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TRANSITIONAL PHENOMENA IN A NORMAL SEEDLING OF ALTHAEA ROSEA CAV.*

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Detailed information concerning the transitional phenomena has a significant bearing on phylogeny. Transitional data have been recorded for six species within the Malvaceae. Two of these, *Lavatera arborea* L., the tree mallow (Sinnott 1918) and *Althaea rosea* Cav. (Gerard 1881(Kaeiser 1936), belong to the second tribe Malveae; whereas the remaining four, *Hibiscus esculentus* L. (Lomanitz 1936), *H. trionum* L. (Kimmell 1936), *Thespesia populena* Sol., the Portia tree (Sinnott 1918), and *Gossypium hirsutum* L. (Spieth 1933) are in the fourth tribe Hibisceae (Engler and Prantl 1895).

In a week old normal seedling of *Althaea rosea* 7.5 cm in length, the transitional region (hypocotyl) includes a distance of approximately 3 cm. Although Gerard described a well marked pith in the root, none was found by the writer. The xylem of the root in transection is of typical cruciform, tetrarch structure. Four arms of exarch xylem alternate with the four groups of pholem which are radically endarch. In all cases observed the lateral roots arise opposite the xylem arms. The pericycle in these regions is several layers of cells thick, although it is only one-layered elsewhere. The endodermis is also one-layered. Both pericycle and endodermis are continuous layers so long as visibly present but are detectable with great difficulty at higher levels in the region of the hypocotyl. This may

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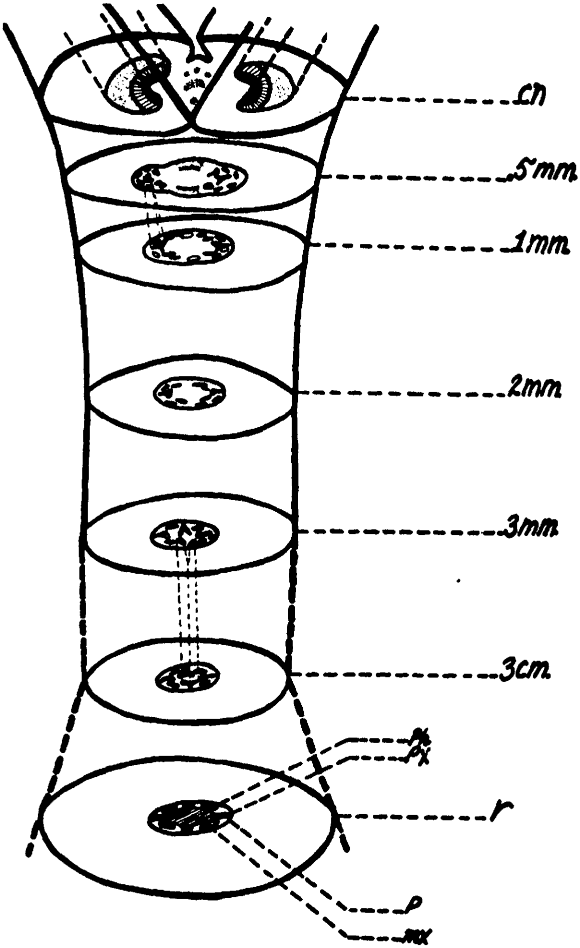
be due in part to the development of a procambium in the stem portion of the axis. The entire circumference in the upper portion of the root is considerably larger than in the lower region of the hypocotyl.

Transition may be said to begin where a pith is first detectable. The presence of this pith marks the lower limit of the hypocotyl. For con-



EXPLANATION OF PLATE

Diagrammatic reconstruction of portion of axis showing transections at various levels indicated. Note separation of intercotyledonary bundles at 3 mm. from cotyledonary node and separation of cotyledonary bundles at .5 mm. from cotyledonary node; first division of phloem at 3 mm. from cotyledonary plate; ten units formed at 1 mm. from cotyledonary node; cn. cotyledonary node; ph. phloem; px. protoxylem; r. transection of root; p, pericycle; mx, metaxylem.

venience the structural changes are traced from the lower, less complicated regions to the higher levels (cf. accompanying diagram). At the lower limit of the hypocotyl, about 3 cm from the cotyledonary node, the metaxylem elements become interrupted by the maturation of parenchyma and, four protoxylem-metaxylem units are distinguishable in transection.

Division and differentiation of xylem elements occur in the upper portion of the hypocotyl. The lower portion may therefore be regarded as more root-like than stem-like in structure. In the three normal seedlings studied in detail endarchy is completed just above the cotyledonary node. Xylem elements of the intercotyledonary plane become divided at 3 mm below the cotyledonary node. Re-division occurs at approximately 0.5 mm from this nodal region and differentiation toward the endarch condition is nearly complete at this level. At this distance from the node the xylem strands in the cotyledonary plane are divided, and endarch differentiation of these strands is also detectable.

Each cotyledonary bundle consists of the original, though completely differentiated, xylem bundle of the cotyledonary plane, together with one-half of each differentiated intercotyledonary bundle. Division of one of the four original phloem units takes place at approximately 3 mm from the cotyledonary node. Thus there may be seen five groups of phloem. at 1 mm from the node ten groups are detectable and appear in transection in the form of a scattered ring.

A slight asymmetrical growth of the cotyledons is observable. Bexon (1926) reports this situation to exist in many seedlings of *Althaea.* It does not appear to be correlated with any change in the normal transitional phenomena. The resultant petiolar bundle of a cotyledon is a complex structure, consisting of a curious central "double bundle" with one lateral bundle on either side (Thomas 1907). The phloem on the same side of the axis as the cotyledon is continuous into that cotyledon. Phloem on the other side of the axis is continuous into the other cotyledon.

Procambial strands, which arise 0.5 mm from the cotyledonary node, differentiate into the respective strands of the foliage leaves, and into a central mass of cells probably comprising the growing point of the stem.

Sinnott's (1918) discussion of *Lavatera arborea* is confined to changes from cotyledonary node to cotyledon, no data on the root-stem transition being given. However, in the same publication he illustrates the root-stem transition in *Thespesia populena.* No measurements are provided but the family relationship is apparent from the diagrams.

Detailed observations on the root-stem transitions have been recorded for the remaining four species, i. e., *Althaea, Hibiscus esculentus, H. trionum* and *Gossypium.* Marked similarities are apparent among all of them. In general, transition is limited to the hypocotyl region. All have a similar ground plan of tetrarch xylem, which is characteristic of the family. Division and differentiation of intercotyledonary bundles precedes in each case, comparable changes of bundles of the cotyledonary plane. Differentiation of xylem elements towards the endarch condition in all four takes place in the upper portion of the hypocotyl.

Differentiation in *Althaea* is completed just above the cotyledonary node, whereas in *Hibiscus esculentus* and in *Gossypium* endarchy is attained below this level, farther below in *Gossypium* than in *Hibiscus.* For this reason *H. esculentus* and *Gossypium* would appear to resemble each other more closely than does either form resemble *Althaea.* Kimmell (1936) has not recorded any distances from the cotyledonary node in her illustrations of the transitional region of *H. trionum.* However, both she and Lomanitz (1936), who worked on *H. esculentus,* report the absence of protoxylem elements in some of the vascular strands at the higher levels, and Kimmell's description of the root-stem transition is, in general, closely allied to the situation found in *H. esculentus.* Thus it would appear that the closer anatomical affinities of the members of the Hibisceae, i. e. the two species of *Hibiscus* and *Gossypium hirsutum* further substantiates their taxonomic arrangement in a separate tribe from the *Althaea.*

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