

Andreas, is strong, with a friction coefficient of at least 0.6 and normal pore pressure⁷. The observations of Chester *et al.* can explain this, because they show that the weakening results only from the presence of a well-developed fault core, which is itself the product of large fault displacement.

Hydrofracture constraint

There is, however, one major problem that remains to be resolved. It is thought that a brittle material can never resist a

with the fault without hydrofracturing occurring is 60°. Data on stresses in California are ambiguous on this point, suggesting that the maximum compression lies between 60° and 80° from the San Andreas fault^{1,8}. The lower end of this range is compatible with the hydrofracture constraint, but the upper end is not, even in the framework of Sleep and Blanpied's model. The problem is that it is not clear if the lower end will also be compatible with the degree of weakening implied by the heat-flow constraint.

IMAGE UNAVAILABLE FOR COPYRIGHT REASONS

Banning Fault, on the San Andreas fault system in southern California. The fault acts as a barrier to moisture, so that water running off the highlands in the background is trapped, producing a characteristic line of vegetation. (M. Rymer, US Geological Survey, Menlo Park.)

pore pressure in excess of the least compressive stress without drainage occurring by hydrofracturing. This limits the extent of weakening by the raising of pore pressure. Sleep and Blanpied, and Chester *et al.*, are each aware of this constraint, and argue that hydrofracturing will be suppressed by increased mean stress in the core of the fault, owing to its strength contrast with the surrounding rock.

But this misses the point: the problem still exists at the seal at the fault core/country rock interface. In the models, this seal is assumed to be impermeable, but is also tacitly assumed to be impenetrable to hydrofracturing. I cannot think of a plausible material with this property. For example, in the experiment of Blanpied *et al.*, the seal was country rock with pores cemented with deposited material. I imagine this material would still hydrofracture, but in their experiments they did not reach this condition and so did not test this possibility.

For an active strike-slip fault with friction coefficient 0.5, say, it can be readily shown that the largest angle the maximum compressive stress can make

These remarks also apply to the case of low-angle detachment faults in extensional regions, which have also recently been argued to be active as a result of high pore pressure⁹. There the hydrofracture constraint is far more severe, because for such faults to be active in the brittle field means that pore pressure must approach the vertical stress, which in this case is the maximum principal compression. □

Christopher H. Scholz is at the Lamont-Doherty Geological Observatory, Columbia University, Palisades, New York 10964, USA.

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Past fears

HALLUCINATIONS, says Daedalus, usually draw on the senses. Some do so directly, like faces seen in the fire, or (more extreme) the rococo sense-fantasies generated by LSD. Others use stored sense data, such as illusions of absent friends or dead relatives. But one form of hallucination seems independent of the senses: that ghastly withdrawal symptom of alcohol addiction, delirium tremens. The sufferer typically sees small, horrible creatures — snakes, spiders, toads or insects — attacking or crawling over him.

This syndrome raises obvious questions. Could an alcoholic who had never seen a snake, a spider or any such small creature, suffer from delirium tremens? If so, where would he get his mental images of them? Daedalus points out that many people are deeply and irrationally frightened of snakes and spiders. He reckons that we carry instinctive mental images of these creatures, implanted genetically at a time when our savage ancestors found them really dangerous. Delirium tremens activates these inherited images and the fear that goes with them.

So DREADCO clinicians are visiting alcohol detoxification centres worldwide, especially in regions free of creatures typical of the syndrome. (Ireland, for example, has a flourishing alcohol culture but no snakes.) They are giving each centre a special DREADCO computerized video system. It is a sort of real-time photofit display, encoding the visual elements of a wide range of possible and impossible small animals and insects. The user can construct and refine any animal image simply by manipulating a pair of joysticks. Only a very strong-minded alcoholic could work the display during an attack of delirium tremens, so as to describe the creatures that were tormenting him. But Daedalus hopes that many will be able to use it later, to reconstruct the creatures of their recent ordeal. Statistical averaging of many such images should reveal the form of the species that so terrified our savage ancestors.

Our distant origins will thus be clarified. If the images turn out to be those of species that flourished a few million years ago in, say, Africa, then an African genesis will be indicated for mankind. If the creatures are Asian, or Australian, or even Irish, the theorists will have to think again.

This subtle argument can be extended. The widespread dream of flying, for example, may be a genetic memory of swimming or floating, thus supporting the theory that we evolved from some water-dwelling primate. More controversially, it may link us to the pterodactyls.

David Jones