tions for mantle convection as well as the geomagnetic field. Moreover, as volcanism has evidently been occurring and the geomagnetic field has evidently existed for at least 3×10^9 years and probably getting on for 4×10^9 years, the convective systems would appear to be almost as old as the Earth. As Elsasser and his coworkers concede, "this is in line with Tozer's often expressed view that since planets are convectively unstable and since the radioactive heat of their interiors can only be removed by convection (for example, Tozer *Phys. Earth Planet. Int.* **6**, 182: 1972), most planets can be expected to convect most of the time".

Obviously an excellent case can be made for whole-mantle convection. Whether it actually occurs or not is more difficult to prove. □

Reproduction in flowering plants

from A. J. Richards

INTRODUCING the International Symposium on the Reproduction of Flowering Plants, held recently in New Zealand*, E. J. Godley (DSIR, Christchurch) discussed the special characteristics of the New Zealand flora. One question posed was whether the proportion of unisexual flowers found in New Zealand is as uncommon as has been previously supposed. Twelve per cent of the 1,800 species of indigenous flowering plants are dioecious (with stamens and pistils on different plants) compared with 2% of indigenous UK species. However, high frequencies of unisexual plants are common in tropical forests (as shown in Costa Rica recently by K. S. Bawa (University of Massachusetts)) and are found in all temperate countries south of the Equator. Dioecy is generally regarded as being a secondary phenomenon, hermaphrodite flowers being the primitive type in the flowering plants, so it seems unlikely that dioecy is a hangover from the ancient southern continent of Gondwanaland. Perhaps the high level of variability and vigour engendered in outbreeders was favoured during the establishment phases of the southern land-masses, as they became increasingly isolated from the mainstream of flowering plant evolution to the north.

Godley also discussed the predominance of white and yellow flowers in New Zealand, so well-known in the hebes, olearias and celmisias cultivated in the UK. He quoted Cockayne, stating that of attractive flowers, over 60% are predominantly white flowered in New Zealand (the comparable figure for the UK is 25%). Certainly, the experience of a casual visitor from Europe, faced with white gentians, white buttercups, white willowherbs and white forget-me-nots bears this out. Godley thinks that white flowers, mostly of an unspecialised nature, might also be representative of an ancient, isolated southern continent, and many anthecologists would agree that this simple syndrome ties in well with the paucity of pollinators that a land-mass, isolated so early, might be expected to demonstrate. Specialisation of flowers will only succeed if a rich flower-visiting fauna is present.

Until recently, gynodioecy, in which pistillate and hermaphrodite plants are mixed, was thought to be uncommon. A number of workers showed that it is much more frequent than previously realised. Theoretically, it is difficult to model a balanced gynodioecy; either the disadvantage to pistillate flowers of requiring cross-pollination for seed to set, and having fewer potential pollen sources; or the advantage of not bearing the reproductive cost of stamens, is likely to upset the balance. This is compounded by the tendency for male sterile genes to be carried cytoplasmically, and thus to be inherited maternally. It was suggested that in stable gynodioecious conditions, nuclear-controlled male fertility restorers help natural selection in the maintenance of a balance between male fertile and male sterile plants. Marianne Philipp (University of Copenhagen) provided some interesting data to show how this balance might operate selectively.

X. Delanny (University of Louvain) echoed the work of other speakers in showing just how cryptic gynodioecy can be. Most European species of thistle are gynodioecious, but the over-familiar creeping thistle, *Cirsium arvense*, is usually fully dioecious although morphologically the flowers appear hermaphrodite. Females show early abortion of pollen, despite normal looking anthers, and males have perfectly functional pistils, apart from the pollen-receptive papillae on the stigma, which fail to develop.

As in so many other sciences, reproductive genetics seems to be emerging with difficulty from a model-building phase, and there are still more ideas than facts. However, this is much less true with respect to recent work on the physiology of sexual fusion in flowering plants. Using technically outstanding light and electron micrographs of cotton ovules W. A. Jensen (University of California, Berkeley) has followed the fate of the male gamete immediately before fertilisation in fascinating detail. The generative nucleus of the pollen tube is a true cell, surrounded by a plasma membrane. On entering the embryo-sac, the pollen tube forms an association with one of the synergid nuclei. This synergid grows and migrates to the egg nucleus, carrying the male cell which has been discharged by the tube into the synergid. Plasma membrane between the male cell and the egg are sequentially broken down, finally permitting controlled fusion. The remains of the synergid subsequently throws out the second male nucleus towards the fused polar nucleus (with which it will fuse to form the triploid endosperm). The polar dikaryon has already fused on the stimulus of pollination, and this fusion is probably triggered by secondarily produced gibberellic acids. In a similar way, the growth and change of appearance of the receptive synergid is apparently triggered hormonally, and can be induced by auxin placed on the stigma in the absence of pollen. There is now good evidence that the directional chemotaxis of the pollen tube occurs in response to a calcium gradient, according to evidence achieved with the use of ion-analysing microprobes.

Ultrastructural work has also thrown light on the control of apospory, a form of agamospermy (seeds without sex) in the New Zealand grass *Cordateria*. Melva Philipson (DSIR, Christchurch), showed that sexual meiosis is able to proceed towards the formation of megaspores and an embryo-sac, protected by a callose sheath. In aposporous conditions, the callose breaks down early, and the megaspore mother cell degenerates, allowing the formation of vegetatively budded, maternal embryo-sacs, which develop embryos autonomously, identical to the parent.

There was much more to report at this conference: a mass of exciting anthecological and breeding system work is emerging from the botanical wealth of Australia, which with over 20,000 species of flowering plants, and a host more waiting to be described, bids fair to replace California as the evolutionary field laboratory of the world. Exciting new techniques were also in evidence, especially in the fields of cell fusion studies, somatic gene transmission, embryology, using new clearing techniques to replace tedious sectioning, and the use of artificial dried 'seeds' cloned from tissue cultures. □

*The International Symposium on Reproduction in Flowering Plants, organised by the Royal Society of New Zealand was held on 5–10 February, 1979 at the University of Canterbury.

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