CHLOROPLASTS OF *MARTYNIA FRAGANS.*

F. M. Andrews, Indiana University.

Martynia shows an interesting arrangement of the chloroplasts in the trichomes on the stems and elsewhere. This arrangement together with the rate of movement of the chloroplasts form the chief points of this paper, which for the plant above mentioned, have not heretofore been determined. Senn[1] has studied a large number of other plants as regards their chloroplasts. Stahl[2] also has investigated the subject and Noll[3] has studied the movements of the chloroplasts in *Schistostega osmundacea.*

The trichomes of Martynia vary in length, some being more than two mm. long. Those under consideration terminate in an enlarged end. Viewed collectively they impart to the plant a velvety appearance, and the rather large clear drop of viscous liquid, often seen on their

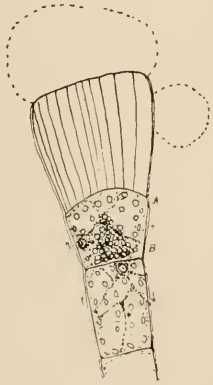

Fig. 1. Top of trichome of Martynia.

ends, gives to the plant its clamminess (fig. 1). When magnified only five times and observed laterally the transverse walls of many of the larger trichomes can barely be seen since they consist of a single roll of cells. When magnified five times, the presence of the chlorophyll color may be discerned in the region occupied by the two cells just under the end of the trichome. The microscope shows few chlorophyll granules near the base of the trichome. This is easily observable since the cell walls are thin. The interior of the cell is clear except for the chloroplasts. Protoplasmic movements are visible in various directions as indicated by the arrows in figure 1. The trichomes near the tip of the plant where the light is more favorable possess more chloroplasts.

The chief interest centers in the first terminal chlorophyll-bearing cell (fig. 1). Under one set of light conditions the chloroplasts collect

[1] Senn, Gustav. Die Gestalts und Lageveränderung des Pflanzen-Chromatophoren 1908 and literature there quoted.

[2] Stahl, E. Botanische Zeitung 1880 Bd. 83. pp. 297, 321, 345, 361, 377, 393, 409.

[3] Noll, F. Arbeiten des Botanischen Instituts in Würzburg Bd. 3 pp. 477-488.

"Proc. 38th Meeting, 1922 (1923)."

at the end of the cell marked B, and under other conditions collect at A. The speed, however, with which these and other movements of the chloroplasts takes place is unusual. Senn[4] has shown that the chloroplasts of Funaria under optimal conditions of light move 4μ in eight minutes. The chloroplasts of the trichomes of Martynia, however, under optimal conditions of light move much faster, in fact, namely, 21μ in seven minutes. In the cells observed it required from 37 to 43 minutes under fairly constant optimal light and temperature conditions for the chloroplasts to traverse the cell. This shifting of the chloroplasts leads to the well known change in chlorophyll color of certain plant organs.

QUANTITATIVE ESTIMATION OF AERATION IN LEAVES.

F. M. Andrews, Indiana University.

It has been known for a long time that air can be made to move back and forth through the stomata of leaves and that this can be accomplished in some plants with only a slight force[1]. Some plants allow the passage of air in this way with marked ease and among them may be mentioned the following: Nymphaea, Funkia, *Calla aethiopica*, *Arum maculatum*, and Rumex[2]. To these I might add *Myriophyllum proserpinacoides* which is cultivated in aquaria.

A quantitative estimation of the amount of air which can be passed through leaves has not been made. The first investigator to see air pass in this way from stomata was Raffeneau Delille[3]. Since that time Sachs[4] and others have worked on the problem.

I have experimented with a number of plants in this respect. One of these was *Nymphaea odorata* which was an especially favorable object. Air was easily caused to pass through the leaf in bubbles with a vacuum of 12 mm. of mercury, which is less force than was required by the specimens of the same genus mentioned by Pfeffer[5]. The same thing was accomplished by arranging the petiole under a cylinder of water filled to a height of about 30 cm. and then inverted over a dish of water as indicated by Jost[6]. The air in this case issued from the petiole with great rapidity and in large quantity. The stream of bubbles can easily be made visible to a large audience by proper arrangement of a lens of correct magnifying power. The volume of air thus passed through the leaf of *Nymphaea odorata* was 10 cc. in 16 seconds. One thing must be borne in mind with *N. odorata* and that is the status of the leaf for

---

[4] Senn. l. c. p. 320.

[1] Pfeffer, W. Pflanzenphysiologie Zweite Auf. 1891 Bd. 1 pp. 178-179 and literature there quoted.

[2] Pfeffer, W. l. c. p. 179.

[3] Raffeneau, Delille. Annales d. Scien. natur. 1841. XIV 328. Quoted by Von Hohnel Jahr. f. wiss. Bot. 1879. Bd. 12 p. 48. See other literature there quoted.

[4] Sachs, J. Ueber die Bewegung der Gase in den Pflanzen. Handbuch der Experimental-Physiologie des Pflanze 1865 pp. 243-262.

[5] Pfeffer, W. l. c.

[6] Jost, L. Lehrbuch der Botanik. 15 Auf. 1921 p. 216.