teams have been able to thread their way over broken ground days afterwards. But an earthquake in California is also remarkable because it is a reminder that those who live there do so in the knowledge that earthquakes are a part of Californian life. Is it courage or foolhardiness that makes people live there in ever-increasing numbers?

By now, the properties of the San Andreas fault system are quite well described. Measurements in the past decade have shown that on those sections of the fault where movement is comparatively uninhibited, the annual displacement may be as much as three centimetres a year. Where the fault runs out to sea, in the southern suburbs of San Francisco, however, the fault appears to be locked as it is in the more complicated region to the south, around Los Angeles. But it has also become clear in the past two years or so that the scale of the tectonic movements responsible for the movement along the San Andreas fault is so great that the movement is bound to be as persistent as any geological process. Briefly, two tectonic plates are moving relative to each other and the fault system in California is merely a consequence of that. If anything, the development of plate tectonics should have sharpened the anxieties of those in California who fear that it can be only a matter of time before there is a much larger disaster than last week's comparatively small earthquake caused.

The first thing to be said is that the system of faults in California is so complicated, and the coastal strip is for much of its length so narrow, that there is very little hope of avoiding trouble by siting buildings away from the immediate locality of known faults. In any case, the damaging effects of a large earthquake reach several miles out from the source of trouble. It is true that mountain sites are probably safer than those in valleys or on the flat, but the extent to which a building will be shaken by a serious disturbance probably depends much more on a detailed relationship of the foundations of a building and their substratum than on any simple rule of thumb. According to Dr Charles Richter, there have been three earthquakes in California of magnitude greater than eight in the past century, one of them the San Francisco earthquake of 1906. Earthquakes of magnitude greater than seven are more frequent, perhaps four a century, but earthquakes of magnitude six, which are quite large enough to cause great damage in a city which is sufficiently near by, occur in California on an average once a year. Evidently there are few places reasonably close to the fault system at which the risk of earthquake damage can be considered small. In fifty years, four of the magnitude six earthquakes have occurred in circumstances as damaging as that last week, a frequency of roughly eight per cent. Would it therefore be reasonable to suppose that there will be a repetition of last week's trouble every twelve years on the average, an earthquake of magnitude seven near some important town every century or so and an earthquake of magnitude eight damaging a region up to a hundred miles across every two centuries or so? Or would it be prudent to suppose that the pattern of the past, with damaging earthquakes in southern California (1857) and San Francisco (1906) will be repeated at some point in the years ahead? These are questions for gamblers to attempt to answer. Whatever the truth, and given the way in which the continuing development of California implies that each year the risk that an earthquake will be near an important centre is increased as is the density with which dollars are invested in bricks and mortar, the average anticipated cost of earthquakes in California must amount to several hundred million dollars a year, the equivalent of a tax of, say, $25 per head per year for California as a whole.

Merely to make this kind of calculation, full of speculation as it is, is a powerful reminder of the scale on which California should be planning for its uncertain future. Although there may yet be developed means of warning people of immediately impending trouble, there is no chance that earthquake prediction will ever be married to regional planning with such delicacy that people will know where not to build towns and factories. The best that can be hoped for is advice for evacuating them in time. It is also improbable that some of the techniques being talked of for relieving pent-up stresses in association with fault systems will be able, if ever successful, to avert any but the obvious dangers. In the circumstances, what California needs most urgently is not so much research on earthquake mechanisms, important though that may be, but a well-run state-wide insurance programme which will allow the frontiersmen of California to pay for the cost of earthquake disasters year by year, not only when disaster strikes. There is no reason why those living in California now should evacuate it, but is there not a case for thinking that those about to move there to build factories should think of going elsewhere?

## 100 Years Ago


### *THE MICROSCOPE*

IMPROVEMENTS IN THE LENSES OF MICROSCOPES

FOR some time, people in England have been content to let the improvement of the optical powers of the microscope remain entirely in the hands of the makers, believing, apparently, that Mr. Lister had effected all in his suggestions and improvements that could be desired. Dr. Royston Pigott, an able mathematician, formerly Fellow of St. Peter's College, Cambridge, and a Doctor of Medicine of that University, was not, however, inclined to look at the matter in this way, and for many years has been working and experimenting with a view, first, to test the accuracy of our best object-glasses, and, secondly, to suggest means for their improvement. It should be remembered that Oberhauser, Nachet, and especially Hartnack, on the Continent, not satisfied with the old system of combinations for object-glasses, and not having the benefit of Lister's researches, have made excellent objectives on a totally different system, and during the last few years the last-named maker has carried his system of "immersion lenses" to such a point of excellence as really to surpass the best glasses on Lister's system, in definition, penetration, working distance, and illumination. Those who do not admit the excellence of these objectives, which are now used by nearly all German histologists, have probably seen older glasses, made at a time when Hartnack had not reached his best. It is worth stating, now that the Parisian opticians are inaccessible, that Gundlach of Berlin has succeeded in making excellent glasses of high power at astonishingly small prices, some of his 1-12ths and 1-16ths immersion 1-16ths (so-called), being admirable in their performance. They are not, however, equal to Hartnack's glasses, which, though costing far less than what similar English glasses cost, yet are more expensive than Gundlach's. It is only fair to all parties concerned to state that the terms 1-8th, 1-12th, 1-16th, &c., as now applied to an object-glass, appear to have no definite meaning, but depend on the caprice of the maker, since the magnifying power of glasses, with the same fraction assigned to them, differs enormously.

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