candidate genes identified by this approach will be direct targets.

Gould *et al.*[5] describe a new, more direct, molecular approach based on the knowledge that homoetic genes encode transcriptional regulators which bind DNA directly via the homeobox domain. Unfortunately, identifying target sites by the ability of *Ubx* protein to bind them *in vitro* is compromised by the potential lack of specificity of DNA–homeoprotein interactions observed under these conditions. To obviate these problems, Gould and colleagues make use of a highly specific monoclonal antibody that recognizes all *Ubx* protein products[9]. They prepare embryonic chromatin at low ionic strength to preserve the native structure so that the *Ubx* protein will be able to bind or remain bound to its *in vivo* DNA targets, and then immunopurify the soluble fraction with anti-Ubx antibody. DNA from the immunopurified fraction is then digested and cloned in small fragments.

It turns out that this population of clones is enriched in sequences matching the consensus TCAATTAAAT to which many homeodomain proteins bind *in vitro* with high affinity[10,11]. Moreover two of four clones chosen for further analysis, numbers 35 and 48, contain sequences to which *Ubx* protein binds *in vitro* with high selectivity. To test whether these clones are actually target sites of downstream gene expression, the authors fished out the associated transcription units and assayed where they are expressed in wild-type and mutant embryos. Strikingly, clones 35 and 48 are both associated with transcription units which are expressed in a segmentally repeated pattern. More importantly, both transcripts show distinct patterns of expression in different parasegments and the differences are dependent on *Ubx* gene function. These results strongly suggest that the method has worked and that two *Ubx* target genes have been positively identified.

An additional and important observation that Gould *et al.* have made is that the two genes also seem to be regulated by other homeotic genes. This is certain for clone 35, which appears to be independently down-regulated by the other genes of the bithorax complex (*abdA* and *AbdB*), and is likely to be the case for clone 48, which also seems to be regulated by homeotic genes in the Antennapedia complex. The possibility that some downstream genes are independently regulated by several homeotic genes makes a lot of sense. It is consistent with the strong amino-acid similarity found in the DNA-binding motifs of homeoproteins, and also provides an explanation for the observation that some homeoproteins can suppress the phenotypic consequences of the activities of other such proteins. For example, the fact that the *Ubx* protein can dictate a parasegment-6-specific pattern in the presence of *Antp* protein[12] is better understood if *Ubx* and *Antp* proteins compete with differential affinity for binding to largely overlapping sets of downstream genes.

The obvious course of action from here is to determine the developmental and molecular function of the two candidate genes already identified. As they have been cytologically mapped to the 64C and 97D regions of the chromosome, it should be possible to alter them by conventional genetic techniques and assess what happens when their function is eliminated. Similarly, it should be relatively easy to determine their sequence, which may reveal aspects of their molecular structure and function. Another direction will be to identify more candidate genes. In principle, the method devised by Gould *et al.* could be used to find out whether pre-existing candidate genes such as *wg* and *dpp* are direct targets *in vivo*. Perhaps more importantly, the method could allow a comprehensive assessment of the numbers and types of target genes which are directly regulated by a given homeotic gene. However, one point to bear in mind is that one of the four genes initially selected by these authors (gene 9) is not likely to be a target of *Ubx in vivo* as it is expressed at high levels in parasegment 15 where the *Ubx* protein is not normally present. So it is possible that *Ubx* protein can dissociate and reassociate with target sites in chromatin under the conditions of the experiment, opening the possibility for artefactual associations between the protein and inappropriate target sites.

But the approach developed by Gould *et al.* could lead to significant advances in understanding how homeoproteins control cell pattern. It should also be applicable to other classes of regulatory proteins and to other developmental systems — a lure, perhaps, for other anglers. □

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DAEDALUS

Micromagnetics

AMBITIOUS chemists are already dreaming of 'molecular electronics', whose components are single molecules. Daedalus recalls that one molecular superconductor is already well known: the ring molecule of benzene. Studied by nuclear magnetic resonance, its six-carbon ring proves to have a current flowing endlessly around it, which varies with the applied magnetic field. Daedalus points out the obvious reason: the molecule acts as a tiny one-turn superconducting coil. Pushing it into the magnetic field induces a current which suffices to exclude the field from the ring.

What would happen, asks Daedalus, if benzene was synthesized in a magnetic field? Each newly formed superconducting ring molecule would have a few flux lines of the field threaded through it. There would be no ring current, but the superconducting ring molecules could never cut through the flux lines to escape. They would be permanently threaded on the lines of force like loose beads on a string.

The consequences would be fascinating. For a start, the benzene could not escape from the synthesis magnet even by evaporation. Each molecule could only move along the line of force which was threaded through it. The molecules would jostle endlessly back and forth between the magnetic poles like a sort of one-dimensional gas, and would be permanently trapped. They might even exert a considerable end pressure on the poles.

So Daedalus proposes a novel 'benzene cushion' hovercraft, whose downwardly directed magnetic field intersects the ground beneath it. *In situ* synthesized benzene vapour, trapped in the field and exerting its saturated vapour pressure of about 0.1 atmospheres, would float the craft above the ground, silently, continuously and without expenditure of energy. This wonderful vehicle, the ultimate in frictionless movement and suspension, would revolutionize transport — provided that smoking was strictly prohibited. A flame would burn the benzene to non-magnetic carbon dioxide, which would immediately escape around the edges of the craft and let it down with a bump.

Even more intriguing, suppose benzene was synthesized between the poles of an electromagnet, which was then switched off? The contracting lines of force could no longer close on themselves and vanish; they would have thousands of benzene molecules packed along them like beads on a circular elastic necklace. The result would be a novel 'poly-benzene' held together, not by chemical bonds, but by lines of magnetic force. It would be a sort of 'portable magnetic field'. Brought near a piece of iron, its flux lines would penetrate it to recreate a magnet with benzene-loaded lines of force again.

David Jones