Daedalus

Down-gazing Dome

London's Millennium Dome is the ultimate triumph of modern styling — all form and no content. Created by the public relations industry, which will say anything but believes nothing, it promises to be an expensive flop. So Daedalus has been thinking of uses for a segment of spherical surface 365 metres in diameter, poised over the surface of the Earth. He reckons it should be ideal for ground-penetrating radar.

This geological technique is widely used for short-range studies. But an accurately shaped downward-pointing aerial 100,000 square metres in area could extend it dramatically. Launching megawatt pulses in the 10-cm to 10-m waveband, it could plumb the geological depths in a way that only seismic shock can do at present.

The Dome will need some modification for the job. The junk that now clutters its interior will have to be removed, and its skin will have to be metallized to reflect and focus the signals. A pit at its central axis, 128 metres deep and 20 metres wide at the bottom, will reach its focal point and allow the focal transmitter-receiver a little sideways movement to steer the beam. The system could then launch accurately collimated radar pulses deep into the Earth, and detect and analyse their echoes.

Conventional seismology detects density or elasticity discontinuities. Dome radar will detect changes in conductance or dielectric character. It should be able to scrutinize the deep slow-flowing regions which generate the geomagnetic field. It might even detect fast transients on the movement, if not the main flow itself, by Doppler effects. By sweeping the beam around, and scanning the wavelength of transmission, the Dome could build up a wonderfully detailed spectrum and map of the Earth's core under London.

Daedalus reckons that the Dome should work as a passive receiver, too. The geomagnetic dynamo, especially if disturbed by seismic shocks, may generate overtones and harmonics which radiate upwards and could be focused and detected by the Dome as a high-gain aerial. And if the New Zealanders can be persuaded to build a duplicate Dome, it might even be possible to detect signals transmitted through the whole Earth, gathering information about its internal structure along a complete diameter. **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

Figure 1 Dorsal signalling in the vertebrate neural tube. **a**, Bone morphogenetic proteins (BMPs) derived from the epidermal ectoderm act on the neural plate to induce first neural crest and then roof plate. The roof plate in turn uses BMPs to signal to the neural ectoderm to induce dorsal types of interneurons (D1 to D3). **b**, Roof-plate ablation in *Gdf7*-DTA embryos results in absence of D1 and D2 neurons, and D3 interneurons expand dorsally³. BMP signalling from the epidermal ectoderm is not sufficient to induce these types of neurons. **c**, In *dreher* mutants there is also no roof plate, but only the specification of D1 interneurons is partially lost⁴. Neural crest derivatives are also affected. It is unknown whether roof-plate signals are lost completely in *dreher* mutants or whether there is a means of compensating for their loss in these mice. **n**, notochord.

How does specification of the roof plate itself relate to that of other dorsally derived structures, such as the neural crest and the rhombic lip (the source of the granule cells of the cerebellum)? The neural crest is normally determined before induction of the roof plate, during a narrow time window⁵. Lee *et al.*³ have shown that many neural-crest derivatives are generated in *Gdf7*-DTA embryos and that epidermal ectoderm maintains its ability to induce dorsal character even when the roof plate is defective. This implies that epidermal ectoderm can induce roof plate and other dorsal

phenotypes (neural crest⁶) through BMP signalling^{7,8,11}, but it does not normally induce differentiated neuronal phenotypes on its own — this job is reserved for the roof plate.

These studies imply that dorsal specification in the neural tube is achieved in two independent and sequential events (Fig. 1). BMP-mediated signals from the epidermal ectoderm to the neural plate induce a general dorsal character in the neural plate that would include first neural crest and then roof plate. In the second phase, the generation of different dorsal cell types would be under the specific influence of the roof plate and later the rhombic lip, independent of the epidermal ectoderm. BMPs act in both of these processes, but the question remains whether they are different mechanisms, or whether the roof plate acts as a relay centre to pass on the epidermal signal. Evidence that functions are divided between different genes, and are not part of a general combinatorial cascade, arises from the observation that only a specific subset of D1 interneurons are affected in the *Gdf7* mutant mice⁹. Finding out which individual BMPs, receptors and associated proteins do the job in each case will be of great interest.

Finally, what other dorsal and ventral signalling centres interact with the floor plate and roof plate? The fact that not all dorsal interneurons are affected by roof-plate ablation (the D3 interneurons are still present in *Gdf7*-DTA mice³) indicates that there must be additional inputs into dorsal patterning. We will have to wait for a compound *Gdf7*-DTA (or *dreher* null)/*Shh* mutant to see what happens in the absence of both dorsal and ventral organizers, if there is anything left at all.

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