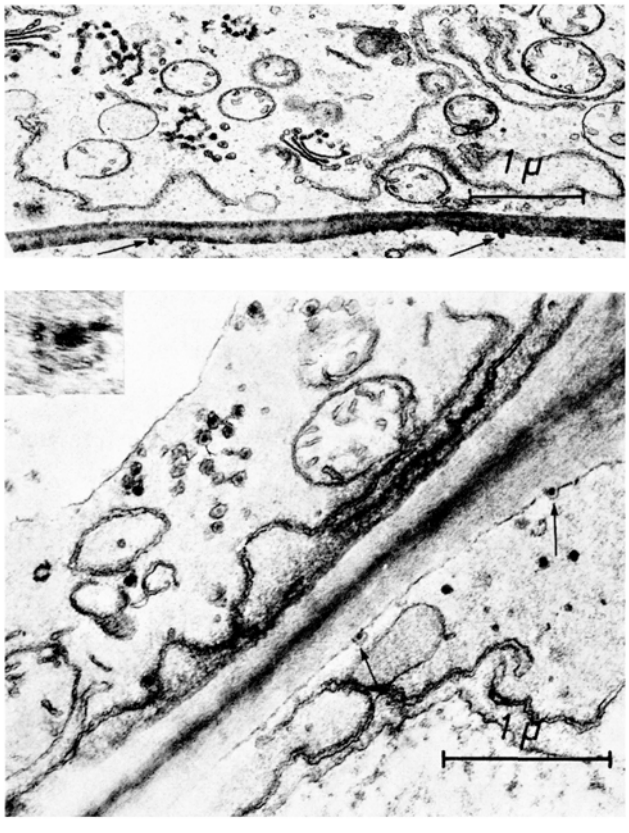
Role of Golgi Vesicles in Plant Cell Elongation

According to JENSEN[1] cell elongation is characterized by low metabolism with reduced protein synthesis, marked absorption of water by the cells and synthesis of material destined for cell wall formation. In the root cells, only the longitudinal walls are lengthened, while the vacuole system evolves in a spectacular fashion.

The cinemicrographic study carried out by GOODWIN and AVERS[2] with the roots of *Phleum pratense*, showed that the epidermal cells were capable of growing to 10 times their initial size on reaching the area of differentiation within a period of 6 h. It follows that elongation is characterized not only by the tremendous ratio of multiplication, but also by the rate at which the process takes place, which can be compared only with the growth of root hairs or with the germination of pollen grain.

The aim of this paper is to study the growth of the longitudinal walls of the cell during the rapid process of elongation.

The roots of *Phalaris canariensis* were used, germinated in the dark at room temperature. The area of elongation was located in vivo with a light microscope as being between 700 and 1200 μ, and this was the area which was used to obtain ultrafine sections for the electron microscope. The roots were fixed in potassium permanganate at 2% in distilled water for 2 h at room temperature. After contrasting in lead-uranyl acetate[3] the samples were included in Durcupan ACM (Fluka). The sections were obtained with an Ultratom L.K.B. and were studied under a Siemens Elmiskop I. electron microscope.



Elongating cells of the root cortex showing a number of small Golgi vesicles; some of them can be observed to fuse with the cell walls (arrows).

Examination of the modifications undergone by the cortex cells during elongation showed the vacuoles system developing in the marked fashion which was already known from observations under the light microscope. The cell walls showed a marked contrast characteristic of pectic substances suggesting that the primary cell wall presents a considerable amorphous matrix during elongation. The most prominent characteristic was the intense secretory activity shown by the Golgi bodies, at the edges of which small vesicles, of about 0.1 μ, were observed, consisting of a unit membrane and an amorphous content that contrasted strongly with the permanganate (Figure). The morphological characteristics of these vesicles are identical with those observed in the vesicles produced in the Golgi apparatus during cytokinesis[4,5] and their content is probably very rich in pectic substances. The cytoplasm showed numerous dispersed vesicles in these cases, some of which were observed to be fusing with the longitudinal walls in course of elongation (Figure). The membrane of these vesicles was seen to coalesce with the plasma membrane and the content to mingle with the amorphous matrix of the cell wall.

These observations agree with the indications of SIEVERS' study[6] in assigning to the Golgi apparatus an important part in the formation of the primary cell wall. In the case of the root hairs SIEVERS showed that the vesicles produced by the Golgi bodies fused with the wall in the apical region of the cell, thus supplying the material needed for the rapid growth. The part played by the Golgi apparatus in the formation of the cell plate during cytokinesis had likewise been demonstrated[4,5], as well as in the growth of the pollen tube[7–11].

Resumen. La rápida elongación de las células durante la diferenciación se debe, entre otros motivos, a un incremento de la membrana envolvente; este incremento es originado por el aporte de vesículas del aparato de Golgi cuyas membranas coalecen con el plasmalema y su contenido se deposita externamente junto al material amorfo de la membrana.

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