PLANT ROOTS

Water Transport

from a Correspondent

A MOST useful exchange of information and ideas between plant scientists from both sides of the Iron Curtain took place from September 7 to 10 at Tatranská Lomnica, a mountain resort in the High Tatras National Park, during a symposium on the structure and function of primary root tissues. Unseasonably cool weather and showers lessened the lure of the mountains and the botanists were able to give their undivided attention to the matter in hand. The symposium was organized by the Institute of Botany, Slovak Academy of Sciences, and among the topics discussed were the organization and development of the root apex. Dr John Torrey (Harvard University) described some features of the quiescent centre—a group of non-dividing cells characteristically found in the middle of root apices—and speculated about its possible role in hormone biosynthesis.

Other sessions were devoted to consideration of the metabolic and enzyme basis of tissue differentiation and to the functioning of roots in the absorption and transport of water and mineral salts. One of the most stimulating and controversial contributions to the symposium programme concerned the absorption of water by root hairs. Dr Marcel Cailloux (University of Montreal) described an elegant technique which has enabled him to measure absorption of water by different parts of a single hair measuring less than 50 μm in diameter. Cailloux has observed that water is taken up much more readily by the growing tip of the hair than by the maturer regions and he associates this with an aggregation of cytoplasm at the tip. As growth of a root hair declines, so does its ability to absorb water and older hairs were found to excrete water rather than absorb it. These observations cast doubt on the commonly held view that root hairs serve to increase the area of absorbing surface in a root. They also raise the question of the mechanism of water absorption.

According to the classical view, the absorption of water by root hairs occurs by diffusion along a gradient of water potential between the soil solution and cell sap, which is maintained by accumulation of solutes. Cailloux disputes this because he finds that altering the relative humidity of the air surrounding the root hair from 99 per cent to 96 per cent, which is equivalent to an increase in the water potential gradient of about 44 bars, does not alter the absorption rate. Furthermore, metabolic inhibitors, such as malonate fluoride and cyanide, reduce absorption. It is concluded that water uptake by root hairs is controlled by some process other than diffusion which is closely linked with metabolism.

The idea that water is "pumped" metabolically into plant cells is not a new one, but no such convincing evidence has been presented before. A major objection to the concept of active water transport has been the deduction that the resistance of cell membranes to flow of water by diffusion in either direction is so low that a water pump would be grossly inefficient and make impossibly high demands on the energy supplies of the cell. It remains to be seen whether the cell membranes of root hairs, and perhaps other specialized water absorbing cells in plants, have unique properties which enable these cells to pump water efficiently.

STEREOLOGY

Analysis of Structure

from a Correspondent

BERNE proved an excellent choice of venue for this year's meeting of the International Society for Stereology. The president of the society, Dr E. Weibel (Berne University), chaired the congress organization committee and the whole meeting, which took place between August 26 and 31, was run with Swiss precision.

The word "stereology" was coined a little more than ten years ago to cover the discipline of obtaining three-dimensional information from two-dimensional sections or their projections on a surface. There is now a wide interest in stereology, particularly among microscopists, and members attending this meeting—the third international congress—were drawn from such diverse fields as anatomy, materials science and mathematics.

The basics of stereology are obviously the mathematical relationships between the object and the way it is imaged or sectioned. Professor G. Mathéron and his colleagues (Bureau de Recherches Géologiques et Minières, Paris) surveyed their work on the application of the theory of sets to this problem. A particularly interesting contribution from Dr R. Miles (Australian National University) derived one simple multi-dimensional formula from which all the standard formulae of stereology could be derived. Dr E. Underwood (Lockheed Georgia Research Laboratory, Atlanta), who is president-elect of the society, derived the formulae for the stereology of projected images and his approach was reinforced by Professor J. E. Hilliard (Northwestern University, Evanston) in a talk covering quantitative measurements on scanning electron micrographs.

Dr H. Elias (Chicago Medical School), the founder and first president of the society, illustrated the many pitfalls that could occur from a non-stereological interpretation of sections. Professor R. DeHoff (University of Florida) illustrated the use of serial sectioning in determining the topography of grains in metals and derived the basic equations of connectivity.

A major portion of the meeting was given over to the use of computers in image analysis with a survey from Dr G. A. Moore (National Bureau of Standards, Washington). It became apparent that the advent of cheaper computers of various types and interface software had already made stereology considerably easier for a much wider spectrum of scientists.

The generally held view was that this meeting was both excellently organized and scientifically worthwhile. It is quite clear that the International Society for Stereology will continue to grow rapidly and it is hoped that it will continue to maintain its interdisciplinary role.

Viscosity of the Earth's Core

IN next week's *Nature Physical Science*, Dr R. Hide of the Meteorological Office, Bracknell, argues that the kinematical viscosity of the Earth's core is not greater than 10^6 cm^2 s^{-1}. Previous estimates of this parameter have varied between 10^{-3} and 10^9 cm^2 s^{-1} and Hide's new upper limit is a clear step towards pinpointing the viscosity more accurately.

Hide bases his arguments on the discovery of a statistically significant correlation between gross features of the Earth's gravitational and magnetic fields (see Hide and Malin, *Nature*, **225**, 605; 1970), and on variations in the length of the day, both of which suggest that the core–mantle boundary is not smooth but is characterized by bumps which would seem to have horizontal dimensions of as much as a few thousand km and rather small heights of only a few km.

The height of a bump, Hide suggests, must be greater than the thickness of the viscous boundary layer at the core–mantle interface by at least a quantity determined by the horizontal dimensions of the bump, the Alfvén speed, the angular speed of the Earth's rotation and the radius of the core. Using a value of 1 km for the height of the bumps (as suggested by measurements of gravitational distortions) Hide deduces that the thickness of the viscous boundary layer must be $\lesssim 1$ km and, therefore, that the core viscosity is $\lesssim 10^6$ cm^2 s^{-1}.