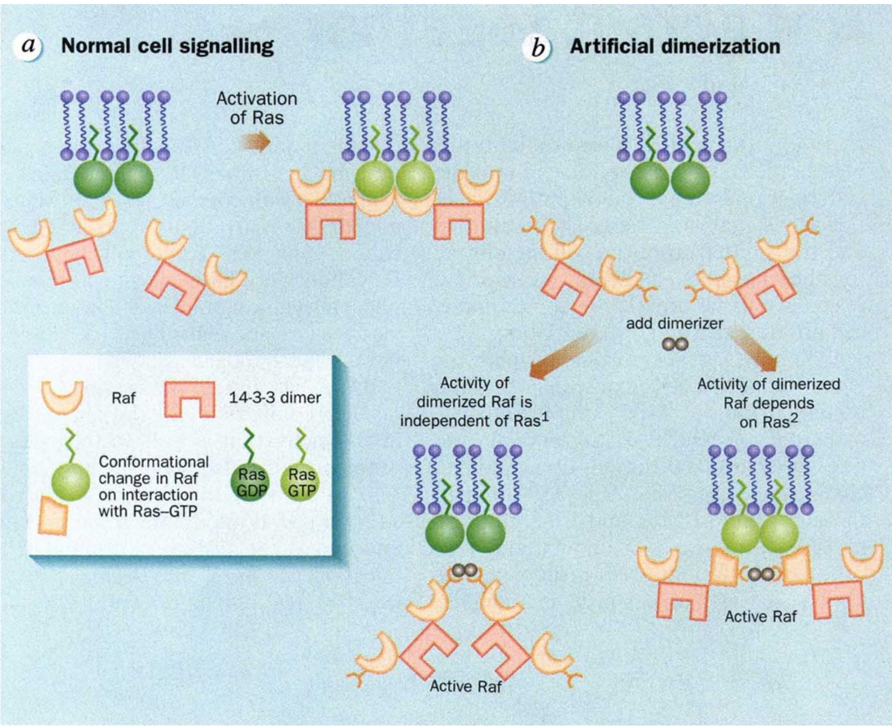

FIG. 2 *a*, Normal cell signalling. Activation of Ras to the GTP-bound form could stimulate Raf dimerization/oligomerization by concentrating Raf at the plasma membrane. *b*, Artificial dimerization. Does dimerized/oligomerized Raf still require interaction with Ras for activity? Farrar *et al.*[1] show that activation of dimerized Raf no longer requires interaction with Ras, whereas Luo *et al.*[2] demonstrate that dimerized Raf still requires interaction with Ras for activity. Raf is shown complexed to 14-3-3 dimers, and interaction with Ras–GTP is shown as inducing a conformational change in Raf.

oligomerization does not require tyrosine phosphorylation of Raf-1, suggesting that this is a separate mechanism of activation.

An attractive way in which oligomerization could lead to activation is through increased autophosphorylation resulting from transphosphorylation between oligomerized Raf proteins. This would provide a striking parallel with the mechanism by which receptor-tyrosine-kinase signalling occurs following growth-factor-induced receptor dimerization (see ref. 11 for a review).

The Ras–Raf interaction is critical for growth-factor-induced Raf-1 activation, so is Ras still required when Raf-1 is activated by artificial oligomerization? Here there is an interesting discrepancy between the two papers. Both groups use Raf-1 mutants that disrupt the Ras–Raf interaction, but whereas Farrar *et al.* find that the constructs that fail to interact with Ras can still be activated by chemically induced dimerization, Luo *et al.* find that their mutants do not. Even though each group has used different Raf-1 mutants, the reason for this difference is not at all clear, and this leads to alternative interpretations of the data.

Both sets of results are consistent with the idea that Ras recruits Raf to the plasma membrane, where the increased concentration of Raf at a two-dimensional surface would lead to oligomerization (see Fig. 2). However, whereas the results of Farrar *et al.* indicate that this is all that Ras does, Luo *et al.* find that dimerization itself is insufficient to activate Raf-1; the interaction with Ras–GTP is still required — perhaps to induce a conformational change in Raf-1.

These two papers clearly demonstrate that oligomerization can lead to activation of Raf-1. But do growth factors or oncogenic Ras activate Raf-1 through this route? It has yet to be shown that growth-factor stimulation of cells leads to increased oligomerization of Raf. Nonetheless, we now have a provocative hypothesis for Raf activation that will stimulate much further work. □

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DAEDALUS

The wired wood

SOLAR energy is hard to trap economically. Thermal systems and photocells are vastly expensive, and are useless at night. Green plants are the supreme trappers of solar energy, yet growing and burning them is primitive, inefficient and labour-intensive. Daedalus now hopes to intercept their energy more directly.

The primary stable product of photosynthesis is, of course, glucose. Ideal for plant metabolism, it is an awkward industrial fuel. But recent research has found that it can be enzymatically converted to gluconic acid and hydrogen — and hydrogen is the perfect fuel, especially for electrical fuel cells. So DREADCO biochemists are seeking to intercept plant glucose, and react it to hydrogen. They are inserting pipes into maple trees to extract the maple syrup, hydrolyse it to glucose, and react it enzymatically to gluconic acid and hydrogen. The hydrogen is bled off to a fuel cell; the gluconic acid and the non-glucose components of the sap are pumped back into the tree. The internal circulation of the sap should convey the gluconic acid to the leaves, where, with good fortune, their reductive photochemistry will intercept it, and reduce it to glucose again.

Much development will be needed to perfect the system. But the final result will be an 'electric tree', most of whose captured solar energy will appear as electricity. Nature will do all the hard work, and a buffer stock of glucose or hydrogen will keep the power flowing, even during the night. A tree subverted in this way would no longer grow, but it should still last for many decades. Whole forests of maple or other trees could be wired in this way. The small reactor and fuel cell unit hidden among the branches of each tree, and the wires looping from it, would be quite inconspicuous. Eco-freaks and landscape lovers would applaud the megawatts of natural, organic electricity flowing from apparently untouched woodland.

A tree should not be drained of all its solar power. It should be left with enough metabolic energy to grow new leaves in the spring, and to repair damage and insect attack. Daedalus even has plans to feed a bit of electricity back into the tree. His electro-osmotic scheme of last week used an electric potential to accelerate the flow of sap, especially in poor or salty soil, where roots find it hard to absorb water. His new electric trees could easily be fitted with the appropriate electrodes, and could generate their own potential. They could then flourish on useless salt marsh or contaminated land, reclaiming it as lush and verdant electric forest.

David Jones