125; 1975) have also demonstrated the existence of splitting beneath Japan. In each case the earthquakes in the upper arm of the split indicate down-dip compression whereas those in the lower arm show down-dip tension.

But is such splitting typical or atypical of Benioff zones? And either way, what causes splitting and the associated difference in focal mechanism? The answer to the second question may well suggest an answer to the first. One possible explanation is that the two arms of seismicity represent two closely associated, but distinct, descending slabs. But although this possibility is not inconsistent with the Adak splitting, it cannot, according to Engdahl and Scholz, account for the Japanese and Kurile examples; nor can it explain the difference in focal mechanisms in any of the three cases. Then it is possible, as suggested by Veith, that splitting is related to the olivine-spinel phase transition, although Engdahl and Scholz make no comment at all on that.

What they do, however, is to propose, following Isacks and Barazangi (in *Island Arcs, Deep Sea Trenches, and Back-Arc Basins*, edit. by Talwani M. & Pitman W. C., American Geophysical Union, 1977), that splitting is due to deformation of the lithosphere during subduction, and to follow up the proposal by constructing a model which seems to account for the observation. The basis of the model is the fact that subducting lithosphere bends at shallow depths but straightens out again as it moves at an angle towards the mantle. Whatever the cause of these changes, the 'unbending' must produce stresses in the descending slab; and Engdahl and Scholz are able to show with little difficulty that, at the observed depths of splitting, an 80-km thick lithosphere has a 22 km thick elastic core with down-dip compression on its upper surface and down-dip tension on its lower surface.

Thus the double zone of seismicity can be explained simply as the result of the release of unbending stresses above and below an elastic core within the lithospheric plate. Moreover, as the plate descends into hotter and hotter regions the elastic core will get thinner and ultimately disappear altogether, which explains why splitting occurs only over a limited depth range below the initial bending of the lithosphere and does not persist to all depths. Since unbending must occur in most, if not all, descending plates, it follows that splitting must be typical of Benioff zones. Failure to observe it in any given case presumably therefore reflects only insufficiently detailed observation and analysis of earthquake foci. □

Jeffreys Lecturer links Sun and weather

from John Gribbin

In this year's Harold Jeffreys Lecture of the Royal Astronomical Society, presented on November 11, J. W. King of the Appleton Laboratory reported the latest work of his team on 'The Influence of Solar Phenomena on Weather and Climate.' Over the past few years, King and his colleagues have received a rough ride from some quarters for their failure to explain the physical basis of the links they have found between Sun and weather; commenting here that the situation is no different from that in climatology, where we know the Earth's climate does change without being able to say exactly why it changes, King went on to present convincing evidence of the reality of the link on timescales down to days, and threw out the challenge to both solar physicists and meteorologists to join the Appleton team in investigating these phenomena further.

To most of the audience, and most readers of *Nature*, the debate about solar influences on weather over the sunspot cycle and longer periods must already be familiar. But the new work from the Appleton Laboratory concentrates instead on much shorter term influences, associated with the roughly 27.5 d rotation period of the Sun. The 'signature' of this rotation shows up clearly in such meteorological parameters as the height of the 500 mbar pressure level in the atmosphere, as well as influencing ionospheric properties. In some danger of numbing his audience with overkill at times, King hammered home the reality of these links with a wealth of data, the most intriguing of which showed clear geographical variations of the magnitude and even sign of the atmospheric changes produced by the Sun. Small wonder, then, that global averages over long periods show much less indication of any solar influence on weather!

The solar influences are particularly strong in a region above the Atlantic just west of the British Isles, which makes this link between Sun and weather especially important for residents of those islands. And if these small variations over the solar rotation cycle can affect weather parameters, then it comes as no surprise to find specific larger events on the Sun—flares and so on—producing specific larger disturbances of the Earth's atmospheric systems.

Such a link has, in fact, been known for some 30 years, since the pioneering work of Duell and Duell (*Smithsonian Misc. Coll.* **110**, 8; 1948) but has only relatively recently become firmly established (see, for example, Olson *Nature* **257**, 113; 1975). The Appleton team have now found that not only does a solar flare produce a disturbance of the atmosphere, commencing some four days after the flare, as shown by the work of Olson and others, but that the atmospheric disturbance is repeated at 32 and 60 days as well, one and two solar rotations later. In at least one case, an effect on the atmosphere is also found at −24 d, that is one solar rotation before the flare became apparent. So a specific region of the Sun which is involved in some disturbance can affect specific regions of the Earth's atmosphere over a period of 2–3 months—and, equally, the effects of solar activity which are disturbing the atmosphere today must be the integrated effects of several such past disturbances, which suggests that we should not find any simple relation between what the Sun is doing today and what the atmosphere does tomorrow.

King also described investigations of the longer run of data, going back for 100 years, available from UK Met. Office statistics, and these show a clear influence of the solar activity on occurrence of westerly weather patterns over the UK, that is, the weather coming from the region of the Atlantic where the solar influence is strong, and moving towards the British Isles. But this evidence was merely the icing on the cake of his presentation.

The challenge to meteorologists is clear, since these effects are certainly large enough that by ignoring them all the present general circulation computer models (GCMs) must be in error. Could this be why such models are notoriously unreliable if run for more than a few days ahead? And equally the challenge is there for the solar physicists to explain what is going on—with the incentive that the work becomes of direct importance and value now that the link with the weather is emerging.

So King closed by saying that the pathfinding stage of this Appleton Laboratory work is now at an end, with the establishment of the reality of the Sun–weather links. In this essentially interdisciplinary study, the time has come for collaboration between the Appleton group at the centre and the meteorologists and solar physicists on either side; 'I hope,' he said, 'that this lecture will mark a starting point in progress towards achieving practical benefits.' □

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