Cell biology

Competitive edge

You might find it slightly unnerving that your cells sometimes compete fiercely with one another, but the process has been proposed to be a way in which organs control their size. Two groups have now taken a closer look at cell competition. Both describe what happens when levels of the growth-regulatory protein dMyc — the human counterpart of which is often hyperactive in cancer — are varied in developing fruitfly wings.

Laura A. Johnston and

colleagues (*Cell* **117**, 107–116; 2004) generated patches of cells that express high levels of dMyc, and found that these patches were much larger than controls, with bigger cells. Adjacent patches were smaller than usual, hinting that these cells were hampered by their faster-growing neighbours; in fact, the disadvantaged cells were killing themselves. This competition ensures that the excessive growth of cells with too much dMyc does not produce a bigger wing, as shown

here — a control wing (blue outline) is overlaid with one containing dMyc-overexpressing cells (orange).

Eduardo Moreno and Konrad Basler (*Cell* **117**, 117–129; 2004) came up with similar results. They suggest that excess dMyc prompts more protein synthesis and thus growth and proliferation, and that nearby cells — being smaller and less prolific — might be dying because they lose out in

the competition for external factors.

Whether cell competition controls organ size under normal circumstances remains to be seen. A further possibility — which prompted Moreno and Basler's study — is that a slight excess of growth regulator could result in adult cells ousting their normal neighbours and becoming cancerous.

Amanda Tromans

ago. It is not even known to what degree different reversals are similar to each other. On page 637 of this issue, Clement¹ sets out to improve on this state of affairs. He has extracted information on the structure and the duration of field transitions from several carefully chosen marine-sediment cores, and one finding in particular stands out: that the standard methods used to estimate the duration of a reversal produce different values, depending on the latitude of the site where the sediments were deposited.

The Earth's magnetic field is mostly generated by electric currents in the iron-rich liquid of the planet's outer core, at depths between 2,891 and 5,150 kilometres. A dynamo process converts the energy associated with fluid convection into magnetic-field energy. There are many models for the dynamo, including three-dimensional self-consistent models that exhibit magnetic-field reversals. But, because of computational difficulties, these models still use parameters that can be factors of a hundred or more different from those appropriate to the geodynamo problem². Consequently the model-builders look to palaeomagnetists to provide information on the properties of reversals that can be used to constrain the dynamo models — and to evaluate recent speculation that the Earth's field is at present in the initial stage of reversal³.

The sources of the magnetic field cannot be uniquely determined from measurements made at the Earth's surface. Instead, palaeomagnetists and geomagnetists often resort to a mathematical description of the magnetic field, known as spherical harmonics, that places all the field sources at the centre of the Earth. The most important component is the geocentric dipole, which can be mimicked by a bar magnet at the planetary centre. The extension of a line through the poles of this magnet intersects the surface of the Earth at two points, the north and south geomagnetic poles. If the Earth's magnetic field were a

pure dipolar field, the path of the north geomagnetic pole during a transition and the duration of the transition would be independent of the location of the site from which the data are taken.

Estimates based on this dipole-field assumption indicate that the field intensity decreases during a transition to a mean low value of about 25% of its usual value and that the duration of a transition is about 1,000 to 10,000 years⁴. Inconsistencies in these estimates have been attributed to a host of factors, including experimental and computational errors and the inadequacy of the dipole-field assumption. In fact, the present magnetic field can be divided into dipole and non-dipole parts, and it is expected that this is typical of fields in the past. A non-dipole field is characterized by a 'degree two', or higher, spherical harmonic, which in simple terms means that the non-dipole field has more than two locations where it is vertical at the surface. The total field at any location, at any time, is the vector sum of the dipole and non-dipole field.

For his analysis, Clement¹ has used drilled cores of marine sediment, carefully selected to contain magnetic minerals that would have accurately recorded reversals as the sediments formed into rock at the bottom of the oceans. The data from these cores indicate that the duration of the transition of the last reversal, 790,000 years ago, was about 2,000 years at the Equator, but about 10,000 years at mid-latitude (see Fig. 2 on page 637). It would be surprising if errors produced such a large systematic change, so Clement attributes this variation to the presence of a non-dipole field. Interestingly, Clement's data for three other reversals, although limited, suggest the same latitudinal variation. There might indeed be some common behaviour for the reversals that have occurred during the past few million years.

Clement¹ also presents simple reversal models in which a dipole, aligned with the

rotation axis, decays to zero and then builds up in the opposite direction, in the presence of a constant non-dipole field that is also aligned with the Earth's rotation axis. He argues that the model most compatible with the data has a constant, axial, octupole field — a degree-3, non-dipole field that is anti-symmetric about the Equator. This is somewhat unexpected, because other data and theory suggest that, in the middle of a transition, the field should mostly be symmetric about the Equator^{5,6}. However, as Clement's data come from discrete sites, his fit to the data cannot point to a unique model.

Moreover, this problem of uniqueness is exacerbated by the likelihood that the non-dipole field is also time dependent. Observational data and theory suggest that, usually, higher-degree fields (such as octupole fields) change faster than lower-degree ones (such as dipole fields)⁷. In addition, there are strong indications from dynamo theory that if the axial dipole field changes, so must the axial octupole field^{8,9}. So Clement's preferred model is not a unique solution, and it is also probably not physically realistic. But the work is an important contribution to our understanding of magnetic-field reversals on our planet, and it is unlikely to be the last paper on this subject to appear in the pages of *Nature*. ■

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