D. DITCHBURN

Figure 1 | The Great Lakes (or American) sea rocket, *Cakile edentula*. Dudley and File's experiments[1] on root growth show that kin recognition occurs in this species. Whether kin recognition translates into kin selection in sea rocket remains an open question.

they are lousy for assessing a plant's full growth potential. Avoidance of root overlap, as a consequence of recognition, requires space, and space is severely restricted in pots.

In a natural field setting, however, a plant detecting neighbouring kin at low densities could decrease root growth in the vicinity of neighbours and increase root growth away from them, thereby decreasing root overlap and competition for resources and increasing its performance. In support of this possibility, other research on sea rocket has shown that, in the field, groups of siblings have higher reproduction rates than groups of strangers[12]. By demonstrating kin recognition, Dudley and File have taken the critical first step; measuring the fitness consequences should be comparatively routine.

Kin recognition is sometimes linked to altruism, but reduction in root growth and overlap among sibling neighbours may not be purely altruistic. By detecting family members and sharing space with them, sea rockets may simply be ensuring that direct competition for resources does not suppress all members of the group. Competition among densely spaced individuals could result in a limiting resource being spread so evenly among relatives that no individual acquires enough to reproduce. This would be a disaster for an annual species such as sea rocket. On the other hand, kin recognition accompanied by inhibition[8] of neighbouring roots may constitute a formidable interference mechanism that would allow plants to form large enough territories[13] for the successful growth and reproduction of some family members at the expense of others. Kin recognition, therefore, may not directly benefit all members in a family. But it may increase the odds that at least a few members will successfully pass on the family genes to the next generation.

Without brains, how do plants recognize their relatives? No one knows. Possibilities include communication through chemical exudates, released volatile molecules, electrical signals, and enzymes functioning at cell surfaces[14]. Research on a desert shrub, *Ambrosia dumosa*, suggests that root interactions may involve at least two levels of recognition and interplay among physiological and genetic components. At the self versus non-self level, roots on the same individual shrub did not inhibit each other upon contact, whereas roots from genetically identical but physically separated individuals did[13]. At the population level, roots on different plants from the same population inhibited each other, whereas those from different populations did not[8]. In addition, recognition and response probably constitute two different mechanisms, because studies on other species have found, in contrast, that self-recognition can lead to inhibition[15].

Clearly, research on root behaviour is just beginning. But if neighbour identity commonly dictates root interactions, major overhauls of theories that assume that direct resource competition determines plant community organization will be necessary. And if kin recognition among roots can be unequivocally linked to evolutionary consequences, we will have to expand the pool of mechanisms known to drive plant evolution. ■

Ragan M. Callaway is in the Division of Biological Sciences, University of Montana, Missoula, Montana 59812, USA. Bruce E. Mahall is in the Department of Ecology, Evolution, and Marine Biology, University of California, Santa Barbara, California 93106, USA.
e-mails: ray.callaway@mso.umt.edu; mahall@lifesci.ucsb.edu

1. Dudley, S. A. & File, A. L. *Biol. Lett.* doi:10.1098/rsbl.2007.0232 (2007).
2. Mahall, B. E. & Callaway, R. M. *Ecology* **73,** 2145–2151 (1992).

50 & 100 YEARS AGO

50 YEARS AGO

"Dr. Josephine Macalister Brew, C.B.E." — It is hard to believe that Dr. Macalister Brew is dead; for if any one adjective could have described her it would have been the hackneyed word 'vital'... [but it] was not surprising that she was worked to death. Government departments, charitable trusts, bodies as varied as the Marriage Guidance Council and the Educational Drama Association all made demands on her strength; and to none of them did she give half-measure.... there must be scores [of boys and girls] who remember this odd little figure who knew what they were thinking before they did and, more, could put it into intelligible words.

From *Nature* 13 July 1957.

100 YEARS AGO

The problem of determining the motion of the sun amongst the stars has undergone a great change in consequence of Prof. J. C. Kapteyn's investigations... These researches indicated that the stars surrounding us do not form a simple system, but a dual one. From a discussion of the motions of the stars of Bradley's catalogue, Prof. Kapteyn demonstrated the existence of two great streams of stars passing through one another, and found the directions of motions of these streams relative to the sun and to one another. The Bradley stars, numbering about 2600, are mainly stars visible to the naked eye; they cover nearly three-quarters of the celestial sphere, and throughout the whole of this area Prof. Kapteyn found the two streams prevailing, and it seemed probable that all the stars he examined belonged to one or other of the two streams... In conclusion, whilst Prof. Kapteyn's theory accounts in a simple manner for the very anomalous and unsymmetrical way in which the directions of motion of the stars are distributed, it is still awaiting the verdict of the spectroscopic determinations of line-of-sight velocities.

A. S. Eddington

From *Nature* 11 July 1907.