THE GOLGI APPARATUS AND CELL PLATE FORMATION—A POSTULATE

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It has long been clear that the cell plate formed during cytokinesis in most plant cells results from coalescence of small vesicles. It has been suggested that the origin of these vesicles is the Golgi apparatus. The repeated observations of the ill defined cytokinesis structure called the phragmoplast (see Sharp, 1943) suggest the involvement of some organelle. The Golgi apparatus grouped at the periphery of the cell plate may well be the phragmoplast (Fig. 1 *a*).

In the maize (*Zea mays* L.) root one of the conspicuous features of telophase cells in which cell plate formation has begun is the association with the forming plate of partially oriented Golgi apparatus with each of which there appear numerous small vesicles (Fig. 1 *a*). These small vesicles appear to be produced from the cisternae of the Golgi apparatus and their presence is a characteristic feature of this stage of cytokinesis. They apparently fuse to form the plate (Fig. 1 *b*).

In cells of the maize root epidermis, the Golgi apparatus also produces a distinctive secretion vesicle, the contents of which can be identified in newly formed cell walls (Figs. 2 *a* and *b*). These Golgi-produced vesicles definitely contribute substance to the new wall, and their membranes contribute to the new plasma membrane.

When the cells under consideration here are injured mechanically, the Golgi apparatus responds by producing much greater than normal numbers of small vesicles. If a cell in late cytokinesis is so injured, the region of cell plate formation becomes literally filled with small vesicles (compare Figs. 3 *a* and *b*). Inasmuch as the endoplasmic reticulum has never been observed to fragment and produce small vesicles in response to comparable injury, these vesicles may well be derived from Golgi apparatus.

Segments of the endoplasmic reticulum are always seen in association with the forming plate, but there is no clear indication that these segments fuse with the vesicles of the plate. Some of the profiles of endoplasmic reticulum bridge the forming plate (Whaley *et al.*, 1960), their membranes remaining, at least for awhile, continuous from one cell to the next.

On the basis of these several observations it is suggested that the Golgi apparatus produces vesicles which fuse to form the cell plate, the Golgi product thus contributing part of the substance of this structure and the Golgi vesicle membranes contributing new plasma membrane.

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FIGURES 1 TO 3

Sections of the cell plate region in dividing *Zea mays* root cells. All material fixed in 2 per cent $KMnO_4$ according to Mollenhauer (1959) and embedded in Araldite or a mixture of Araldite-Epon epoxy resin.

FIGURE 1 *a*

An early telophase cortical cell. × 13,000.

FIGURE 1 *b*

A later telophase cortical cell. × 22,500.

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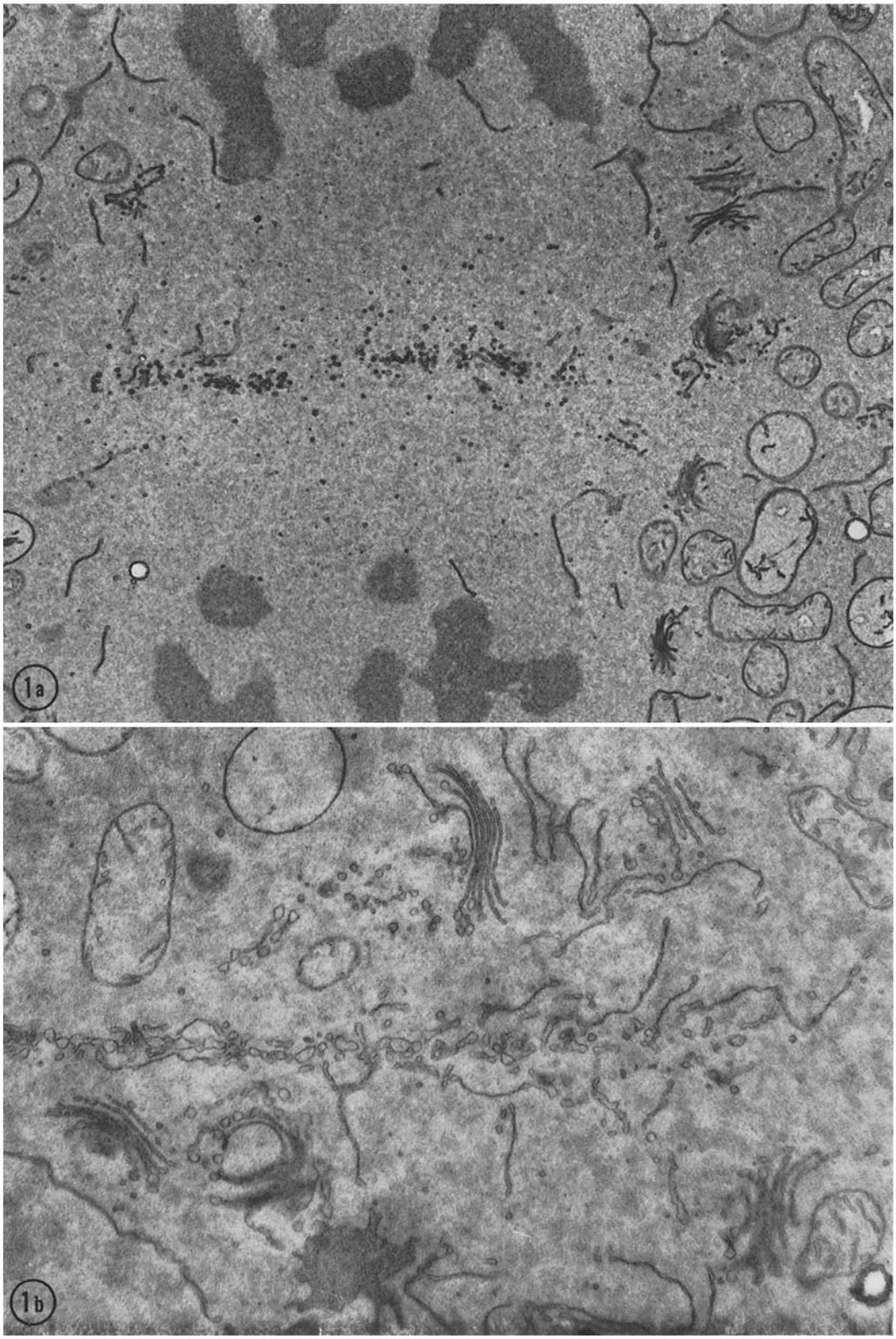

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FIGURES 2 *a* AND 2 *b*

Late telophase epidermal cells. × 14,000, × 22,500.

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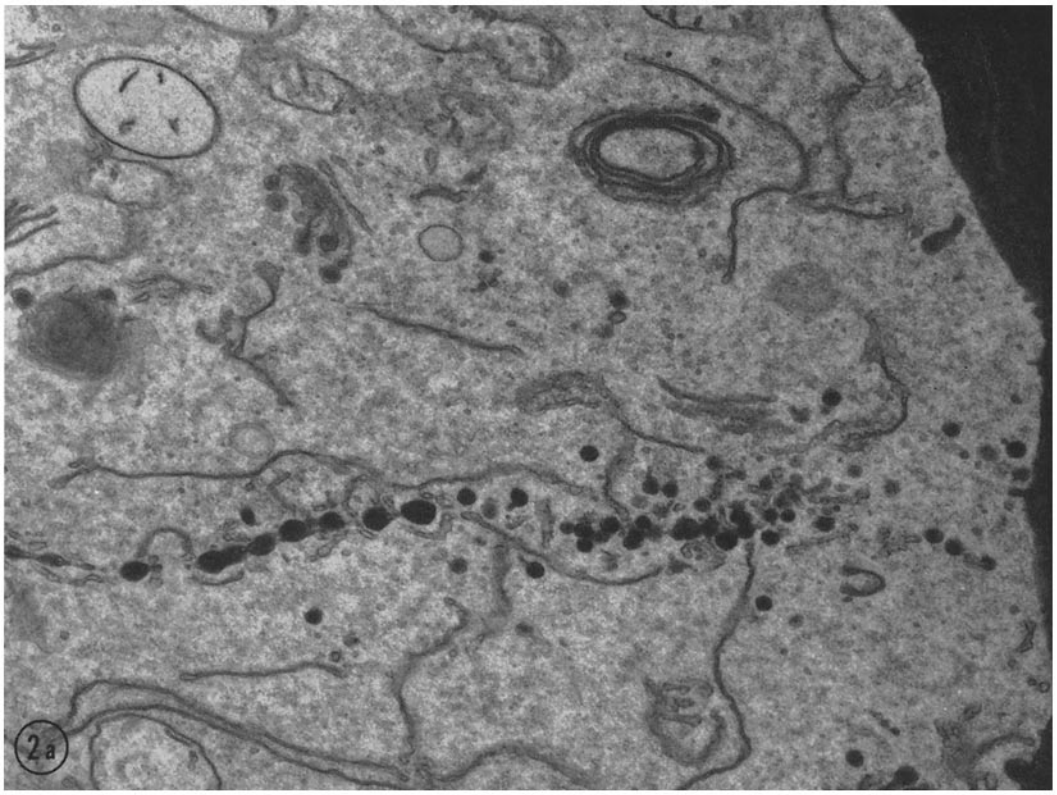

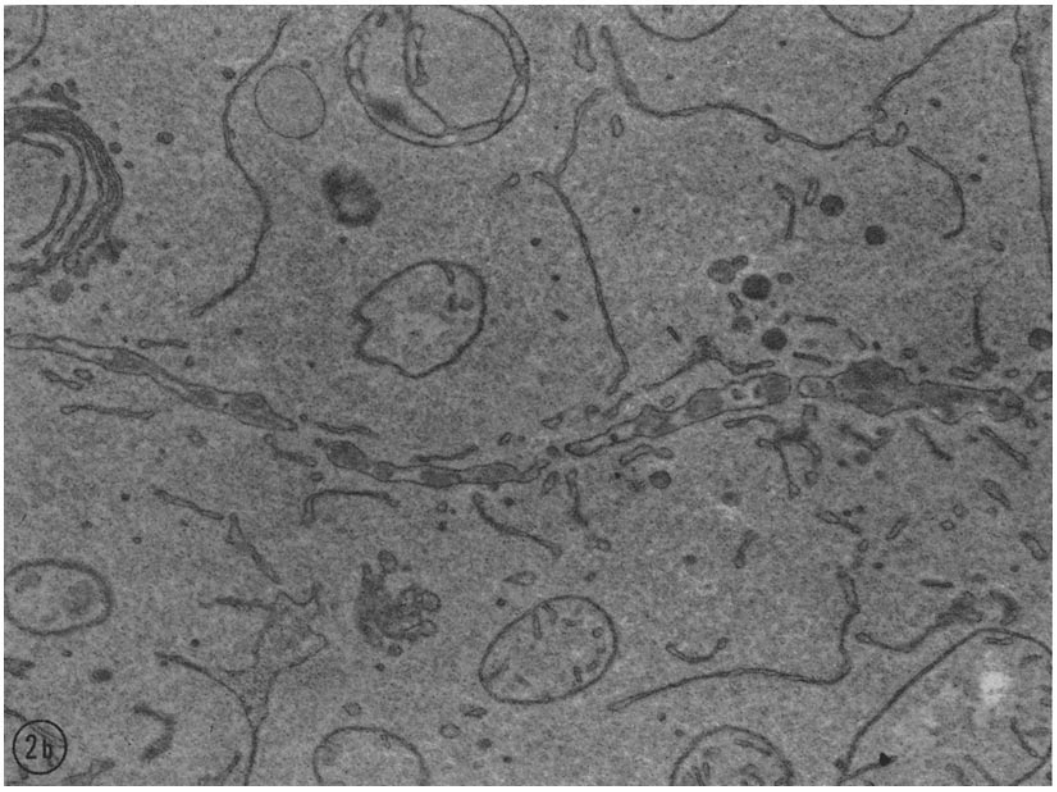

FIGURE 3 *a*

Plate formation in a normal cortical cell. × 13,500.

FIGURE 3 *b*

Accumulation of small Golgi vesicles in a comparable injured cell. × 15,500.

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