

INTERCELLULAR SPACES IN THE EMBRYOS OF ERECHTHITES HIERACIFOLIA AND BIDENS CERNUA.

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Some months ago the writer had occasion to investigate the structure of the achenes of many of our native Composites. Among other interesting phenomena observed, were found well organized intercellular spaces in the embryos of *Erechthites hieracifolia* and *Bidens cernua*. Since the occurrence of intercellular spaces in embryos is comparatively rare, it was natural that surprise should be occasioned by finding them developed to such a degree in these two species. This was more noticeable since they were not found in any other Composites examined. Deeming it important that some note of this should be made, the following descriptions have been prepared:

Erechthites hieracifolia (L) Raf.—The embryo is oblong with the cotyledons somewhat wider than the hypocotyl, but each not over one-half as thick. The cotyledons about equal the hypocotyl in length, and there is an indication of the growing point in the axil between them. Some of the cells of the embryo have already begun to differentiate into a portion destined to become the vascular portion of the plant. This now consists of a central-cylinder in the hypocotyl and three branches in each cotyledon, one of which lies in the center and one near each edge. Immediately adjoining each of these strands and toward the circumference of the seed is a cylindrical cavity extending the whole length of the cotyledons. Each is about 25 microns in diameter and in cross section appears to be surrounded by four cells of such a shape that together they form a ring. These cells, like other cells of the embryo, are approximately isodiametric and have similar cell-contents.

Tracing these spaces down toward the hypocotyl, the two lateral ones are found to disappear in the vicinity of the plumule, while the other two continue on either side of the central cylinder for about one-third its length, when they too, disappear.

Meanwhile two larger spaces have arisen in the axil of the cotyledons and continue down the hypocotyl close to the central cylinder until they reach a point not far from the root cap, where they each divide into two branches. The cellular sheath of all of these spaces in the hypocotyl is similar to that described for the spaces in the cotyledons.

Bidens cernua L.—The embryo of this plant is similar to that of *Erechthites* except in the following features:—1. It is a great deal larger and longer; 2. The cotyledons are much broader than the hypocotyl; 3. The general form of the hypocotyl is elongated conical rather than oblong. It presents the same traces of the future fibro-vascular bundles in the cotyledons, and central cylinder in the hypocotyl. The area of the latter is, however, larger and less distinctly marked off.

The spaces in this plant are wholly confined to the hypocotyl, and are much more numerous than in *Erechthites*. They consist of cavities between the adjacent cells in the tissue between the central cylinder and the epidermis. Since in general the cells are arranged in vertical rows, the spaces are much elongated and extend for a considerable distance in a longitudinal direction in the hypocotyl. In case of the larger ones they often extend through its entire length. Viewing them in cross section the tendency seems to be for the cells about the spaces to arrange themselves in the form of a circle enclosing the space within. This is similar to the structure in *Erechthites* and somewhat analogous to the peculiar arrangement about resin ducts in coniferous plants. The exact structure in both embryos will be more apparent on reference to the drawings of cross and longitudinal sections of each.

To determine the effect of water and growth on these spaces some seeds were soaked for forty-eight hours and others were germinated. In both cases the specimens soaked showed a decided increase in the diameter of the spaces. Investigation of the seedling, on the other hand, gave rather astonishing results. It was found that in *Erechthites* they disappeared almost immediately. They could not be distinguished in the hypocotyl at all

after germination but were present in the cotyledons for a short time. In *Bidens* they seemed to increase slightly in size, but how long this increase continued was not determined owing to the death of the seedlings.

To determine the nature of the contents of these spaces some specimens were treated with strong sulphuric acid. In the case of *Bidens* an embryo was taken that had been soaked in water for some time and was presumably nearly ready to germinate. When cleared by the acid, the spaces were seen to be filled with some gas, which became very conspicuous in the hypocotyl, but, as would be expected, was not present in the cotyledons. A young germinating hypocotyl treated in the same manner showed the presence of the gas in a still more marked degree. *Erechthites*, on the other hand, showed no gas at all; but when the cotyledons of a young seedling were treated, a series of small globules of some fluid matter was left along the path formerly occupied by the spaces. A fresh cotyledon was treated with Fehling's solution as a test for sugar, but no reaction was obtained. A test was then made for oil with alcanna. The result here was more favorable. Bright red drops were plainly visible not only in the general tissue of the cotyledons, but also arranged in a row in each of the spaces.

From the above experiments alone it is not possible to understand the exact uses of these structures to the plant. Perhaps in *Bidens* they in some way have to do with the transmission of gases due to growth at the growing point. In *Erechthites* where oil is found in the tubes, the function may be one of food transmission.

Many investigations have been carried on with reference to intercellular spaces which contain gases. The papers of Martins, Mangin, Schenk, Schrenk, Devax and Rowlee are some of the more important. A list of papers relating to the subject is given in Professor Rowlee's paper published in the Proc. Amer. Micro. Soc., p. 143 (1894.) The work has been almost entirely confined to organs of mature plants, and as far as the writer is aware such spaces have not been observed in mature seeds.

EXPLANATION OF THE PLATE.

1. A cross-section of the hypocotyl of *Erechthites hieracifolia*, before germination, showing two large intercellular spaces (s.)
2. A vertical section of the hypocotyl of the same showing one space (s.)
3. A cross section of two cotyledons of the same showing the three spaces (s) in each.
4. A cross-section of the hypocotyl of *Bidens cernua* before germination, showing the spaces (s) scattered throughout the tissue between the central-cylinder and the epidermis.



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