NOTE ON EMBRYO DEVELOPMENT IN *HIPPURIS*

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Hippuris, commonly known as Mare's Tail, has been extensively studied by botanists. Schleiden (1859) used this plant in an attempt to prove his theory of the origin of the embryo from the pollen tube. Its stem tips have long been of interest to the histologist. Because of the seeming regularity in appearance of its histogens i. e., dermatogen, periblem and plerome, it has been commonly used as an example among angiospermous plants to support the histogen theory. That such a strict regularity in the origin of epidermis, cortex and stele from these three respective histogens does exist in all plants has been questioned in recent years (Schmidt, Foster, and others). In fact, Barratt (1916) has shown that in *H. vulgaris* L. ordinarily the endodermis and the three inner layers of the cortex originate from the plerome.

Material for this study was collected by Dr. W. C. Muenscher during the summer of 1939 in the state of Washington, that of *H. montana* Ledeb. being obtained from Mt. Baker.

Young proembryos were dissected, stained, and mounted according to the Buchholz (1938) method for mounting conifer embryos. The use of Fast Green saturated in absolute alcohol proved advantageous. The cellular endosperm made possible the partial dissection of the proembryos from this mass of tissue enough that by a somewhat prolonged clearing of several days to several weeks in glycerin all stages of proembryo development from the first division of the tip cell onward could be studied. The illustrations (figs. 1-6) of these stages were drawn from material prepared in this manner. Some of the more mature embryos were dissected, stained, and mounted whole while others were sectioned in the usual manner.

Juel in 1911 worked on fertilization and early embryo development in *H. vulgaris* L. The writer finds the development of the early embryo in *H. montana* Ledeb. to be similar to it and, in general, both species have what may be called Schnarf's Type I or the Crucifer Type of embryo.

The first division of the proembryo tip cell is vertical (Fig. 1). Figure 2 represents the eight-celled stage although it may serve equally well to illustrate the second stage since walls formed after the third division are not shown in this view. Figure 3 represents the sixteen-celled stage, only eight of the cells being shown in this plane. The cells of the dermal layer are already differentiated and quite frequently were found to be vacuolate as shown in the figure, thus appearing distinct from the cells which are to contribute to periblem and plerome. Each nucleolus of each interphase nucleus in the proembryo and later embryo stages is surrounded by a hof. Similarly conspicuous hofs have been seen by the writer in nuclei of other aquatic seed plants (*Elodea*, etc.).

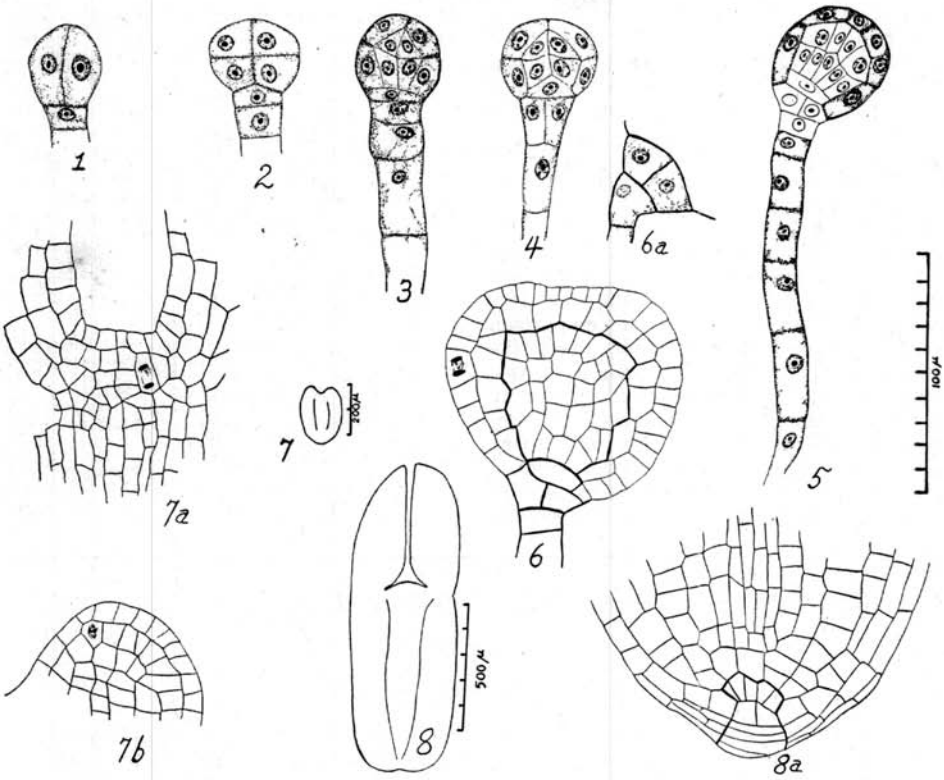
Cells of the suspensor more than two cells away from the proembryo tip often appeared collapsed in proembryos left embedded in the endosperm. The suspensor cells are indefinite in number and at times show evidence of later divisions, particularly just behind the hypophysis cell (fig. 5).

The lowermost cell derived from the hypophysis at time divides longitudinally and elongates (fig. 4) before extensive development of the embryo proper. More often the hypophysis contributes to the periblem and dermatogen of the root apex in the usual manner, so that at a slightly later stage the appearance is usually as that shown in Figure 5.

Figure 6 represents a later stage. A sub-dermal cotyledon initial may be observed in the upper left of the figure. Only anticlinal divisions were found in the dermal layer. The four basal cells (two of which are shown) appear as shown in Figure 6a.

The cotyledons may exhibit periclinal as well as anticlinal divisions in the periblem region (fig. 7b). The meristematic zone of the stem apex likewise shows periclinal divisions in this region (fig. 7a).

Additional layers (up to five) are added to the base of the embryos, apparently



(Unless scale is given on plate, all magnifications are x320.)

Fig. 1. Two-celled tip of proembryo. **Hippuris vulgaris.** June 7, 1939.

Fig. 2. Eight-celled stage; cell beneath is hypophysis.

Fig. 3. Sixteen-celled stage; vacuoles in outer layer of cells and in suspensor.

Fig. 4. As above, lower derivative of hypophysis has divided longitudinally, the two cells have already elongated and are highly vacuolated.

Fig. 5. Later stage; cells of dermatogen have divided further anticlinally; cotyledon initials are distinct; further divisions in suspensor have occurred; hypophysis has divided to contribute to periblem and dermatogen.

Fig. 6. Older multicellular stage; cotyledon initial discernible at left; anticlinal division in cell of dermatogen.

Fig. 6a. Different optical view of two cells of hypophysis. Elongation of these two cells is not as pronounced as those of Fig. 4.

Fig. 7. Outline of embryo of **H. montana,** showing young cotyledons. Aug., 1939.

Fig. 7a. Stem apex of same; periclinal division in meristematic zone of stem apex.

Fig. 7b. Cotyledon of same showing periclinal division in sub-dermal region.

Fig. 8. Outline of embryo of **H. vulgaris** showing greater elongation of cotyledons and hypocotyl. July 16, 1939.

Fig. 8a. Base of embryo similar to that in Fig. 8 showing multi-layered zone.

derived from the region of the hypophysis, and extending around the base of the embryo increasing in extent by anticlinal divisions. Figure 8a shows four such layers. These form uniseriate layers which eventually merge above with the one-layered dermatogen. The suspensor cells by this time are generally collapsed although a small knob of cells at the tip are occasionally seen in sections.

Except for the smaller size of the embryo in *H. montana* Ledeb. the development is similar. It is hoped that this work may be followed by a comparison of the stem apices of the vegetative shoots of the two species, since they, too, differ in size. *H. montana* L. grows in Illinois, although there seem to be but few recent records of collections. One stem over three feet in length from a rhizome growing in the northern part of the state is in the writer's possession. It would be interesting to know the present distribution of the species in the state.

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