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Active Earth

The Lessons of the Armenian Earthquake

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***Editor's Note:** Releases dealing with technical developments in the USSR are occasionally received from the Press Office of the USSR Embassy in Canada. This article is presented here as an interesting summary of the state of earthquake prediction in the Soviet Union. (Received 3 October 1989).*

The tragedy which occurred in Armenia on December 7, 1988, continues to pose many acute questions addressed to the leadership of the Soviet Union, the leadership of the Armenian Republic, and scientists tackling the problem of seismic danger.

The great loss of human life and the enormous economic losses were caused, first of all, by the inadequate design of buildings and the severely low quality of construction; by errors in the seismic map, in which the city of Spitak, a region which experienced an earthquake of magnitude 10, was indicated as a region of force 7; and by the absence of an earthquake forecast system in Armenia.

A series of discussions were held in the Presidium of the USSR Academy of Sciences, the Interdepartmental Council on Seismology and Aseismic Construction, and the USSR Academy of Sciences' Institute of Earth Physics. Here scientists expressed several viewpoints on the measures of combating seismic hazards.

What are the main drawbacks of the existing maps of aseismic regionalization of the USSR? How should they be improved? An extreme viewpoint was expressed by Igor Gubin, corresponding member of the USSR Academy of Sciences. He believes that the map does not take into account information on the dimensions and depth of the penetration of geological fissures into the Earth's crust. His formula is as follows: study fissures in detail, and you will know the places and potential of future earthquakes.

A more complex scheme is offered by Dr. Georgy Reisner, head of a laboratory at the Institute of Earth Physics. Yes, the geology of the crust is very important, but a whole array of various geophysical factors should be taken into consideration. He reproached the compilers of the existing map for ignoring geologists' recommendations. As a result, the boundary of a force 8 zone in the vicinity of Leninakan is indicated on the map across the main geological faults.

In Dr. A. Nikonov's opinion, the effective paleoseismological method is underdeveloped and hardly used in the USSR. This method consists of searching for discontinuities and landslides originating from major ancient earthquakes, of which Nikonov has discovered numerous traces in the Spitak area.

The opponents of the geological approach say that knowledge of the place and intensity of a probable earthquake is not enough. For instance, it follows from the existing map of seismic regionalization that earthquakes of magnitude 8 in the Leninakan area are possible once in a millennium. In such cases, construction workers believe that it is unreasonable to construct specially reinforced (and hence much more expensive) buildings, if earthquakes are not forseeable in the lifetime of many generations. Consequently, it is necessary to single out on the map such regions where earthquakes are expected over the next few decades. This can be done from seismological data, studying, for instance, the earthquake recurrence period. But large earthquakes rarely occur in the same place, and the history of seismological observations is very short. The investigation of traces left by destructive earthquakes on ancient monuments, churches or other structures, whose construction time is known, can be helpful here.

Of late, seismological methods have been worked out, based on monitoring the growth of minor earthquakes, their concentration in a single place, and the coming of a lull before a seismic storm. They allow the assessment of the probability of a large earthquake over the next few years. Of help can be geodetic methods which make it possible to single out sections of the Earth's surface which rise or go down relatively fast.

Despite their different theories, the participants in scientific discussions have all agreed on one thing: the existing map can, and must be, improved by a reasonable combination of geological and seismological methods.

A delicate question arises. On the one hand, it is clear that the seismic regionalization map of the USSR's territory should have a single methodological basis. But seismically hazardous zones pass through the territory of different republics and scientists from neighbouring republics often disagree on the geological structure and the position of dangerous fissures. How is it possible to reach a consensus on what should be done while observing the rights of republics to independently determine the degree of danger of natural calamities, including earthquakes? Who should be responsible for the map of seismic regionalization — a federal department or a republican one?

The same questions arise regarding earthquake forecasts. The region of the Caucasus where the Spitak earthquake took place was proclaimed dangerous by the long-term forecast compiled at the Institute of Earth Physics. The information about this forecast was handed over to scientists and leaders of the republics in the area, including Armenia. However, no measures for intensifying observations of short-term harbingers of earthquakes were taken. But harbingers did exist: the level and temperature of subsoil waters varied, weak tremors and noise became more frequent, and animals exhibited unrest. But this failed to alert Armenian seismologists. A survey carried out after the disaster showed that many modern devices were not functioning, while records of operating prognostic devices were not being analyzed. Of course, to a certain extent, this is due to the abnormal situation which developed in Armenia in 1988 in connection with the aggravation of the national issue. On the other hand, we cannot write off the low level of responsibility of local seismologists for their work.

But there is a third aspect. Academician Guri Marchuk noted, at the session of the USSR Academy of Sciences' Presidium, that the local leadership did not react to reports on the long-term forecast because of a mistrust of science. Besides, the USSR has no law prescribing the actions authorities are to take when an earthquake is predicted. The earmarking of funds for protective actions is not envisaged either. As a result, preventive measures for taking stock of buildings and their reinforcement were not taken, the preparedness of civil defence forces, firefighters and other units working in extreme conditions was not checked.

Soviet scientists are now discussing another fundamental problem: can a short-term earthquake forecast be useful for society if it is not 100% reliable? Knowledge about harbingers accumulated at the present time indicates that the site and time of a major earthquake can be determined only with a small degree of reliability. Therefore, false alarms are possible. But should this be regarded as a crime. We receive with gratitude and understanding the reports of the hydrometeorological service that rain or thunderstorms are predicted. But, regrettably, an earthquake is not the same as rain.

Seismologists could make similar forecasts. But what should be done by regional officials if, say, a 50% probability of a major earthquake within the next 24 hours is proclaimed. Their duty would prompt them to take protective measures and warn people against a probable danger. At the same time, a false alarm could spark panic, people might not go to work, and public and cultural undertakings could be disrupted.

Of particularly great harm are unfounded forecasts made by amateurs. They have become especially frequent since the Spitak earthquake. The population of such cities as Ashkhabad, Stavropol and Frunze became nervous as a result of such forecast spread through careless publications in the press, telegrams, and printed leaflets.

The situation was typical in Frunze, the capital of Kirghizia. Three years ago, seismologists warned about the probablility of a large earthquake south of the city. Between February and March 1989, a series of tremors of magnitude 6 occurred in this region. They did not threaten the population or buildings. However, due to increased nervousness after the Spitak tragedy, these weak earthquakes sparked a panic. After some hesitation, a decision was taken to inform the people of Frunze in detail about the seismic situation. This was done through TV and the press. Recorded harbingers were publicized. The impossibility of making an exact forecast of future developments was openly admitted. Moreover, statements by local researchers and scientists who specially arrived from Moscow declared that the Spitak disaster would not be repeated in Frunze. A frank conversation with TV viewers in the form of a round-table conference and answers to all their questions helped to eliminate the panic.

This example has demonstrated once again that strict scientific information even about socially dangerous phenomena should not be passed over in silence. But due to the serious consequences of earthquake forecasts, it is reasonable for experts to discuss them preliminarily. Such a procedure is envisaged by a projected system of prognostic observations on the territory of the USSR. It will be set up under the aegis of the USSR Academy of Sciences. In seismically dangerous areas, local networks of integrated stations will monitor harbingers. The stations are to be connected by efficiently operating telemetry communications with the republican and federal Prognostic Information Centres. Such Centres will set up Experts' Councils prepared to transfer prognostic information to leaders of appropriate regions and to the population. The prime task today is to produce a sufficient number of modern prognostic devices. Scientists believe that the accuracy of earthquake forecasts will rise gradually with the accumulation of experience of the federal system which is now being established.