EMBRYOGENY OF *ISOTOMA LONGIFLORA* PRESL.

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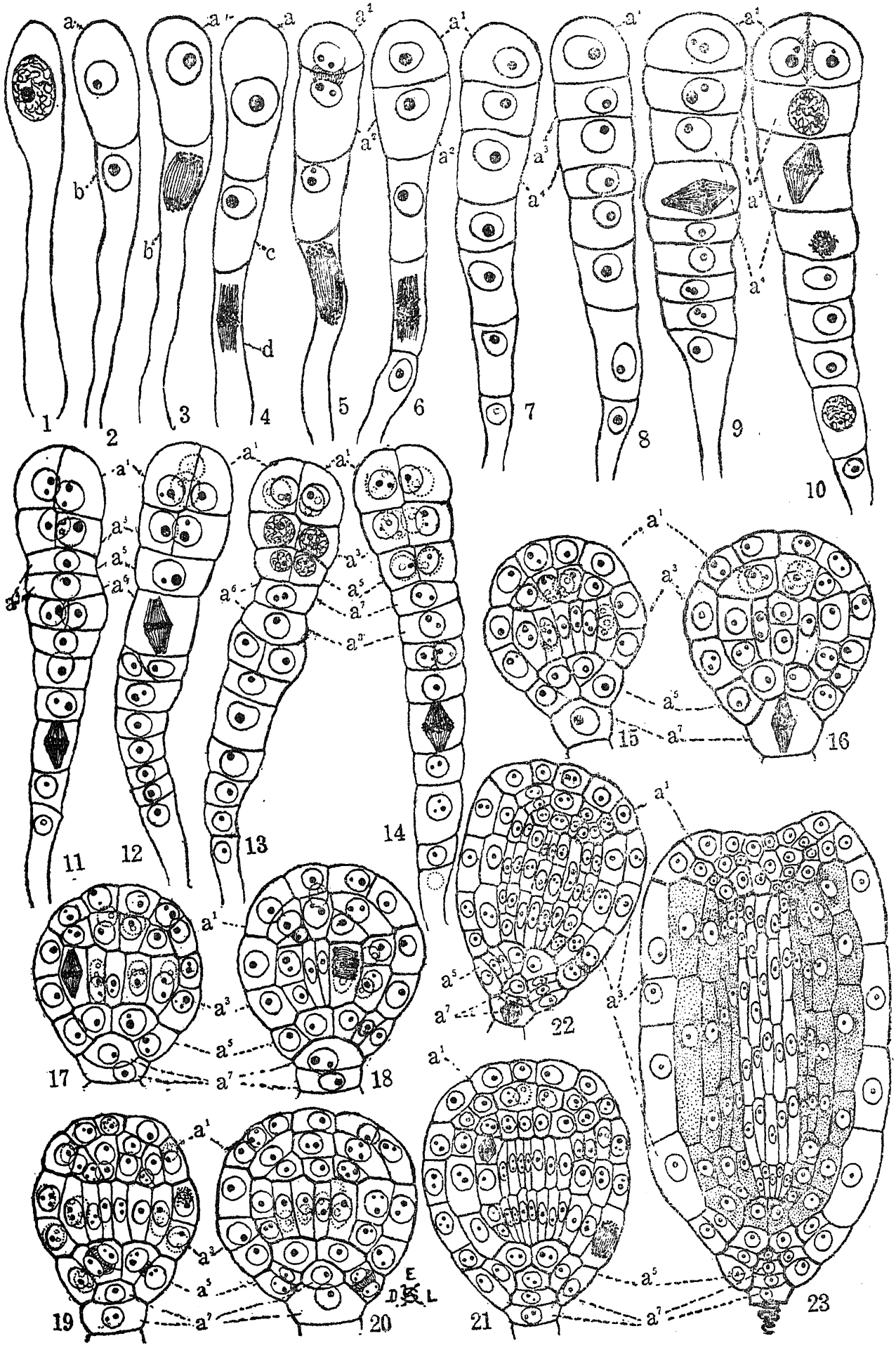
IN a previous paper of ours (Kausik and Subramanyam, 1945 *a*) a detailed account of the development of the male and female gametophytes and endosperm formation in *Isotoma longiflora* Presl. has been given. The present paper deals with the development of the embryo in this plant. During this study a single case of polyembryony was met with and this has been separately described (Kausik and Subramanyam, 1946).

Fixation of the material was done in Formalin Acetic Alcohol and the sections were stained in Heidenhain's iron-alum-hæmatoxylin with eosine as counterstain.

The fertilised egg elongates rapidly and becomes tubular with the nucleus situated at the apex (Fig. 1). The first division of the fertilised egg takes place after the endosperm has passed through its initial development. It divides in a transverse manner cutting off a primary embryonal cell (Fig. 2 *a*) and a primary suspensor cell (Fig. 2 *b*). Of these it is the primary suspensor cell (Fig. 2 *b*) that divides first by a transverse wall to form a middle cell *c* and a basal cell *d* (Fig. 4). Thus a three-celled proembryo is formed. In this respect *Isotoma longiflora* resembles *Campanula patula* L. (Souéges, 1936), *Lobelia amœna* (Hewitt, 1939), and *L. trialata* Buch-Ham. (Kausik and Subramanyam, 1945 *b*). In *L. syphilitica* L. (Crete, 1938) and *Cephalostigma Schimperi* Hochst. (Kausik and Subramanyam, in Press), however, it is the primary embryonal cell that divides first. In the three-celled proembryo the middle and basal cells (Figs. 3, 4 and 5) usually divide by further transverse walls, thus adding to the length of the suspensor (Figs. 6 to 14).

The primary embryonal cell *a* now divides first by a transverse wall (Fig. 5) cutting off an apical cell a^1, which does not divide further until longitudinal divisions begin, and a second embryonal cell a^2. The second cell of the proembryo a^2 divides by a transverse wall to form cells a^3 and a^4 (Figs. 7 to 9). At about this stage one of the suspensor cells, usually in the upper region of the filamentous proembryo, divides by a vertical wall (Figs. 9 and 10) to form two cells, which are characteristically seen in the early stages of embryogeny (Figs. 11 to 14). A similar feature is seen in *Jasione montana*



FIGS. 1–23. *Isotoma longiflora* Presl.—Stages in the development of the embryo. For explanation see text. Figs. 1–20. ×1260. Figs. 21–23. ×900 (Original magnifications given here, but figures have been reduced to half in reproduction).

Linn. (Souéges, 1938), *Lobelia amœna* (Hewitt, 1939) and *L. trialata* (Kausik and Subramanyam, 1945 *b*). In *Lobelia syphilitica* (Crete, 1938) and *Cephalostigma Schimperi* (Kausik and Subramanyam, in Press) a group of four cells is formed by the activity of one of the suspensor cells. In *Campanula patula* (Souéges, 1936) more than four cells are formed in this region.

The cells a^1 and a^3 of the filamentous proembryo divide by two sets of longitudinal walls (Figs. 10 to 13) at right angles to each other, thus resulting in two tiers of cells with four cells in each tier. Almost simultaneously with these divisions cell a^4 divides by a transverse wall producing cells a^5 and a^6 (Figs. 10 and 11). Cell a^5 then divides by two vertical walls so that three tiers of cells are now formed in the terminal region of the proembryo (Fig. 14) with four cells in each tier. Cell a^6 also divides by a transverse wall adding two more cells a^7 and a^8 to the terminal region (Figs. 12 to 14). Thus in this region five tiers of cells can be made out *viz.*, a^1, a^3, a^5, a^7 and a^8, the three upper tiers having four cells each and the lower two having only a single cell each. Of these five tiers it is only the first four tiers that actually take part in the formation of the various regions of the embryo.

In the distal tier a^1, anticlinal divisions occur followed by periclinal divisions to form the dermatogen in this region (Fig. 15). The first anticlinal divisions in this tier can be traced in the various stages upto the formation of the mature embryo (Fig. 23). The next division in tier a^2 is tangential cutting off a dermatogen peripherally from a group of inner cells (Fig. 15). The inner cells divide longitudinally separating the future periblem from the plerome. Both longitudinal (Fig. 18) and transverse divisions (Fig. 17) occur in the further development of the plerome and periblem (Figs. 18 to 23).

When the primary body regions are differentiated in the first two tiers, the third tier a^5 develops into a semicircular layer of cells at the base of the embryo. To start with, this layer is made up of four cells (Figs. 15 to 17); but subsequently forms about 8 cells (Figs. 22 and 23) by further oblique divisions (Figs. 18 to 21). The innermost two cells of this group take part in the completion of the periblem (Fig. 23). The remaining cells of this layer help to complete the dermatogen and the root cap. The single cell of tier a^7 does not divide any further until the embryo is rather well developed and spherical in shape. Then it divides by a transverse wall (Fig. 16) forming a proximal and a distal cell (Figs. 17 to 20). Both these cells divide transversely (Figs. 21 to 23) forming a part of the root-cap which is also increased on all sides from tier a^5 and also by extra cells cut off from the dermatogen in tier a^3. According to Hewitt (1939) however, in *Lobelia amoena* the cells of the proximal row, cut off from this tier, do not divide again, but the cells

of the distal row divide transversely separating the periblem from the dermatogen. He further states that the cells of the proximal row become a part of the root-cap. In a mature embryo (Fig. 23) the body regions can easily be assigned to the primary tiers, *viz.*, a^1, a^3, a^5 and a^7, which are clearly recognizable in the early stages of embryogeny. Thus from tier a^1 arise the cotyledons, the stem tip forming in the notch between them; from tier a^3 the hypocotyl is formed with its central row of long and narrow plerome cells, the outer zone of much larger periblem cells (the region shown dotted in Fig. 23) and the outermost layer of dermatogen; from tier a^5 the completion of the periblem and the organisation of a part of the root cap take place; and lastly, from tier a^7 the rest of the root-cap is formed.

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