NEWS AND VIEWS

Phytochrome, Hormones and Membranes

In recent years, the view has been gaining ground that phytochrome, the proteinaceous photoreceptor responsible for a wide range of developmental responses of higher plants to light, operates in some way by regulating the permeability or other properties of cell membranes. In no small way responsible for this view has been the discovery by Dr Takuma Tanada of the United States Department of Agriculture Soils Laboratory at Beltsville, Maryland, that excised root tips of barley and mung bean can be caused to adhere to a negatively charged glass vessel upon irradiation with red light (*Proc. US Nat. Acad. Sci.*, **59**, 376 ; 1968 ; *Pl. Physiol.*, **43**, 2070 ; 1968). The tips adhere to the glass very rapidly and subsequent irradiation with far-red light causes their release. It has been shown that this adhesion response is probably attributable to very rapid changes mediated by phytochrome in the electrical potential across the root tips (M. J. Jaffe, *Science*, **162**, 1016 ; 1968) thus supporting the concept that phytochrome is either a component of the root cell membrane, or acts upon those membranes.

On page 460 of this issue of *Nature* Tanada extends these observations and demonstrates a most intriguing interaction between phytochrome, indoleacetic acid (IAA) and abscisic acid (ABA) in the control of root tip adhesion. It was already known that low concentrations of IAA were necessary for the adhesion response to red light but that above 10^{-8} M the hormone prevented adhesion. Tanada has now shown that ABA at very low concentrations has an exactly opposite action to that of IAA in preventing the release of the root tips by far-red light. Tantalizingly, Tanada also refers to as yet unpublished data showing that IAA and ABA act antagonistically in this response and that the inhibitory effects of IAA on adhesion can be reversed by ABA.

The effects of these two hormones on electrical potential are consistent with recent work on the rapidity of their action in other phenomena. For example, similarity between the effects of IAA and low *p*H on elongation growth of *Avena* coleoptiles (D. L. Rayle and R. Cleland, *Pl. Physiol.*, **46**, 250 ; 1970) could indicate that IAA might alter membrane characteristics, perhaps by the activation of a proton pump. Similarly, the rapid effects of ABA on stomatal movements (C. J. Mittleheuser and R. F. M. Van Steveninck, *Nature*, **221**, 281 ; 1969) and on the permeability of carrot discs to water (Z. Glinka and L. Rheinhold, *Pl. Physiol.*, **48**, 103 ; 1971) suggest a membrane site for the action of this growth regulator also. It therefore seems that research into three of the substances—phytochrome, IAA and ABA—which regulate growth and development in higher plants is converging on the plant membrane and one must expect a flurry of interest in membrane properties. One of the limiting factors, of course, is the technical difficulty associated with the preparation and purification of plant cell membranes. Anybody who develops a successful method for the large-scale preparation of plant membranes would deservedly earn the gratitude of a very large number of frustrated plant physiologists.

Another article in this week's *Nature New Biology* (**236**, 255 ; 1972) deals with yet another phenomenon controlled by phytochrome, but in this case with a much longer time course and therefore providing no additional information on the primary action of phytochrome. Nevertheless, this report by G. J. Acton of the University of Glasgow of a phytochrome-mediated increase in the levels of ribonuclease in etiolated lupin hypocotyls serves to underline the fact that the complexities of the phytochrome system are not yet fully explored.

Acton shows that the increase in ribonuclease is at first sight a typical phytochrome response in that it is potentiated by brief red light and this potentiation is negated by far-red light. What is particularly intriguing, however, is that reversal cannot be demonstrated with a narrow band-pass filter source with peak transmission at 729 nm (very close to the absorption maximum of isolated P_{fr}, the far-red absorbing form of phytochrome) yet is relatively easily achieved with a broad band source ranging from 735 to 1,300 nm. Although the data for the 729 nm source is only referred to in passing by Acton, its potential significance is such that the attention of other photomorphogeneticists should be drawn to it. Taken at face value it implies that P_{fr} in lupins has very different absorption properties from those known for isolated phytochrome, which if confirmed would necessitate a reappraisal of some hitherto accepted ideas. —H. S.

Catecholamine Synthesis

As students of aminology well know, one of the few enzymes with high substrate specificity involved in the metabolism of the catecholamines is "tyrosine hydroxylase", which catalyses the first and rate-limiting step in catecholamine biosynthesis. Other enzymes such as L-aromatic amino-acid decarboxylase or monoamine oxidase, on the other hand, have a broad substrate specificity and are not involved exclusively in the metabolism of the catecholamines, dopamine, noradrenaline and adrenaline. The specificity even of tyrosine hydroxylase, however, has recently been called into question.

In a study of the partially purified enzyme from beef adrenal medulla, Shiman *et al.* (*J. Biol. Chem.*, **246**, 1330 ; 1971) demonstrated that the preference of this mixed function oxidase enzyme for L-tyrosine was highly dependent on the nature of the pteridine cofactor used. In the presence of certain synthetic pteridines, L-tyrosine was the preferred substrate, but with other pteridines such as tetrahydrobiopterin (the probable endogenous cofactor) L-phenylalanine was hydroxylated as least as rapidly as L-tyrosine by the partially purified adrenal enzyme. The report by Karobath and Baldessarini in a recent issue of *Nature New Biology* (**236**, 206 ; 1972) suggests that these two amino-acids may also be alternative substrates for catecholamine biosynthesis under normal conditions in mammalian brain.