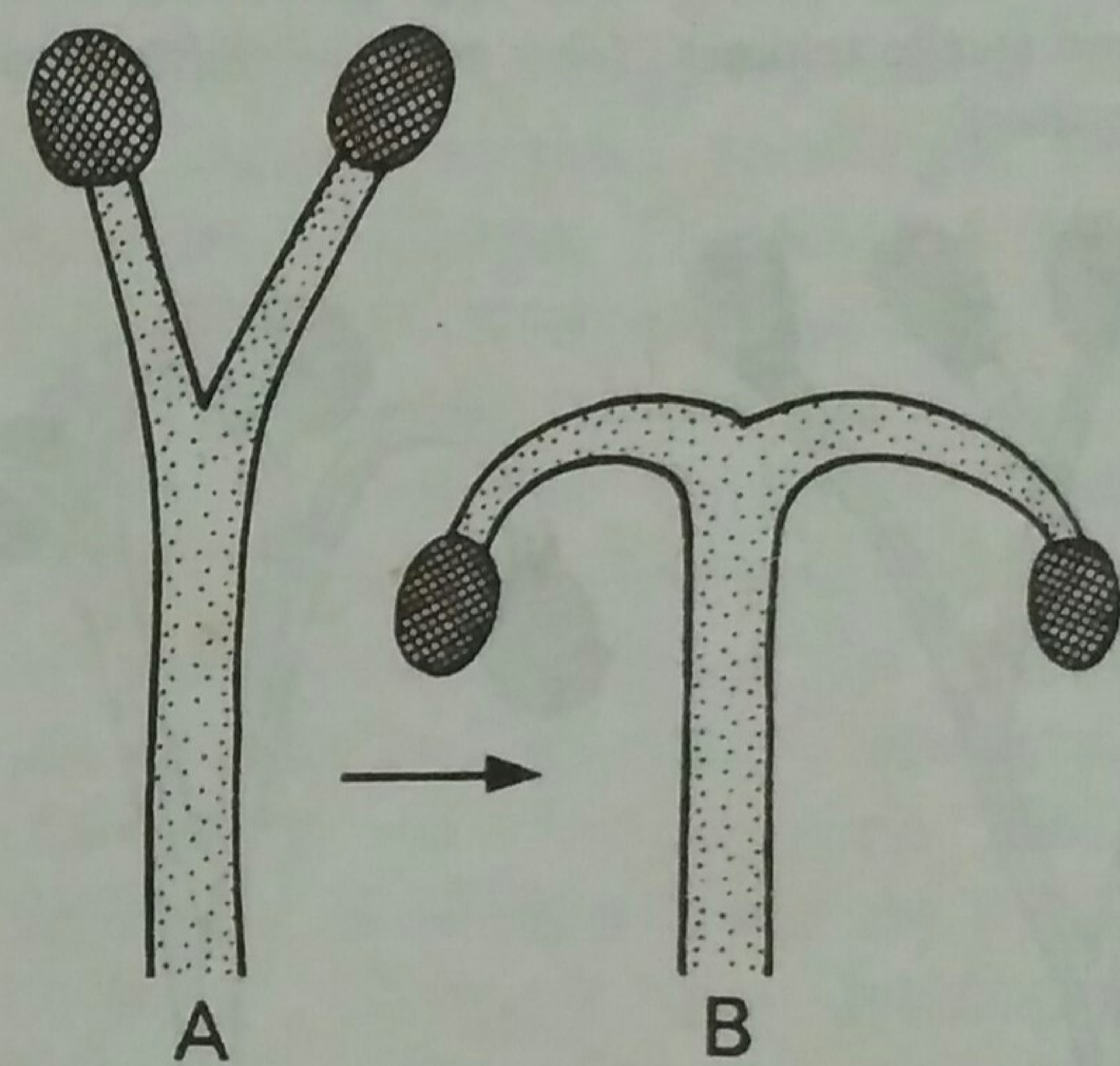

Fig. 6 **A-B.** Recurvation of telomes.

[III] Syngenesis

In this process, telomes and mesomes came to lie within a common parenchymatous tissue. This process is also known as **fusion** or **webbing** (Fig. 4 A-C). Syngenesis also involves the fusion of vascular strands of telomes. It is an important process which explains the formation of (i) leaves with open dichotomous, pinnatified and reticulate venation, and (ii) polystelic condition found in *Selaginella* and some fossil members of the Devonian and Lower Carboniferous period (e.g., *Cladoxylon, Steloxylon*).

[IV] Reduction

It involved transformation of a syntelome into a single needle- like leaf (Fig. 5A, B). This process thus accounts for the evolution of simple microphyllous leaves of the lycopods.

[V] Curvation

It is brought about by unequal growth of tissues on two opposite flanks of the telome. The following two types of curvation processes have been recognized.

1. **Recurvation.** When telomes bent down -wards, it is called **recurvation** (Fig. 6 A,B). It is believed that recurved position of sporangia in the Sphenopsida is the result of this process.

2. **Incurvation.** This process accounts for the shifting of sporangia to the ventral surface of the leaf in ferns.

Origin of Sporophylls

Zimmermann also attempted to explain the origin of sporophylls in three main groups of vascular cryptogams. According to him, a sporophyll is composed of one or more telomes or both, telomes and mesomes.

[I] Origin of sporophylls in Lycopsida

The lycopsids are characterised by the presence of axillary sporangia and Zimmermann visualized the following steps in the formation of axillary sporangia.

(1) Aggregation of sterile and fertile telomes.

(2) Reduction in the number of telomes and mesomes.

(3) Reduction in the number of sporangia.

Transitional stages of the origin of axillary sporangia by the above process are shown in figure 7 A-D.