occurring in the borderland should have a substantial component of convergence perpendicular to the San Andreas fault. In the south, a shear zone passes between the coast and Channel Islands, whereas further north, localized convergence occurs across the Los Angeles basin, the Santa Barbara Channel and Ventura basins and the Santa Maria basin, as well as thrust-sheet systems that abut the San Andreas fault. Between these basins, it has been suggested that rotating crustal blocks accommodate the shear strain⁴.

Ambiguity

At the meeting, a series of talks showed that significant shear strain is observed between islands of the California borderland, and rapid shortening occurs across basins within the borderland. Ambiguity that caused controversy over plate boundary slip distribution during the early 1980s has now been almost completely resolved. Although there are important details to be worked out, the main quandaries that formerly surrounded the San Andreas discrepancy have been resolved, most of them by geodetic studies.

Challenges remain, of course. Searches with continuously recording GPS receivers for possible temporal variation in strain might explain, for example, observed fluctuations in the seismicity rate. And the details of deformation along the plate boundary with denser networks of GPS receivers could reveal transitions in strain as the plate-bounding fault system widens, narrows and bends between the Gulf of California and Cape Mendocino. Can the geological evolution of this plate boundary be understood well enough to give us a full picture of why the distributed plate boundary appears as it does today? Can we use the surficial data to constrain patterns of deformation in the mid- and lower crust, and clarify our vision of how the plate boundary looks at depth? How might this plate boundary become reorganized in the future?

It also remains to use southern California as a testing ground to address some general problems in continental tectonics and earthquake mechanics. Palaeomagnetic data suggest that block rotation played a large part in early structuring of the plate boundary, particularly in the Transverse Ranges and Mojave Desert. It will be interesting to see whether present-day rotations of rigid crustal blocks can be distinguished from simple shear across the zone. It has been proposed that convergence across the San Andreas fault is partitioned, occurring as slip on orthogonal detachment and thrust faults instead of oblique slip on the San Andreas. Geodesy might throw light on this fundamental process.

With the known geometry of secondary faults, it is clear that slip on these secondary structures must influence the San Andreas fault. Geodetic studies should help model such fault interactions and elucidate how earthquake recurrence is modulated on the San Andreas fault. How does an elastic response of the crust at the low strain rates observed geodetically enter into these observations, and are elastic models inadequate to explain the data?

GPS should also help reveal significant movement on deep structures, for instance on blind thrust faults in the Los Angeles region, where it is being used to identify which portions of these faults are accumulating strain that could be released in earthquakes. This work will lead to better estimates of earthquake hazard, and will help to quantify the mechanics of large thrust sheets abutting strike-slip faults, so improving our models of the earthquake cycle, and our attempts at long- and intermediate-term earthquake forecasting.

Speed

The quicker seismologists can learn about movement before, during and after earthquakes, and of aseismic slip events, the better. At present, it takes days to analyse GPS data. With more dense GPS networks, continuous monitoring and automated analysis, it should be possible to reduce the delay to hours. Geodesists could then match the rapid response of seismologists to earthquakes. It might also be possible to recognize precursory changes to warn of impending earthquakes. Measurements of coseismic movement could help disaster relief workers identify where they are needed most, for example in finding where tilting and disruption might affect water supplies.

Unfortunately, the conflicting military interest of the US Department of Defense, which runs the GPS satellites, could deprive earth scientists of the system's greatest advantages. Planned restriction of real-time access to part of the GPS signals could hinder moves towards automated data processing. How this political dispute between civilian and military interests is resolved will be of great interest to those living in earthquake zones. □

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Born again babies

ALONE among mammals, human beings are born with great difficulty and danger. It's all the fault of the baby's big head. In evolutionary terms, a big-headed, big-brained baby is so valuable that it is well worth facing certain pain and possible death to bear it. Even so, Daedalus plans to reduce the risks.

He recalls the technique of giving birth to a baby under water. This is said to be more relaxing for the mother. The baby doesn't drown because it is still being nourished from the placenta and need not begin breathing until the umbilical cord is cut. It may not even realize that it has left the womb. Daedalus is now taking this idea to extremes. He is designing a sort of external auxiliary womb, a water-filled tank that can be attached to the mother-to-be by a short flexible pipe. At a stage when the baby's head is still small enough not to pose serious risks, birth can be induced by the usual drugs. The baby emerges into the tank, still attached to the mother, and can stay and grow there until it is ready to be 'born again' into the atmosphere.

An external womb will obviously be massively inconvenient. Even if supported on wheels it will severely limit the mother's mobility. The problems of maintaining sterility and hermetic sealing will complicate matters further. It may be best to design the whole thing as a sort of high-tech child bed in which the mother can lie and be looked after, for however many weeks it takes for the child to develop fully.

The benefits, however, will also be great. Slim-hipped mothers may well prefer a month or two in bed to the threat of caesarian section, while those at risk of premature birth could turn events to their own advantage. The baby could be inspected through a transparent panel, and minor damage from the birth process could be corrected via a glove insert. The mother could also touch and caress the baby; if the two could also look at each other they might become emotionally bonded even before final delivery.

Daedalus also comments that the normal nine-month pregnancy must be an evolutionary compromise between the interests of the mother and those of the baby. His artificial womb could relax this compromise, and allow a pregnancy of ten months or even longer: as long, in fact, as the placenta could deliver adequate nourishment. Finally, a far bigger and better-prepared child would emerge into the world. Unlike the rest of us, it should be free of the 'birth trauma' which, according to some psychologists, lurks worryingly in the normal human subconscious. Or it could have two of them.

DAVID JONES