Cell Physiology and Cinematic Cell Research

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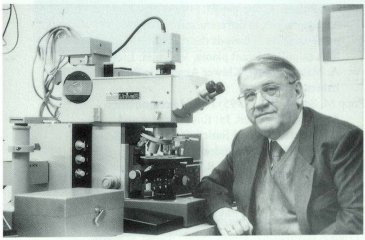
Research

The organisation and dynamics of plant cells and the dynamics of whole plants are the main topics of our group which consists of myself and two assistants together with a few graduate and PhD-students. In our laboratory several main lines of research are established.



Cinematic description of plant dynamics

A great number of plants perform various movements too slow to be seen in real time. These movements are therefore speeded up by time lapse cinematography using the excellent 16mm equipment in our laboratory. We document and analyse the mechanisms of plant movements following the stimulation by light (e.g. suntracking of *Helianthus*), temperature (tepals of *Tulipa*), gravity (roots, shoots), humidity (roots), and mechanical contact (stamina of *Sparmannia* and *Berberis*) and in addition we study spontaneous movements in the absence of any exogenous stimulus (leafs of *Desmodium*). Our films have been designed for the use in highschool and university lectures. Together with a few more films to be finished in the near future they will be arranged to form a video disc called "Plant Movements". This disc is to be published by the Austrian Institute for the Scientific Film (ÖWF), where scientific films and videos can be rented and bought.

Cinemicrography and videomicroscopy of the living plant cell

The dynamic processes of living plant cells are described in films designed for teaching and research. Slow motions become observable by time lapse cinemicrography on 16mm film. For the visualization of as small details as possible in the living undisturbed cytoplasm we try to enhance the resolution of the light microscope (LM) in an effort to narrow or even bridge the gap between light and electron microscopy. We apply **a)** "UV Microscopy", a brightfield technique utilizing UV light of 280-360nm, and **b)** "Video Enhanced Contrast Microscopy" working with bright field, phase contrast and differential interference contrast. The use of UV sensitive and high resolution video cameras in combination with an image processor allows to at least double the resolution of the LM. In convenient cells, even particles as small as 30nm become visible. **c)** Specific staining with fluorescent dyes and antibodies is improved by light sensitive video cameras in combination with an image processor and allows the identification of cytoplasmic details ("Video Intensified Microscopy"). These results are compared with pictures from the electron microscope gained from cryofixed and cryosubstituted cells.

Organization and function of the plant cytoskeleton

We seek to contribute to an understanding of cytoskeletal functions including the generation and maintenance of the cell form, the construction of the cell wall and the dynamics of organelle movement by investigating the dynamics of living plant cells with video and electron microscopy. **d)** The influence of actin microfilaments (AFs) on the shape of the protoplast was investigated in plasmolyzed onion inner epidermal cells and in naked protoplasts of onion and of pollen tubes; **e)** the role of the cytoskeleton for exocytosis of vesicles during cell wall formation in polar cells and in protoplasts is examined in growing pollen tubes; **f)** the dynamics of organelles is analyzed in inner epidermal cells of onion and in cells of the tentacle epidermis of *Drosera* by immunotechniques and by cinemicrography.

Origin and fusion of exo- and endocytotic vesicles in plant cells

The dynamics of Golgi bodies and the origin and fate of Golgi vesicles are analysed by investigation of living gland cells (*Drosera*) with video microscopy.The fusion of Golgi vesicles with the plasma membrane is observed in growing pollen tube tips and in wounded onion inner epidermal cells. The endocytosis of excess membrane material during cell wall formation (growing pollen tubes) and during plasmolysis (onion inner epidermal cells) is visualized by the uptake of fluorescent dyes in endocytotic vesicles.

Measurement of intracellular ion concentration

With ion specific fluorescent dyes we try to estimate intracellular concentrations of calcium and protons, which play a role in a multitude of cell processes. Our main interest lies in the organization of the cytoskeleton and in fusion processes of membranes.

Teaching

My coworkers and I conduct lectures and lab courses on the following subjects: General Biology and Botany for Pharmacy and Nutritional Science, Plant Anatomy, Cell Physiology, Scientific Photography, Microscopy, and Media in Science including Technological Aspects of Teaching . During the last years, as the head of the Senat's commission for Audio- Visual Matters I got involved in the planning of lecture halls together with a team of specialists who build and improve the lecture halls of the University of Vienna.

International Cooperations

We had the pleasure to host guests from the Universities of Njimegen and Leiden (Netherlands) and from Siena (Italy) who worked with our UV and video microscopical equipment. In addition we cooperate with the Universities of Rostock (Germany) and of Massachusetts (USA).

Selected References

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