Earth science

Heated exchange on the coast

Geology **33,** 245–248 (2005)

Volcanologists are continuing to dig into the consequences of eruptions of the Soufrière Hills volcano, Montserrat, in the Caribbean. The volcano began to erupt in 1995, but an especially severe episode occurred on 13 July 2003. Marie Edmonds and Richard A. Herd have examined deposits to the northeast of the volcano, and conclude that the devastation there was the result of the explosive combination of sea water and pyroclastic flows from the volcano.

Pyroclastic flows are among the deadliest results of a volcanic eruption. They are intensely hot mixtures of gas, ash and rocks, which travel downslope at great speed. On reaching the coast, the flow of 13 July continued underwater and generated a tsunami. But Edmonds and Herd believe that the interaction with sea water also produced a reverse, inflated pyroclastic surge, which flowed along the coast and inland. They estimate that it caused destruction at least 25 m above the ground, reaching 4 km inland and 300 m above sea level.

Such 'coastal explosions' can be simulated experimentally. But, given that coastlines are especially prone to erosion, they are comparatively rare in the geological record. **Tim Lincoln**

IMAGE UNAVAILABLE FOR COPYRIGHT REASONS

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15 July 2003: the Soufrière Hills volcano still steams after the violent activity two days previously.

Pharmacology

Antidepressant action

Neuron **46,** 65–74 (2005)

Antidepressants such as Prozac are thought to work by interfering with the conversation between neurons that transmit the neurotransmitter serotonin and those that receive it. Fu-Ming Zhou *et al.* suggest that such drugs also have an effect on dopamine-producing cells.

Neurons generally use chemical neurotransmitters to talk to each other, the neurotransmitters then being taken back up into the transmitting cell. In the striatum of the mammalian brain — a region involved in processes including motor coordination and cognition — 'dopaminergic' nerve terminals, which release dopamine, are common, and serotonin-releasing terminals are more modestly represented. Generally, these nerve terminals take up only the particular neurotransmitter that they make.

But Zhou *et al.* find that increasing the serotonin levels in mouse striatal slices leads to serotonin uptake into dopaminergic cells. The authors further show that the dopaminergic cells then release both dopamine and serotonin. Moreover, applying fluoxetine (Prozac) — which inhibits serotonin uptake by serotonin-releasing cells — seems to have similar effects. If borne out, the results imply that such antidepressants may work in part by altering the balance of dopamine and serotonin release. **Amanda Tromans**

Quantum dynamics

Reverse for simulation

Phys. Rev. Lett. **94,** 130401 (2005)

It may be possible to turn back time, at least in quantum-dynamical simulations of many-body systems. That's the conclusion of Mark Dowling and colleagues, who have studied the evolution of an ultracold Bose–Einstein condensate of atoms.

They used a fundamental property of the hamiltonian, the quantum-mechanical 'operator' that determines the energy states of a system. Evolution backwards in time under one hamiltonian is equivalent to evolution forwards under the same hamiltonian with the opposite sign. Changing the sign of the hamiltonian halfway through a simulation is therefore equivalent to reversing the direction of time.

Doing just this and seeing whether the initial conditions are regained is an effective check of the accuracy of a simulation, the authors suggest. Such checks are essential, but taxing — the complexity of many-body systems scales exponentially with the number of bodies involved, and small changes in initial conditions can produce large variations in outcome.

Dowling *et al.* tested their method on a system modelling a Bose–Einstein condensate with Avogadro's number (6.02×10^{23}) of atoms. The final state of their simulation accurately reproduced the initial state. The authors note that their condensate simulation could be realized experimentally, and their method used to check similar quantum-dynamical calculations with applications not just in condensed-matter physics, but also in biology and astrophysics. **Richard Webb**

Solid-state optics

Good vibrations

Appl. Phys. Lett. **86,** 154107 (2005)

To cool a block of material, you have to take heat out of it. There are various ways to do this. Shining laser light onto the material is one of the less intuitive methods — you might expect the material to heat up rather than cool down.

But certain solids respond to laser illumination by emitting light themselves. In most such luminescent systems, there is less power in the emitted light than in the incident light; in some, however — such as glasses doped with special absorbing ions similar to those used for optical fibres — the emitted light can gain energy from thermal vibrations in the solid, and so can be more energetic than the absorbed light. If non-radiative losses are kept low, the material, when illuminated, cools down.

J. Thiede *et al.* have now used this technique to cool a piece of glass fibre down to −65 °C, comfortably beating the previous lowest temperature achieved for a solid using this method, −37 °C. Optical refrigerators based on this technology could be of great practical importance owing to their compact dimensions and the absence of vibrations associated with moving parts, the authors say. **Andreas Trabesinger**