

EARTHQUAKES

Warning in time

Accounts of recent successful earthquake predictions in China have reached Western scientists. Colin Norman reports

THREE successful earthquake predictions were made in China last year, and warnings were issued in time to evacuate people from hazardous buildings in the threatened area. But there were also some failures. A number of false alarms were issued, and Chinese scientists failed to predict the devastating earthquake which levelled the city of T'angshan in July last year.

Those recent successes and failures were discussed for the first time by Chinese scientists who attended an international meeting on earthquake prediction sponsored by UNESCO (the United Nations Educational, Scientific and Cultural Organization) in Paris late last month. According to American scientists who attended the meeting, the Chinese were frank in their discussions and provided much previously unreported information on their methods.

Interest in China's earthquake prediction programme has been intense

ever since it became known in the West that Chinese scientists had accurately predicted a major earthquake which struck the city of Haicheng in February 1975. That prediction led to evacuation of the city and it is credited with saving many lives.

The latest successful predictions, according to Robert L. Wesson, a seismologist from the US Geological Survey who attended the UNESCO meeting, involved three earthquakes in 1976 of about magnitude 7 on the Richter Scale. They occurred in Yunnan Province on 29 May, in Szechuan Province on 16 August, and in the Szechuan-Yunnan border region on 7 November.

Wesson reported that in each case, Chinese scientists made long-term predictions that an earthquake would occur. Based on a variety of geophysical and magnetic anomalies, the long-term predictions were used as a basis for more intense monitoring in the threatened area, and for disaster planning. They were, however, not made public.

Public warnings that an earthquake was imminent were issued only on the appearance of foreshocks—minor tremors

which sometimes precede major quakes. The public warnings, according to Wesson, were accompanied by evacuation of people from potentially hazardous buildings. The appearance of foreshocks in the Haicheng area was also used as the trigger for issuing an earthquake warning there in 1975.

Major earthquakes frequently strike abruptly, however, with no foreshocks, and thus imminent hazard warnings may not be issued in time. That seems to have been the case with the T'angshan earthquake. Wesson said that the Chinese had made a medium-term prediction of a quake in the area which had underestimated the magnitude of the event and no imminent warning was issued. In the past, Chinese officials have been reluctant to discuss the T'angshan earthquake, which killed more than 600,000 people.

Wesson also said that the Chinese scientists at the UNESCO meeting admitted that several false alarms have been issued, although their success rate was not revealed. According to Dr Jack Savage, a geophysicist who has visited China, Chinese scientists have acknowledged issuing false alarms before, but they argue that they would prefer to issue warnings whenever necessary rather than risk the consequences of an unpredicted major quake. □

DENMARK

Big science in a small country

A new nuclear physics project is under consideration in Denmark. Sven Godtfredsen reports

THE fate of experimental nuclear physics at Denmark's Niels Bohr Institute is in the process of being decided. An accelerator project now under consideration by the Ministry of Education marks an attempt by the institute to proceed on its own following the failure of an attempt at Scandinavian collaboration. But the enormous costs mean that the matter is likely to become a central issue in Danish science policy.

The project, known as the Danish heavy ion project, was submitted to the Ministry of Education, by the Danish Council for Scientific Policy and Planning. It involves building a 20MV or 25MV tandem accelerator. The total cost of the project will include the cost of building the accelerator, estimated at DKr115 million or DKr86 million depending on the choice of terminal voltage, and the DKr3 million increase

in grants to the institute for operating the accelerator (£1=DKr10.4). Financially speaking, the project is breathtaking compared to expenditure on other natural science projects in Denmark. Grants from the Danish Natural Science Research Council (DNSRC) whose function is to finance and to some extent lead Danish research in the natural sciences, amounts to only DKr25 million a year.

The DNSRC gave its view on the project last May in a report called *The Future of Nuclear Physics in Denmark*. Apart from examining the scientific content of the heavy ion project, the report reviews it in relation to broader issues—specifically, Danish participation in CERN, the attempts to establish collaboration in nuclear physics between the four Scandinavian countries (the NORDAC project), the possibility of collaboration between the institute and the heavy ion laboratory in Darmstadt, and of course, the particular financial aspects of nuclear physics in Denmark. But the question

really concerning the DNSRC is how long a small country like Denmark can run its own programme in such an expensive branch of natural science.

This question is not new. It was asked in 1970 when the Niels Bohr Institute needed to renew the 9MV tandem accelerator, and inspired nuclear physicists from the four Scandinavian countries to discuss the possibility of building a major heavy ion laboratory in the North. The idea was elaborated into the NORDAC project, which the DNSRC strongly recommended and which received financial assurances from the Danish government. Unfortunately the other Scandinavian countries were unable to back the project. Since then the institute has used the heavy ion tandem accelerator in Darmstadt for most of its nuclear physics experiments. But scientists at the institute feel that this approach weakens the contact between experimental and theoretical nuclear physics, traditionally the institute's strong feature.

There is little reason to believe that the NORDAC project is any more likely to happen now, so the Niels Bohr