

Using Prediction Properly

UP TO 1970 no one had yet predicted an earthquake and there was no prospect of success. Certainly *Nature* received and declined a large number of manuscripts seeing strange coincidences in the time and location of past earthquakes and proposing, either with the aid of the Moon, the Sun or some strange and as yet undiscovered symmetry within the Earth, that there would be a quake in South America within the next five years, or some similar impossible-to-fail prophecy. As a scientific discipline, however, prediction did not exist.

The change has been remarkable. Not only have a whole class of premonitory symptoms been identified for certain earthquakes, but there are the makings of a physical theory. We need not elaborate here—last week we reviewed the most recent work (*Nature*, 245, 121). It seems that the rocks in the vicinity of a fault prepare themselves for an earthquake in the same way that one takes a deep breath before sneezing.

This is good news, especially as many geophysicists, with much justification, could see no clear-cut reason why there had to be any premonitory symptoms at all, let alone ones that could be easily detected. It is necessary to say, of course, that we have not moved from a state of complete ignorance to one of complete understanding—there are as yet few case histories and many doubts; nonetheless the mood is clearly optimistic.

It is now urgently necessary to think seriously about the social issues that this new knowledge raises. The situation is in some ways similar to that in 1939 when nuclear fission suddenly became a reality. The prospects for society are neither uniformly good nor uniformly bad and there is still time, but relatively little, to explore ways in which good prospects can be encouraged and bad ones minimised. What are the prospects ten years hence?

A rather clear warning of many earthquakes will be available. Their size, their location to within a few tens of kilometres and their time of occurrence to within a month or two, should be predictable.

Techniques used will be relatively cheap and involve no complex new equipment that only governments, for instance, would be able to afford.

Interpretation will not require unusual skills—no more, probably, than a skilled technician would have.

It will be impossible to suppress such information or keep it behind some security screen.

The technology and skills will be marketable and exportable rather like an air traffic control system.

Property values will be affected by earthquake warnings. What little is known about population movements suggests that there will be a marked reluctance to leave homes for months on the basis of scientific advice.

It will still be next to impossible, given even rather precise predictive information, to say with any confidence what damage an earthquake will cause.

Earthquake prediction is founded on the same physical basis as the fairly successful but as yet very modest scale work on earthquake control. Thus success in prediction will lead to demands for success in control.

All of which suggests that without sustained wise and firm action the benefits will be extensively mixed with

misadventures. Will earthquake prediction and control need a Hiroshima of its own before there is widespread thought on the subject?

It is not easy to see the most logical steps to be taken at present to keep this new skill under strict control. While there is an obvious need for research to continue with as much vigour as possible, it would be folly to leave to the scientist the job of public information. And yet the scientist may be infuriated if his clear conclusions are watered down in the interest of public tranquillity. From a previous era, when the only prediction could be that if it has happened in a spot once it can happen again, there are many examples from all over the world of rebuilding for convenience exactly where the previous damage had occurred. More must be expected of an earthquake defence policy in the future.

The problem is that there is no organisation at present remotely suited to the job of preparing such a policy. The skills that will be needed are as much political, military and financial as scientific, indeed the sort of organisation that may be best fitted to assess and make decisions could well have many features much closer to those of a defence ministry than those of a science ministry.

Can such an organisation be international, for instance under UN auspices? It is not clear whether within UN confines the operation could transcend serious political and administrative obstacles. A more realistic analogue is the international corporation with vigorous activity within each of its members directed at the specific needs of the country and drawing its financial support from that country and yet transferring management and skills across frontiers in response to immediate needs.

The organisational character is disputable, the need for a rapid response to a new-found skill is not. Those who doubt this should spend ten minutes listening to Dukas' *L'Apprenti Sorcier*.

100 Years Ago



The Frog is the never-failing resource for the physiological experimenter. It would be long indeed to tell the sufferings of much-enduring frogs in the cause of Science! What Frogs can do without their heads? What their legs can do without their bodies? What their arms can do without either head or trunk? What is the effect of the removal of their brains? How they can manage without their eyes and without their ears? What effects result from all kinds of local irritations, from chokings, from poisonings, from mutilations the most varied? These are the questions again and again addressed to the little animal which perhaps more than any other deserves the title of "the Martyr of Science."

From *Nature*, 8, 470, October 2, 1873.