occurred "not as the result of the superposition of two whole normal crusts on each other, but rather as the result of separate doubling (by decoupling and thrusting) of the upper crustal and lower crustal layers (plus Moho)"[1]. Whether this model can be applied to other orogenic belts remains to be seen. □

1. Hirn, A. *et al. Nature* **307**, 23 (1984).
2. Brewer, J.A. *et al. Nature* **305**, 206 (1983).
3. Dewey, J.F. & Bird, J.M. *J. geophys. Res.* **75**, 2625 (1970).
4. Powell, C.McA. & Conaghan, P.J. *Earth planet. Sci. Lett.* **20**, 1 (1973).
5. Watson, J. & Dunning F.W. in *The Caledonides of the British Isles Reviewed* (eds Harris, A.L., Holland, C.H. & Leake, B.E.) 67 (IGCP Proj. 27, Scottish Academic Press, 1979).
6. Lyon-Caen, H. & Molnar, P. *J. geophys. Res.* **88**, 8171 (1983).
7. Barton, P., Matthews, D.H., Hall, J. & Warner, M.R. *Nature* **308**, 55 (1984).
8. Chen, W.P. & Molnar, P. *J. geophys. Res.* **88**, 4183 (1983).
9. Meissner, R. *J. Geophys.* **40**, 57 (1974).
10. Oliver, J., Cook, F. & Brown, L. *J. geophys. Res.* **88**, 3329 (1983).
11. Mathur, S.P. *First Break* 1(7), 9 (1983).
12. Hale, L.D. & Thompson, G.A. *J. geophys. Res.* **87**, 4625 (1982).
13. Fuchs, K. *Zeitschr. Geophys.* **35**, 133 (1969).
14. Smithson, S.B., Brewer, J.A., Kaufman, S. & Oliver, J.E. *J. geophys. Res.* **84**, 5955 (1979).
15. Brewer, J.A. & Smythe, D.K. *J. geol. Soc.* **141**, 105 (1984).

Drummond Matthews is at the Department of Earth Sciences, Bullard Laboratories, University of Cambridge, Cambridge CB3 0EZ, and Alfred Hirn at the Institut de Physique du Globe, Université Pierre et Marie Curie, 75230 Paris Cedex 05.

Crop science

The genetic manipulation of crop plants

from Ben Miflin and Peter J. Lea

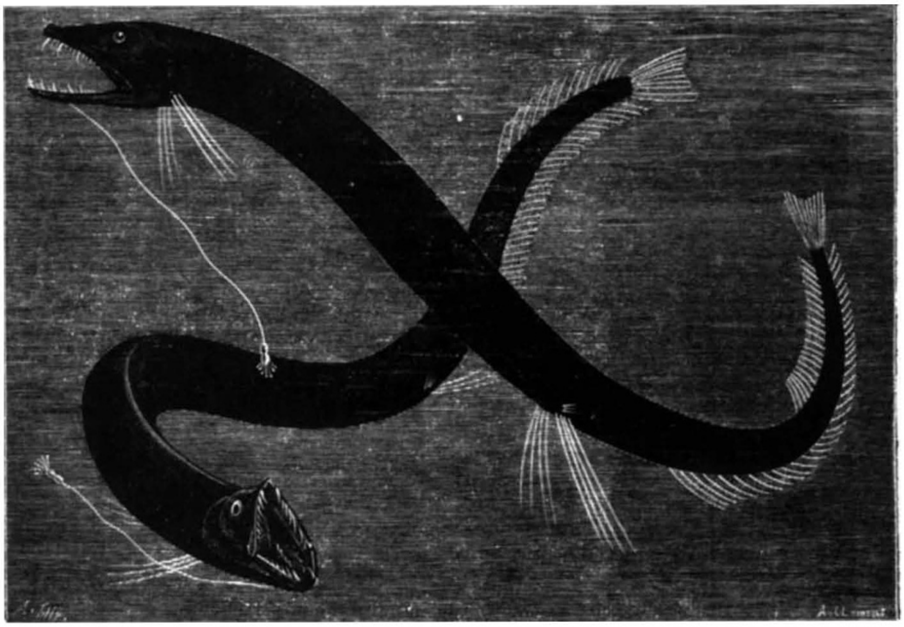
TWO recent UK symposia* devoted to the genetic manipulation of plants addressed the same question: 'what has it done for agriculture?'. The superficial answer might be: 'so far, not much'. But that would be to misunderstand the long-term nature of crop science. Bear in mind, for example, that although the initial sexual cross in the production of the currently successful wheat cultivar Avalon was made in 1969, the variety was only ready to be released in 1980 — a period that more than encompasses the whole history of recombinant DNA technology. Moreover, the amount of information available and the number of systems under study are already impressive compared with what was known and foreseen five years ago. What then has been achieved?

For a start, recombinant DNA techniques for gene isolation have been applied to a wide range of crop species. The work has centred on the genes for the most abundant proteins, such as ribulose bisphosphate carboxylase, an enzyme of the carbon-fixation cycle, and the seed storage proteins of cereals and legumes. From this, a pattern of organization is emerging in which each major group of cereal proteins is encoded by one or more complex multigenic loci, the individual genes of which contain a number of different tandem and interspersed repeats (B. Forde *et al.*, Rothamsted). The genes themselves, particularly those of the legume storage proteins, appear to have a conventional structure of coding sequences interspersed with introns (D. Boulter, University of Durham). Currently the flanking regions of various plant genes are being searched and tested for sequences that are important in controlling the expression of genes particularly in response to environmental stimuli such as stress or light.

Although the study of plant protoplasts is expanding and the list of species that can be regenerated from protoplasts grows ever larger, monocotyledonous species are notable by their absence and techniques producing large number of regenerants at high frequency have only been worked out for very few species. Protoplasts are potentially valuable for at least three reasons. First, new genes can be introduced into plants through protoplasts, whose co-cultivation with *Agrobacterium* appears to be an efficient way of going about the task (J. Schell *et al.*, Max-Planck-Institut, Köln). Second, the selection of plant mutants by screening protoplasts is, in theory, valuable. It has, for example, led to mutants deficient in nitrate reductase (R. Mendel and A. Muller, Akademie der Wissenschaften, Gatersleben, GDR), but in general the technique has been somewhat disappointing and many workers have turned to other methods. Third, protoplast fusion offers a way of combining species that are not sexually compatible.

Although progress in the development of protoplast and tissue culture techniques has been slow and frustrating, the techniques have an immediate application. Micropropagation of high-value crops is of increasing use in the horticultural industry (G. Hussey, John Innes Institute) and there is considerable interest in the exploitation of the variation ('somaclonal variation') induced by passage of plants through

*ARS genetic manipulation of crop plants: 5 years on', organized by the Agriculture and Food Research Council, Cambridge, 12–13 December 1983, and 'The genetic manipulation of plants and its application to agriculture', organized by the Phytochemical Society of Europe, London, 19–20 December 1983.



100 years ago

DEEP-SEA FISHES OF THE "TALISMAN"

IN THE exhibition, now open at the Jardin des Plantes, Paris, the great interest of the fish captures of the *Talisman* centres in the remarkable forms taken from the depths of the sea. The question of whether certain fish inhabit certain zones of depths was closely considered, and is answered in the affirmative. These zones are of very considerable depth, varying from 600 to over 3650 metres, and in bringing up specimens from such areas of great pressure these suffer immensely through the phenomena caused by the rapid decompression of the air, the more remarkable effects being dilation of the swim bladder, the eyes being squeezed out of their orbits, and the scales clothing the body are shed. In some cases even the fishes body has become smashed into pieces.

In some of the deep-sea fishes peculiar organs, unknown for the most part among surface fishes are to be found. Long filamentous organs are to be met with showing apparently a brilliant type of phosphorescence. One of the most singular is that to be seen on a fish represented in the annexed woodcut. In this form (*Eustomias obscurus*) the tactile organ takes the appearance of a long filament, which is placed underneath the lower jaw, and which ends in an inflated and rayed knob-like phosphorescent mass.

From *Nature* **29**, 483, 20 March 1884.