located very close to the western margin of the Sierra Nevada or the California Cascades, but admit that the evidence is not sufficient to rule out the other possibility. On the other hand, from Atwater's models, they deduce that subduction ceased beneath station MIN about 4 Myr ago, beneath ORV about 6 Myr ago and beneath JAS about 12 Myr ago. In other words, the dead slab seems to age towards the south.

This theory would offer a natural explanation for a southward decrease in P wave velocity, for the older the slab the more it will be thermally assimilated with the surrounding mantle and thus the lower will be the mantle-slab velocity contrast.

Eyeglow in butterflies

from our Insect Physiology Correspondent

IT is a familar observation that the dark-adapted eyes of nocturnal moths produce a conspicuous glow when viewed in a beam of light. The 'tapetum' responsible for this reflection is believed to be the rich network of air-filled tracheoles which invest the deepest levels of the retina. As Horridge (*Proc. R. Soc. Lond.*, **B179**, 98; 1973) pointed out, if the light entering one facet is confined to a single rhabdom (as in the light-adapted eye) its reflection will not emerge through another facet. On the other hand, whatever the precise mechanism of eyeshine may be, in the dark-adapted eye the scattered light may follow many possible routes within the eye and emerge through other facets.

Particular interest has been taken in the eye glow of butterflies, which can be very brilliant, and of diverse colours, in the dark-adapted state; but which disappears very rapidly on illumination. Miller and Bernard (1968) attributed this light to the flange-like taenidia of the tracheoles running vertically between the bases of the rhabdoms, which they suggested were functioning as a quarter-wave stack made up of alternating layers of air and cuticle with refractive indexes of 1.0 and 1.4 respectively. Swihart *et al.* (*J. insect Physiol.*, **20**, 359; 1974) now question this 'basal reflection theory' for the origin of eye glow in butterflies.

These authors concentrated on butterflies of the genus *Vanessa*, which show a uniform orange reflection over almost the entire eye. The band of wavelengths reflected is far narrower than was to be expected from a quarter-wave stack. The time required for the extinction of the eye glow is constant at some 5–10 s for a given eye; the cycle of extinction (and reappearance in the dark) can be repeated hundreds of times with little variation. No detectable changes in pigment distribution can be detected. As Exner had shown, the response can be completely localised to a few ommatidia. The reflections are more intense than would be expected from a basal reflection—perhaps 20 to 50% of the incident light—and they can be upset by the slightest mechanical contact with the cornea. .

Furthermore, the authors show that during light adaptation there is a photomechanical contraction of two specialised retinula cells; this causes the rhabdom to fold and the crystalline cone to be withdrawn away from the cornea. The elastic 'corneal process' between the cornea and the crystalline cone is stretched and its optical properties are altered. The corneal process is believed to be the source of the eyeglow reflections, the spectral properties of which will be largely determined by the overlying cornea. When the corneal process is stretched the reflections are extinguished. This 'distal reflection theory', according to the authors, has no physiological implications for vision in butterflies: these are diurnal creatures; at the levels of illumination they normally encounter the eyes are in the light-adapted state and the corneal process does not reflect—it is simply a portion of the dioptric apparatus, serving to conduct light from the cornea to the lens.

How swamp plants react to thermal pollution

from Peter D. Moore
Plant Ecology Correspondent

THERMAL pollution is a problem of the future; as nuclear reactors proliferate, so larger quantities of waste heat will be pumped into the environment causing problems of thermal tolerance to the organisms living in their vicinity. To date little is known about the effects on wetland plant communities of artificially raising the temperature, although some information exists regarding aquatic organisms.

Sharitz (*Oikos*, **25**, 7; 1974) has been able to study the effects of reactor effluent in a situation where adequate controls have been possible—in the swamp forests of the south-eastern United States. Many of the lower stretches of rivers in this area are surrounded by swamp forests which, as the term implies, are dominated by trees, such as *Acer rubrum*, *Fraxinus pennsylvanica*, *F. caroliniana* and *Planera aquatica*. In these swamps, 48% of the plant species are trees and a further 14% are shrubs and woody vines. Swamp forests experience considerable seasonal fluctuation in water table and most of the tree species are intolerant of prolonged flooding. Even *Taxodium distichum* and *Nyssa aquatica*, which are the most tolerant to floods, are killed by lengthy exposure to a high water table.

Part of the Savannah River catchment in South Carolina is occupied by a nuclear reactor of the US Atomic Energy Commission, which pumps hot water into some of the tributary streams. One stream in the area is unaffected (providing a convenient control), two others are thermally polluted and a fourth has been recovering for more than 4 years following 14 years of thermal stress. The area therefore provides a useful setting for the study of the effect of nuclear plant discharge on swamp vegetation and the way in which the flora recovers after the activity is stopped.

The area currently polluted has water temperatures which frequently exceed 45° C and the vegetation of the area has been profoundly altered. All trees, shrubs and lianes have been destroyed and the only habitats suitable for plant growth are the islands formed from collapsed, dead timber; here some herbaceous plants, such as *Ludwigia leptocarpa* have become established. In fact the diversity (Shannon-Weaver index) of the ground flora is fractionally increased, resulting from the new microhabitats created.

The recovery area has similar stumps and logs, together with emersed, floodplain sediments which have been colonised by adventive herbs, such as *Polygonum punctatum*; a large proportion (35%) of the plants of this area are annuals. Some woody plants are recorded, including *Pinus taeda* and *Salix nigra*, but these are not species typical of the mature swamp forest, so that it is difficult to judge how long the area will take to return to the typical swamp forest if, indeed, it ever does.

The loss of woody species during flooding could be of particular concern if it resulted in local erosion and consequent silting of the Savannah River. It is unfortunate, however, that it has not been possible to distinguish between the truly thermal effects of disturbance and those resulting from a permanent raising of the water table. It is probable that the loss of trees and shrubs is due to flood intolerance rather than sensitivity to high water temperatures. Such a distinction, were it possible, would indicate whether the destruction of the swamp forest could be avoided by providing drainage conduits direct to the Savannah River. Although such action would stabilise the forest, it would not, of course, reduce the effects of thermal polution on aquatic organisms in the river.