Living plant fossils

SIR — The article "Seeds of thought for plant conservationists" by P.D. Moore[1] is of great interest but it should be added that seeds are not the only plant reproductive parts that remain viable over a considerable period of time in datable contexts. The same is true of fungal mycelia and spores[2], bacteria[3,4], apparently not viruses[5] but probably algae, which can survive as cysts.

Moore[2] isolated 61 microfungi from two peat profiles collected in the Dublin-Wicklow mountains, Ireland, using Warcup's soil plate method. More viable remains occurred at the surface but the number of viable taxa (6 or 7) was constant with depth. Unfortunately the peats have not been dated by radiocarbon methods.

Bacteria of the thermophilic actinomycete genus *Thermoactinomyces* are relatively easily isolated and identified[5]. Their resistant endospores survive for longer than 1,500 years in anaerobic lake muds[3] and have been cultured using occupation debris from the Roman fort site of Vindolanda, Northumberland[4]. The concentration of colonies grown varied with sediment type. The microbiology of grain stored in Iron Age-type pits has also been studied[7] as part of an experimental project on agricultural practices.

Conservation should not be confined solely to higher plants and the medical value of *Penicillium* is a good indication why. Soils that are totally anaerobic or clay-rich (holding water tightly in the clay-humus bond) may serve as storehouses of viable remains of lower plants in addition to seed banks, as Moore suggests.

Definition of extinction in lower plants may be even more difficult than for angiosperms, given the possible longevity of spores.

The palaeoecological importance of these findings requires stressing. While little research on fossil Holocene microfungal remains has so far been carried out in Europe, interest may grow if it can be demonstrated that data which add to interpretations of vegetation history based on pollen analysis may thereby be acquired. Microfungi are impossible to identify taxonomically using mycelial remains preserved in peats, and accurate determination using the various spore types is very difficult[8], but if viable remains occur the prospects are much better.

The various spore types of *Ceratocystis ulmi* (Dutch elm disease) are extremely small[9] and are probably not identifiable by light microscopy. Finds of fossil elm bark beetles would provide no proof that they were carrying the disease. However, if *C. ulmi* spores remained viable for 5,000–5,200 years, the theory that the elm decline in the British Isles was due wholly or partly to this disease could be properly tested. It has already been shown[6] that *Thermomycetes vulgaris* (actinomyces) spores are plentiful in samples from Seamere, Norfolk, which have cereal and associated weed pollen and *Thermomycetes spp.* occur today in association with cereal cultivation and storage.

Finally, it is of note that Seaward *et al.*[4] found viable endospores of *T. vulgaris* and *T. dichotomica* at Vindolanda differing from those regarded as typical of currently recognized species. So resuscitation can add potentially to genetic diversity.

B.K. MALONEY

Department of Geography and Palaeoecology Centre, Queen's University, Belfast BT7 1NN, Northern Ireland

1. Moore, P.D. *Nature* **303**, 572 (1983).
2. Moore, J.J. *Scient. Proc., R.D.S.*, **26**, 379–415 (1954).
3. Cross, T., Attwell, R.W., in *Spore Research 1973* (eds Barker, A.N., Gould, G.W. & Wolf, J) (Academic, London, 1974).
4. Seaward, M.R.D., Cross, T. & Unsworth, B.A. *Nature*, **261**, 407–408 (1976).
5. Shackley, M. *Environmental Archaeology* (Allen and Unwin, London, 1981).
6. Unsworth, B.A., Cross, T., Seawald, M.R.D. & Sims, R.E. *J. appl. Bact.*, **42**, 45–52 (1977).
7. Lacey, J. *Stored Prod. Res.* **8**, 151–154 (1972).
8. Van Geel, B. *thesis*, Univ. Amsterdam (1976).
9. McNeel, D.J., Kulkarni R.K. & Nickerson K.W. *Can. J. Bot.* **61**, 1349–1352 (1983).

Plants from culture

SIR — Recently there has been an increasing amount of research on the inheritance of characters in the progeny of tissue culture-derived plants. Genetic analyses of this type are likely to become even more common as the techniques for generating (somaclonal) genetic variants and transformants via tissue culture become more widely applied to crop species. In discussing results of this type of research, it has come to our attention that there is a potential source of confusion in the nomenclature used.

It is common practice to self-pollinate plants regenerated from culture and to analyse the resulting progeny for the inheritance of novel traits. The progeny of such selfed regenerated plants have been referred to variously as the F_1, F_2, R_1, R_2, RF_1, RF_2, SC_2, S_1 and G_1 generation[1-9]. It is therefore apparent that a consistent nomenclature is needed to clarify the nature of the material being described.

Ideally any system adopted should be logical, easy to use and be compatible with established plant breeding nomenclature. We believe that these criteria can be met by strict adherence to the use of letters to designate the process, followed by numbers to show how many times the process has been performed. Thus the original regenerated plants are to be referred to as the R_1 generation. It follows that successive cycles of cell culture and plant regeneration, without a sexual cycle, would produce R_2, R_3, etc. generations. If the regenerated plants from the R_1 generation are selfed, their progeny become the R_1S_1 generation. Repeated selfing to eventually produce homozygous inbreds would progress through the R_1S_2, R_1S_3, R_1S_4, etc. generations. Back-crossing to non-cultured material would similarly be described as R_1BC_1, R_1BC_2, R_1BC_3, and so on. By using nomenclature that is compatible with current plant breeding conventions, the same system can easily be extended to more complex breeding programmes. For example, using maize inbreds, (Mo17 × B73 R_1S_1) BC_2 would represent the second backcross generation derived from the cross of Mo17 by an S_1 progeny of a plant regenerated from a B73 culture. Although such complex situations would not be met by most researchers, we feel that any system adopted should be able to cope with all eventualities.

N.P. EVERETT
S.M. FLASHMAN

Stauffer Chemical Company, 1200 S 47th Street, Richmond, California 94804, USA

1. Wullems, G.J., Molendijk, L., Ooms, G. & Schilperoort, R.A. *Cell* **24**, 719-727 (1981).
2. Bourgin, J.-P. *Molec. gen. Genet.* **161**, 225-230 (1978)
3. Hibberd, K.A. & Green, C.E. *Proc. natn. Acad. Sci. U.S.A.* **79**, 559-563 (1982).
4. Lörtz, H. & Scowcroft, W.R. *Theor. appl. Genet.* **66**, 67-75 (1983).
5. Edallo, S., Zucchinali, C., Perenzin, M. & Salami, F. *Maydica* **26**, 39-56 (1981).
6. Gengenbach, B.G,, Connelly, J.A., Pring, D.R. & Conde, M.F. *Theor. appl. Genet.* **59**, 161-167 (1981).
7. Otten, L. *et al. Molec. gen. Genet.* **183**, 209-213 (1981).
8. Straub, J. & Schell, J. *Molec. gen. Genet.* **183**, 209-213 (1981).
9. Beckert, M., Pollacsek, M. & Caenen, M. *Agronomie* **3**, 9-18 (1983).

Species named

SIR —It is surely of fundamental importance in research work in the areas of basic biology and genetics that the organisms being studied should be precisely identified. I find it extraordinary, therefore, that in the interesting article by Bernards *et al.* on the growth of chromosome ends in trypanosomes (*Nature* **303**, 592; 1983), that neither the genus nor the species of the trypanosomes studied was given.

DAVID WALLIKER

Institute of Animal Genetics, University of Edinburgh, Edinburgh EH9 3JN, UK

BERNARDS AND BORST REPLY — Our experiments were done with *Trypanosoma brucei brucei*, strain 427. We expect, however, that the growth and contraction of chromosome ends will be a property of chromosomes in all African trypanosome species, and possibly in all organisms. We apologize that this expectation has inadvertently crept into our paper and we hope that other readers have found the missing information in our earlier papers, amply quoted in the *Nature* article.

A. BERNARDS
P. BORST

Antoni van Leeuwenhoekhuis, Het Nederlands Kankerinstituut, 1066 CX Amsterdam, The Netherlands