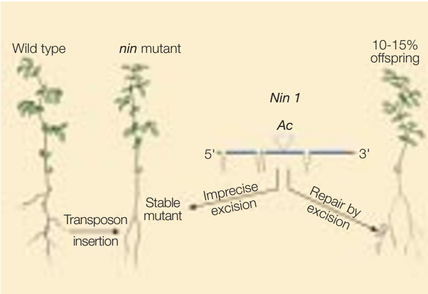

Figure 1 **Strategy used by Schauser *et al.*[2] to characterize the 'nodule inception', *nin*, mutant. By inserting a mobile DNA element (transposon) called *Ac* into wild-type *Lotus japonicus*, the authors generated mutant plants with *Ac* inserted into the *nin* gene. This transposon can excise itself from the DNA. If it does so imprecisely, a mutation remains in the *nin* gene. But if it excises precisely, the gene can be repaired and the plants return to a wild-type phenotype. This is a powerful technique for generating mutations in plants.**

studying root nodulation in the legume family. Root nodules are the result of a symbiotic (mutually beneficial) interaction between plants and various soil bacteria, collectively called rhizobia[1]. Within these nodules, the bacteria fix atmospheric nitrogen into ammonia. This means that leguminous plants do not depend on fixed nitrogen in the soil — usually a major growth limitation.

Two decades of research into the molecular basis of this symbiosis have shown that it is due to an exchange of signal molecules. These molecules are recognized specifically by the host plants and their bacterial partners[3], and they include the bacterially produced nodulation factors, which can trigger the roots of leguminous plants to form a root nodule[4–6]. The bacterial genes involved in the symbiosis have been studied in detail[7], stimulating research into the genomes of rhizobia in general (for example, the sequence of the entire *Sinorhizobium meliloti* genome is close to completion[8]).

From the plant side, far less is known of the genes (and corresponding functions) involved in the symbiosis. This is mainly due to the technical bottlenecks in plant genetics. Various plants have been identified with an impaired capacity to be nodulated or infected by rhizobia[9], but these mutants were derived by chemical mutagenesis. So the resulting defects (such as point mutations) are still difficult to identify.

The transposition approach used by Schauser *et al.*[2] now makes it very easy to identify mutated genes, because they are tagged by the known nucleotide sequence of the transposon. The strategy yielded a mutant that could not form root nodules, so was called a *nin* (for 'nodule inception') mutant (Fig. 1). Interestingly, the mutant does not seem to be affected in any other aspect of plant development — such as root, shoot, leaf, flower or seed development — as long as nitrogen nutrients are supplied externally. This suggests that the mutated gene is dedicated to root-nodule formation.

The authors went on to show that the genetic defect in the *nin* mutants is indeed caused by integration of the transposon. To do this, they used the fact that the *Ac* transposon can excise spontaneously from the affected gene at a certain frequency. They found that when the transposon was precisely excised, mutant plants reverted to the wild-type phenotype (Fig. 1). Then, because the transposon acted as a tag for the mutated gene, Schauser *et al.* could easily obtain the nucleotide sequence of the complete gene using established procedures. This sequence showed that the Nin protein is probably a transcription factor, which may have a membrane-spanning domain. The *Nin* gene seems to be related to the *mid* ('minus dominance') genes from the alga *Chlamydomonas*. These genes regulate sexual reproduction in response to short supplies of nitrogen. Because root nodulation is also regulated by nitrogen limitation, this relationship might point to a conserved function for this type of regulator in evolution.

The identification of this hitherto-unknown regulator of nodule inception is a landmark discovery that will influence future studies in the legume field. This kind of approach will be strengthened by linking it to detailed analyses of leguminous-plant genomes. Two international consortia are currently obtaining nucleotide-sequence data from *L. japonicus* and another model legume, *Medicago truncatula*. Such large-scale projects are important owing to the role of leguminous plants in studies on the interaction of plants with symbiotic mycorrhizae[8] (which are involved in the supply of phosphorus), or in research on the various plant pathogens that are specific for the leguminous family. It will be exciting to follow research in this area, and to see the vast amount of biochemical and physiological data obtained as leguminous plants are linked to plant genetics. ■

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Daedalus

Asteroidal defence

One day, a stray asteroid or comet may smash into the Earth, when we shall go the way of the dinosaurs. Pessimists advocate a close watch on asteroidal neighbours, and the building of a vast nuclear missile to disrupt the incomer before it hits the Earth. Daedalus has a neater scheme.

He wants to put an asteroidal 'anti-missile' in a high Earth orbit. If a potential invader were sighted, we would arrange for the guard asteroid to collide with it. An asteroid already in orbit would patrol near-Earth space very densely. Even a slight nudge, if well calculated, could guarantee a successful interception, shattering both asteroids.

But how to capture a guard asteroid in the first place? Many asteroids, comets and planetesimals contain hydrogen, water, ammonia or methane ices, which can deliver useful thrust by direct evaporation. Indeed, it has been suggested that an asteroid could be steered by flying a big concave mirror alongside it, to focus sunlight on the icy surface. The resulting plume of hot gas would deflect its orbit. Daedalus goes even further. Most asteroids, he claims, are not loose rubble piles of the sort discussed by E. Asphaug on page 127. They have a compressed centre, in which the ices are converted to energetic hydroxonium, ammonium or methylammonium 'alloys'. Release the over-pressure, and these compounds will decompose to hot pressurized gas. A space probe that landed on such an asteroid and drilled down to its energetic core would release a gas-jet that would turn the asteroid into a natural rocket. With crafty enough steering, it could be detached from its solar orbit and put into one round the Earth. The drill-hole would then be plugged, restoring the stabilizing pressure. When the asteroid was called on to make the supreme sacrifice for its new primary, the hole would be unplugged again to steer it to its final, fatal encounter.

This elegant scheme can be put into effect long in advance of any threat. With the guard asteroid safely in orbit, the Earth is well defended. Of course, if the deadly incomer turns out to another ice-cored asteroid, it might still be feasible to send a spacecraft to intercept it on the old plan. But instead of blowing it up, it could be steered into Earth orbit as an additional defender. David Jones

***The further Inventions of Daedalus* (Oxford University Press), 148 past Daedalus columns expanded and illustrated, is now on sale. Special *Nature* offer: m.curtis@nature.com**

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