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Mountain Building and Plate Tectonics Pakistan's Salt Range, lying S of the Pamirs, has always been recognised as a structural anomaly calling for a special explanation apart from the general theories of Himalayan mountain building. A Canberra researcher last year advanced a new hypothesis to explain this 300-km long E–W chain of hills. He speculated that this folded block of strata once lay in continuation with the main Himalayan chain, forming its NW part. When the Pamir arc was formed—very recently in geological time—two central Asian blocks of crustal material, the Turan and Tarim blocks, approached one another in an E–W vice to squeeze it into its present tightly curved shape, convex towards central Asia. On the S side, however, the Salt Range was 'expelled' towards Pakistan. In the process it revolved through about 75° in an anticlockwise direction. The Australian geologist finds support for this contention in some results of the fossil magnetism of the Salt Range rocks. These yield an anomalous position for the Cambrian magnetic pole vis à vis those derived from elsewhere. Once the Salt Range is restored to its hypothetical original position, this pole matches its colleagues. Further consequences of the tectonic movements which may have caused the swing around of the Salt Range are the 'granitisation' responsible for creating Nanga Parbat, and the uplifting of the whole Karakoram.

There is an increasingly popular theory among volcanologists that the strings of volcanic islands which populate our oceans are the results of the drift of the Earth's crust across specific fixed 'hot spots'. There is now good evidence for the lateral spreading of the sea floors of all the major oceans—the modern version of the old theory of continental drift. But whether permanent hot spots exist on the underlying mantle of the Earth is still something of a moot point. Nevertheless, one of the American authors of the hot-spot hypothesis recently put forward a novel idea connected with these oceanic volcanoes. The heights which their summits eventually reach, he speculated, depend on hydrostatic forces alone. The popular concept of hot spot volcanology is that a volcano 'switches itself off' once it has passed beyond the influence of the hot spot. Hydrostatic control, conversely, implies that a volcano will only go on growing until the combined pressure of Earth's crust, ocean and atmosphere overlying the hot spot equals the downward pressure exerted by the column of hot molten magma in the volcano's supply pipes. This hot liquid will be of lower density than the surrounding solidified crust and so will rise a finite distance above it. Once the pressures balance, of course, there will be no force to pump up further magma to the volcano's top.

Shear faults, the great dislocations in plan of the Earth's crust, have become fashionable objects for geologists to study since their presence on the ocean floors in large numbers became apparent. The classical example is the San Andreas Fault of California, the seat of that state's major earthquakes. But Britain also sports such a feature along the Great Glen which separates the NW Scottish Highlands from the rest. British geologists, however seem unable to decide which way the NW Highlands shifted—from NE to SW, or vice versa. The matter has been debated since 1946 when the fault was first recognised. Last year at Durham University a new survey of the recrystallised sedimentary rocks surrounding neighbouring granite masses indicated that the NW Highlands once lay 100 miles to the NE of its present position. This block has subsequently, therefore, shifted to the SW along the Great Glen.

Earthquakes Traditionally geologists have regarded all earthquakes as the results of shearing movements between adjacent blocks of rock. New work hints, however, at the possibility that some very deep ones may be the result of implosions. Those familiar only with imploding television tubes may wonder how such a process can happen several hundred km down inside the solid Earth. But crystalline reorganisation within rocks can often, in principle, result in a change to a smaller volume as matter adjusts itself to increased pressures. Seismologists at the University of California, San Diego, analysed slow earthquake waves from 2 recent events in America. They detected a uniform compression preceding each earthquake, which lasted over a minute. In one case they calculated a volume decrease of 1.9 cubic km; in the other of 0.5 cubic km!

Glaciology We tend to think of glaciers as relatively stable ice rivers moving steadily, if ponderously, downhill. But in glaciated regions all over the world there can be found a second type, those that 'surge' suddenly at speeds from 10 to 100 times normal over periods of months or even years. Following the surge the glacier slows down again. It repeats the process in periodic fashion. A surging glacier is an example of 'positive feedback', conditions which begin the surge leading to increased volumes of melt water along the sole of the glacier with a resulting increase in lubrication; the increased lubrication, in turn, speeds up the glacier still more. But, despite this general hypothesis, there has been no workable numerical model to describe surging glaciers. Late last year, however, two Melbourne glaciologists produced a computer model which explains surging glaciers as just one end of a spectrum that includes all glaciers. Basically the different types of flow depend upon the steepness of the glacier (or more correctly the profile of its bedrock), and the mass balance between snow accumulation and glacial wasting. Given these factors and a certain viscosity (or stickiness) of the glacier, whether it will surge or not rests upon the degree of basal lubrication. Obviously a less sticky glacier will surge more readily and the surge will be over quicker. The frequency of the surge likewise depends on the above 4 factors; but the surge ends when it has reduced the ice thickness and reached a sufficiently low surface slope. The surge can be thought of as a wave of increased velocity travelling down the glacier from the accumulation zone to the snout. A reduction in snow precipitation can change a surging into a non-surging glacier; increasing it steps up the size of the surge and makes it happen more quickly. Steeper glaciers are more prone to surge than less steep ones. But the essential feature of a glacier with oscillating velocity is that it goes too fast for the accumulation at its top end to keep up with the change in its profile. It thus has to slow down again and wait for the ice to pile up once more.

Climatology With the continuing disastrous drought in the Sahel lands S of the Sahara, and the failure of the Indian monsoon, some climatologists are beginning to ask if we are not at the start of a decline in the climate to harsher conditions. This view is borne out by rumours of a shift in Alpine weather, the traditionally sunnier skies of Italy, giving place to rain, while the habitually wet weather of the N watersheds moves S. Climatological pessimism received considerable publicity last year, culminating in the marathon TV programme 'The Weather Machine' in which we heard how new work along several lines, ranging from historical studies of ice cores, to 'fossil' sea temperatures preserved in oxygen isotopes, to the evidence of fossil pollen spores, could all be interpreted as pointing towards the onset of a new Ice Age. The programme concluded that there was a 'virtual certainty' of the next ice-age beginning some time within the coming 2000 years; and a 20 : 1 chance, even, of its starting within the next 100. In view of this gloomy outlook (or is it so gloomy for mountaineers?) it is heartening to read the alternative opinions of the optimists. For a staunch body of climatologists, while admitting the need to learn more about weather systems and how they work, admits that scientists cannot yet, in all truth, construct models of the weather which adequately explain what we know happens, let alone what will happen in the future. The weather machine, they say, is of enormous complexity and modelling—even with large computers—is still in its infancy. So there is still room for hope with each new season!

Whichever way the climate is now trending, some systems have a built-in time lag and the Antarctic ice continues to shrink. A new study of W Antarctica by a researcher at Ohio State University, last year strongly implied that this vast area of ice, which drains into the ocean via the ice shelves of Ronne and Ross—unlike other parts of Antarctica—is disintegrating much faster than it is being renewed. Several lines of evidence point to that conclusion and suggest that, at Byrd Station, for example, the ice is now between 300 and 500 m thinner than it was 4000 years ago. The resulting rise in sea level is estimated at 3 to $3\frac{1}{2}$ m. A comparable rise would accompany the complete melting of the entire ice of W Antarctica.

Meteorology Why is a thunderclap so often followed by a violent cloud burst, rather than more moderate rainfall? The old theory was that the electric field in the thundercloud suspended the rain drops electrostatically until the discharge which, in effect, 'cut the strings' and let all the water fall at once. But a more recent idea was that the lightning flash itself drives together near-by cloud droplets, increasing their mass and causing precipitation. A recalculation of the forces involved has recently re-established the previous theory. Two cloud physicists at Tel Aviv University have shown how the electric field builds up in the thundercloud by polarisation of the larger droplets, followed by charge separation as these droplets collide with one and another and break up. Smaller, positively charged droplets are carried by updraughts to the cloud tops; larger, negatively charged ones sink to the cloud base where they are held by the electric field thus built up over the cloud. The lightning discharge abruptly weakens the field and the cloud 'bursts'. The rate at which a cloud charges up determines the type of storm.

So-called lee waves are a popular topic among meterologists in mountainous countries. The Föhn and Mistral are perhaps the two most common winds of this type. Others are the Bora, Santa Ana, Germich and Zonda. The US National Centre for Atmospheric Research is ideally situated at Boulder, Colorado, for the study of lee waves generated by the neighbouring Rocky Mountains. Not only have its researchers been flying directly into severe wind storms to probe their nature, but workers there have come up with a new theory enabling workable predictions to be made of strong downslope winds. Lee waves arise when stably stratified air is forced upwards over a mountain barrier; on the lee side these layers strive to regain their original altitude under the action of gravity. The large-scale oscillation this motion sets up can cause strong gusty winds on mountain lee slopes. These mountain waves affect the large-scale properties of the atmosphere because they increase stratospheric drag on the atmosphere's overall W motion. Colorado workers have shown that lee waves become more strongly pronounced when a temperature inversion lies upstream of the mountain barrier's crest, and especially if the waves undergo a reversal of phase between the surface and the tropopause. Under these conditions the mountain wave propagating upwards is partially reflected and can reinforce the wave near the surface in a constructive manner, increasing its amplitude to several times the mountain height. The new model of the lee waves can, the Boulder team say, permit the forecasting of short-range hazardous weather arising from this source.