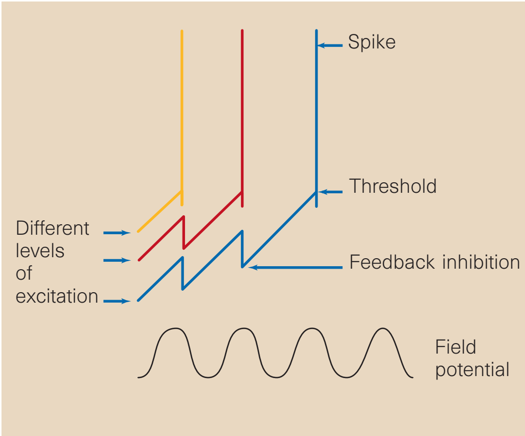

Figure 2 **Mechanism by which a negative-feedback version of 40-Hz oscillation could serially activate memories in sequential 40-Hz cycles. Each trace represents the membrane potential in a cell that encodes a given memory. After the most excited cell fires, it causes feedback inhibition (down phase of intracellular 40 Hz) and cannot be excited again (trace no longer shown). As the inhibition wears off, the next most excited cell reaches threshold. A memory is represented by a group of neurons whose synchronized firing generates the field potential.**

occurs in successive 40-Hz cycles[11]. These results, and related studies[12] in invertebrates, indicate that 40-Hz oscillations separate different units of information and organize the serial activation of these units.

Although such serial activation brings to mind the operation of a digital computer, simple models have been developed for how this could be done by neural networks. The models are based on the 'winner-take-all' process[13] that is implicit[10] in the negative-feedback model of 40-Hz generation[3]. Memories are assumed to have different levels of excitatory drive — the problem is how to get them to fire in separate 40-Hz cycles, and Fig. 2 shows how this could be achieved. During the inhibitory phase of oscillations, all neurons are shut off. After inhibition partially decays, the most excitable group (the 'winner') reaches threshold first, inhibits all of the others by feedback inhibition and then inactivates itself (owing to a hyperpolarizing after-potential, for instance). On the next cycle, the next most excitable group will fire and, in this way, memories can be serially read out.

Inhibition is vital for all models of 40-Hz oscillation, but it is unlikely that inhibition can account for the much faster 200-Hz oscillations[5,14]. These oscillations occur during sharp waves[15] — events that may be an ultra-fast form of memory recall, important for transferring information from the hippocampus to the cortex. Draguhn *et al.*[2] provide the first information about the mechanism of 200-Hz oscillations, concluding that synchronization is due to gap junctions between nearby axons. This makes sense because the direct flow of current between cells that occurs at gap junctions is much faster than chemical synaptic transmission, so it is appropriate for rapid synchronization. What remains unclear is the function of this synchronization. Without it, two cells firing at 200 Hz would differ in firing time by no more than 2–3 milliseconds. Downstream neurons are not thought to be affected by jitter this small, but perhaps this assumption is wrong. What is clear is that this and other questions about brain oscillations can now be approached using brain slices, a development that will help us to understand what makes the brain tick. □

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Retraction

I wish to point out that I no longer stand by the views reported in my News and Views article "Immunology: Ways around rejection" (*Nature* **377,** 576–577; 1995), which dealt with a paper in the same issue ("A role for CD95 ligand in preventing graft rejection" by D. Bellgrau *et al.* – *Nature* **377,** 630–635; 1995). My colleagues and I have been unable to reproduce some of the results of Bellgrau *et al.*, as reported by J. Allison *et al.* (*Proc. Natl Acad. Sci. USA* **94,** 3943–3947; 1997). □

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D. Bellgrau *et al.* (e-mail: don.bellgrau@uchsc.edu) consider that their results are reproducible and stand by them. They note, however, that the magnification in Figure 1*g* of their paper should be 113 times, not 45 times as printed. Both groups believe that other published data support their views, and interested readers can contact them directly for further details. – Editor, *Nature.*

Daedalus

Corrugated carbon

Last week Daedalus was devising a method of making carbon nanotubes to order, by the electrolytic deposition of C_2 radicals. His subtle catalytic anode had circular reaction sites as templates, to assemble the radicals into nanotubes. These would grow out from the anode as a close-packed 'fur' of parallel nanotubes, which could be stripped off and made into threads and fabrics like any other staple fibre.

He is now generalizing the idea. Already carbon membrane structures can be fabricated by deposition on an alumina template; an anodic template could do so far more controllably. It would assemble whatever carbon structure was defined by the pattern of catalytic sites laid down on it. In particular, if it bore a hexagonal lattice of such sites, it could assemble a carbon honeycomb. Imagine, says Daedalus, a plane hexagonal lattice 'ground plan'; and imagine each line on this lattice extruding a graphite monolayer sheet upwards out of the plane. Each sheet will touch two others at 120°. If the carbon atoms forming the junctions are bonded together by the tetrahedral sigma bonds found in diamond, the result will be carbon honeycomb — a giant polymeric generalization of the triptycene molecule.

The holes running through a block of carbon honeycomb will have the size defined by the hexagonal catalytic pattern laid down on the anode that forms it. Even the best modern microfabrication methods would produce a catalytic array very coarse on the molecular scale. Finer arrays might be made by cunning surface-crystallization methods, or painstaking assembly by atomic-force microscope. They might even be given two different pore sizes, alternating across the lattice.

So carbon honeycomb could be given a wide range of useful properties. With the finest pores, it would be structurally superb: combining the stiffness of diamond with the oriented strength and toughness of carbon fibre. Larger pores would allow ions and molecules to traverse them, giving novel one-dimensional ionic conductors for batteries, shape-selective catalysts, and molecular sieves and absorbents of vast capacity. The coarser grades would be increasingly tenuous but still very strong, a sort of oriented carbon aerogel. They would be ideal for the insulating interior of laminated panelling and light-weight aerospace components. Filled with epoxy or polyester 'honey' and set solid, they would give an outstanding reinforced composite.

David Jones