tile towards the base was not significantly different from normal. This made possible a test of the statolith hypothesis. The longitudinal movement of IAA from the tip of the coleoptile downwards controls the extension growth of the coleoptile, but it is the lateral movement of growth regulator—the deflexion of IAA towards the lower side of a horizontal coleoptile—that is the essential link between the perception of the magnitude and direction of the initial stimulus and the eventual growth curvature. Hertel *et al.* used radioactive IAA to compare lateral transport of IAA in the mutant and normal corn, and have found that there is much less lateral movement of the growth regulator in the mutant strain than in normal corn. The implication is that the lateral transport of IAA, and therefore the extent of the geotropic growth response, is directly linked to the rate and extent of statolith sedimentation, and therefore that the statoliths have a primary function in the perception of gravity.

On balance, the statolith hypothesis must be clear favourite for the role of gravity sensor in plants, but answers must be found to the awkward questions posed by Pickard and Thimann.

MYCOLOGY

Fungi in the Swamps

from our Botany Correspondent

IT is surprising to find that J. Kohlmeyer's comprehensive account of the fungi of mangroves (*Trans. Brit. Mycol. Soc.*, **53**, 237; 1969) is the first of its kind. The associations of plants growing in muddy swamps washed daily by the tide, which we know as mangroves, cover considerable stretches of shore in the tropics. They play an important part in the building and stabilizing of land and the factors leading to their biodeterioration are obviously interesting to know about. But since the first description of a marine fungus in the nineteenth century none was described from warm waters until 1955, when the first fungus was collected on mangrove roots. Kohlmeyer's survey has surpassed all previous mangrove mycology in attempting to clarify ecological relations between the trees and their fungi.

He counted thirty-one species of Ascomycetes, Basidiomycetes and Deuteromycetes that have been described from the submerged parts of stems, branches and roots—the proproots and pneumatophores of trees such as *Rhizophora* and *Avicennia*. Six of the fungal species seem to be restricted to a particular species or genus of *Avicennia* or *Rhizophora*. Most common marine fungi in mangrove swamps are apparently species of *Lulworthia*, *Metasphaeria australiensis* and species of *Phoma*. Of course, mangrove trees are also subject to attack by terrestrial fungi. Most of the forty-four terrestrial species have been found parasitic on living leaves, although a few inhabit the wood.

The submerged parts of the trees clearly form an excellent substrate for marine biodeterioration. Their high content of tannin does not protect them from attack by higher marine fungi or wood boring animals, even though mangrove extracts have been patented for antifouling compounds. Fungal hyphae that penetrate mangrove wood leave the series of holes characteristic of "soft rot". The bark escapes more lightly than the wood, perhaps, Kohlmeyer suggests, because fungi growing here have to be able to decompose the fatty suberin.

A clear vertical zonation of fungi and other organisms can be seen along the roots, stems or branches of mangrove trees. Submerged parts are inhabited by marine fungi, algae, balanids, shipworms and gribbles. No distinct pattern in distribution is discernible, however, within the species of submerged fungi. But a horizontal distribution has been described in a Hawaiian mangrove swamp, where salinity increases with distance from the sea. There are no marine fungi in the freshwater part, and so the host specific *Keissleriella blepharospora* grows only on *Rhizophora* in salt water. On the whole, Kohlmeyer concludes, the host specific fungi have a limited distribution, while the omnivorous species are found throughout the tropics and subtropics. Most mangrove fungi, it seems, are warm water species.

PROTEINS

Yet More Sequences

THE pace of protein sequencing is fast and furious. The 1969 edition of the *Atlas of Protein Sequence and Structure* (edited by Margaret O. Dayhof and published by the National Biomedical Research Foundation) contains about twice as much information as last year's edition. As usual, more than half of the atlas is packed with data about sequences and structures, but this year there are more of the preliminary, discursive chapters. The globins and the immunoglobulins now have chapters to themselves, and another is devoted to the evolution of species and proteins. Indeed, the writers of the atlas seem to be confident that proteins are the means by which the full phylogenetic story, the evolution of all living things, will be unravelled.

Some proteins are apparently more suitable for the construction of phylogenetic trees than others. Obviously those that have changed very little, such as the histones, which have accumulated only two mutations since the divergence of the lines leading to peas and cattle, are of little value. Cytochrome *c*, which changes less slowly, is useful for comparing widely diverse species such as fungi and vertebrates. Haemoglobin, which mutates more rapidly—at least thirty more abnormal human haemoglobins are listed this year—seems to be suitable for making finer distinctions. The table, taken from the atlas, shows how rates of mutation can vary from protein to protein.

RATES OF MUTATION OF SELECTED PROTEINS

Proteins	Accepted point mutations per 100 million years
Fibrinopeptides	90
Growth hormones	60
Immunoglobulins	34
Kappa C region	40
Kappa V region	34
Heavy C region	28
Ribonucleases	30
Haemoglobins	12
Beta	13
Alpha	11
Myoglobins	9
Gastrins	9
Adenohypophyseal hormones	9
Encephalitogenic proteins	7
Insulins	4
Cytochromes *c*	3
Glyceraldehyde 3-phosphate dehydrogenases	2
Histones	0·06

© 1969 Nature Publishing Group