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Book Reviews

H.K. Gupta and B.K. Rastogi: Dams and Earthquakes. Developments in Geotechnical Engineering, Vol. 11. Amsterdam: Elsevier Scientific Publishing Company, 1976. pp. XVI + 229, 116 figures. US$ 32.95.

The impoundment of the reservoir behind a high dam may induce earthquakes, even in places shown by the historical record to be essentially aseismic. The occurrence of earthquakes as the direct result of the creation of the reservoir raises important questions both for the engineers who design high dams and tectonophysicists interested in the mechanics of the earthquake process. We do not yet know enough about the critical factors to judge beforehand from field observations whether or not a planned dam at a specific site will lead to induced seismicity. The authors have prepared a timely, comprehensive review of the best documented cases of reservoir-induced earthquakes and of the current state of understanding of the phenomenon. A substantial part of the book is drawn from their own research.

The interest of Indian seismologists, including these authors, in this subject was stimulated by the Koyna earthquake, December, 1967. They start their book with a discussion of the seismological studies of this earthquake and its effects on typical local buildings and engineered structures, including the dam itself. Although the largest reservoir-induced earthquakes that have occurred anywhere are considered moderate by seismologists, in the magnitude range 6 to 6.5, they are capable of causing severe local damage.

Case histories of seismicity associated with 18 dams are presented, with detailed descriptions of the geological and hydrological settings of four of the most famous cases: Koyna, India; Kariba, Zambia; Kremasta, Greece; and Mead, U.S.A. The Hsinfengkiang Dam, Kwangtung Province, China, is discussed briefly and perhaps is worthy of more thorough discussion in view of the excellent work of the Chinese scientists in documenting all aspects of the associated seismicity.

In addition to the cases of dams, three instances of earthquakes stimulated by fluid injection into deep boreholes are reviewed. The inclusion of these case histories is certainly appropriate in view of the likely connection between the basic operative mechanisms of the two ways of inducing earthquakes.

When an earthquake occurs near a dam, debate often begins as to whether the event was actually related to the existence of the reservoir. The controversy is especially heated when the region has previously experienced low-level seismicity. Therefore, the chapter presenting the observed characteristics of reservoir-related earthquakes is valuable as an effort to systematize those features that may serve to distinguish induced events from ordinary activity. The number of small events relative to the number of larger ones in the sequence is greater for these earthquakes than for other activity in the region. The preponderance of small events during the foreshock activity is a marked difference from the results observed by several investigators for ordinary earthquakes. Reservoir-induced earthquakes seem to be characterized by having the largest of the aftershocks much closer in magnitude to the main shock than is the case for normal seismicity. Another characteristic property is that the aftershock activity decays more slowly.

Two mechanisms have been called on as the explanation of the stimulation of earthquakes by reservoirs: the increase in subsurface stresses caused by the added water load and the increase in pore-pressure in the rocks below as a result of penetration of water. Each of these is nicely reviewed in a separate chapter. Although the theory is far from complete, the informative discussion provides a good background for understanding the current status of the problem. A brief final chapter touches on some practical questions, such as the kinds of site studies that should be carried out before construction of a high dam and the design of seismic networks to be deployed in the area in order to gather data for documenting the pre-impoundment seismicity and detecting changes in the seismic regime afterwards. The properties of the sites of large reservoirs at which no earthquakes have occurred, the great majority, are discussed briefly in terms of the lessons they offer. The determination before final site selection of the susceptibility of a proposed location to induced seismicity is a major unresolved problem of engineering geology and geophysics. This synthesis of experience and theory will be a valuable addition to the libraries of geologists, seismologists and engineers concerned with the problem.

Carl Kisslinger, Boulder, Colorado

Exploitation of Seismograph Networks. K.G. Beauchamp (ed.). 643 pages, Nato Advanced Study Series, Series E: Applied Sciences-No. 11, ISBN 9028600655, Dfl 138,–. Leiden: Noordhoff International Publishing 1975.

The book contains 46 papers, which were presented by 35 authors of ten countries at the Nato Advanced Study Institute on the Exploitation of Seismograph Networks at Sandefjord, Norway.

According to the intention of this meeting the authors, most of them strongly engaged in array problems, discussed all aspects of scientific work connected with seismic arrays especially those, which show the interaction of seismology, computational techniques and communication systems.

Besides the highly speciallized contributions concerning the use of computer networks like ARPANET and the application of the great arrays like LASA and NORSAR the first sections of the book contains articles, which deal with the problems and the utility of the different medium aperture arrays and with the chances of a combined data analysis of several array units.

In the second half of the book one will find first papers about data processing and fundamentals of time series analysis. These articles, as well as the following chapters about the results and the fine methods for detection and about investigation of earth structures and wave propagation with the aid of seismic arrays, are of great value not only for the array seismologist.

The book is divided in 9 parts:

Part 1, Introductory, 3 papers over 35 pages about the historical background of array seismology and a review of array processing and instrumentation
Part 2, Communication Networks, 5 papers, 82 pages
Part 3, Seismic Array Systems, 6 papers, 96 pages
Part 4, Time Series Analysis, 9 papers, 89 pages
Part 5, Generalized Computer Analysis, 4 papers, 38 pages
Part 6, Detection and Classification, 6 papers, 107 pages
Part 7, The Earth's Structure, 8 papers, 93 pages
Part 8, Scattering and Multipath Transmission, 5 papers, 55 pages
Part 9, Wave Propagation and Seismicity, 3 papers, 27 pages.

Most of the articles are well arranged and fitted with many good and lucid drawings and, if necessary, clearly written formulas. Every author gives a long set of references. Certainly because of the use of a quick printing method the print of the different articles is not as uniform as in normal printed books, but it is quite clear and well edited.

J. Klußmann, Hamburg