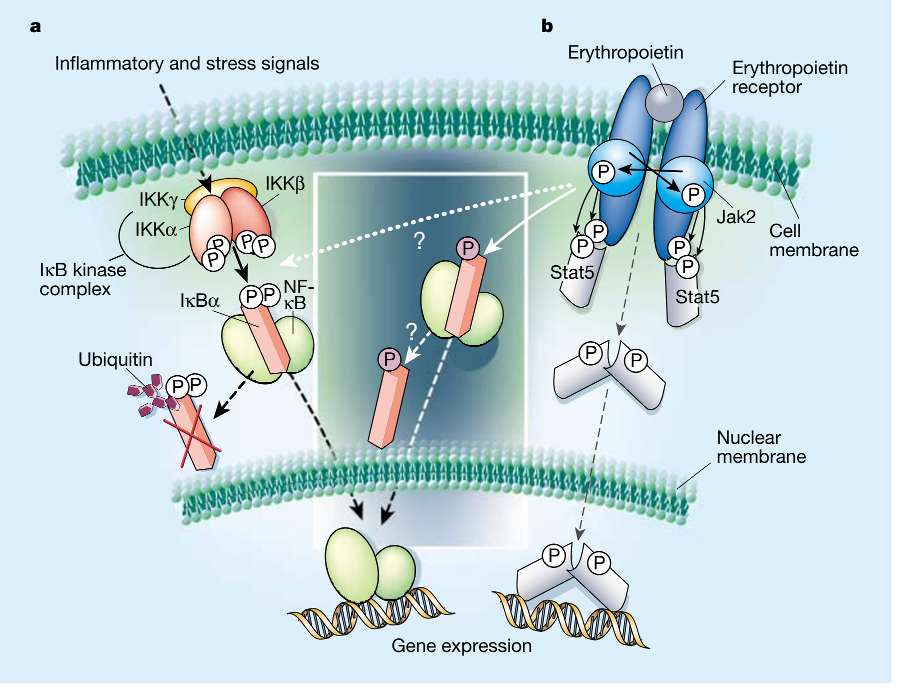

Figure 1 **Crosstalk between two seemingly disparate signalling pathways.** a, **The classical NF-κB pathway, induced by stress or inflammation. This pathway involves the activation of the IκB kinase complex, the phosphorylation (circled 'P') of IκB on serine residues, its labelling with a small protein (ubiquitin) and degradation, and the release of NF-κB, which moves to the nucleus.** b, **The classical pathway that is induced by the growth factor erythropoietin in non-neuronal cells. On binding of erthyropoietin to its receptor, the enzyme Jak2 activates itself by phosphorylation. It also phosphorylates the receptor, which recruits the transcription factor Stat5. After Stat5 is also phosphorylated by Jak2, it dimerizes and moves to the nucleus. Centre, the crosstalk between these two pathways that might occur in neurons[1]. This crosstalk might involve the typical activation of IκB kinases, as well as the atypical phosphorylation of IκBα on a tyrosine residue. Dotted arrows indicate events that are not understood in detail; dashed arrows indicate multistep processes.**

Enzymes of the Jak family, on the other hand, are associated with, and mediate signalling from, several receptors involved in the regulation of growth, differentiation and immune functions. When the Jak proteins activate themselves, their next substrates are the associated receptors, which, when phosphorylated, can recruit transcription factors from the STAT family. These in turn become the final substrates of the Jaks (Fig. 1b). Although NF-κB and STATs (or the products of their gene targets) may collaborate or antagonize each other in gene-specific contexts, the upstream signalling pathways have not previously been shown to communicate — but they are now connected in erythropoietin-stimulated neurons[1] (Fig. 1, centre).

It is not clear why erythropoietin should have this effect only on neuronal cells. Maybe there are neuron-specific linking proteins that allow Jak2 to activate the IκB kinases and to phosphorylate IκBα. Further questions include whether other growth factors or hormones that signal through Jak2 can also activate NF-κB, and whether Stat5 (the better-known target of Jak2) collaborates with NF-κB to protect neurons. Finally, it might seem difficult to reconcile these results with the fact that the short-lived activation of NF-κB has actually been associated with neuronal apoptosis[4]. But what may distinguish this situation from the anti-apoptotic effects described here is that the activation of NF-κB is sustained after preconditioning with erythropoietin[1].

If the proposed communication between the two pathways is confirmed, and the intermediate molecular events by which Jak2 activates NF-κB in neurons are worked out, this system might provide a model for how otherwise separate signalling systems can be linked in a potentially cell- and signal-specific manner. We might anticipate the discovery of cell-specific proteins that link Jak2 with its targets. We might also envisage similar scenarios for other, normally unrelated signalling pathways. Such combinatorial diversity would engender specific cells with great flexibility and unexpected biological responses. It would also pose untold challenges for cell biologists. ■

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Daedalus

Encapsulated gas

Daedalus once invented a 'fractal' concrete. Ordinary concrete contains gravel, the interstices of which are filled with sand, the interstices of which contain reactive cement suspension. Daedalus' concrete had big spaces filled with big particles, the gaps between them filled by smaller ones, the gaps between those filled by smaller ones still, and so on…. The tiny, densely reticulated network left for binding cement could contain high-performance polymer.

Suppose the nested particles were replaced by air bubbles. With each designed to fit neatly in the gaps left by the next larger size, the result would be an immensely complicated foam, nearly all air (or whatever gas was used to blow it). It would be enormously strong for its weight. Evaporation would be poor as a setting reaction. The solvent would take ages to escape through the many almost monomolecular layers, and might take the gas with it. Polymerization would be better; carbonization might be better still. So DREADCO chemists are at work.

With a liquid monomer such as a superglue or a substituted acrylate, the result should be a wonderfully light, translucent foam. Blown with hydrogen or helium, it might be lighter than air, a building-block for Zeppelins. Blown with air, it would rival the aerogels as a thermally insulating filling for two-wall skylights. Indeed, if the bubble-size could be kept away from a wavelength of light, it might even be transparent. As a paint, it should be a wonderful absorber of sound. Weak sounds would be almost completely absorbed by 'pumping' the small bubbles flat at each cycle. Strong sounds should suffer little loss. Thus in a church, ringing calls to repent should survive unattenuated, while the small random noises of the congregation itself would be lost.

The biggest challenge, of course, is carbonization. Battery-makers long for a way of storing hydrogen, possibly under the inherent pressure of its monolayer on benzenoid carbon, using nanotubes or their derivatives. The DREADCO team reckon that a carbonized foam, taken to almost atomic dimensions, should be able to store vast amounts of hydrogen, and deliver power electrolytically via a carbon electrode. It could then be recharged with hydrogen again. With luck both small-scale applications such as mobile phones, and even big ones such as hydrogen-powered cars, could use the new electrode. David Jones