Uttarkashi Earthquake. H. K. Gupta and G. D. Gupta, eds. Geological Society of India, Bangalore. 1995. xxii + 233 pp.

The Uttarkashi earthquake of 19 October 1991 was important in many ways Firstly, this was the first earthquake of magnitude (M_s) 7.0 in the Indian domain for quite a number of years. Secondly, the casualty figure was high and the damage to dwellings excessive. The loss occurred in an already backward region of India. Thirdly, this was the first substantial earthquake in the vicinity of the Tehri dam site since the designs for the Tehri hydroelectric and irrigation project were completed in the late nineteen sixties. Fourthly, the earthquake triggered a number of accelerographs installed in the region. These records are valuable evidence in the debate about seismic hazards to the Tehri project. Fifthly, the first Indian estimate of the epicentral location for the earthquake was in error grossly. The earthquake also exposed the lack of preparedness of the civil administration for relief and succour operations.

A conference on the Uttarkashi earthquake was organized at New Delhi in November 1992. The volume under review is a compilation of 19 articles presented at the conference.

Chandrasekaran and J. Das report analyses of records from 13 US-made accelerographs that were triggered by the Uttarkashi earthquake in the Garhwal region. The maximum peak ground acceleration was 0.30 *g* and 0.29 *g* at Bhatwari and Uttaikashi respectively, the two stations closest to the epicentre. Brijesh Chandra and others in a companion article report recorded peak ground acceleration of 0.52 *g* at Uttarkashi where an Indian-made accelerograph was operating also. Both the articles present information of interest to earthquake engineers, civil engineers and architects. But there should have been a more critical examination of the data in these articles. Since they are from the same university department, cross-referencing would have been possible and it would have been useful to the readers. A question of great importance left unanswered nonchalantly is, Why did the Indian-made instruments show higher accelerations than the imported instruments at the same station?

S. Jain and S. Das analysed the accelerograms reported in the above-mentioned article by Chandrasekaran and Das to assess the provisions of the Code IS 1893: 1984 for design of earthquake-resistant structures in different parts of India. It may be recalled that India has been divided into zones I to V in the code. Maximum attention has to be paid in design of structures for parts of India assigned to zone V. The authors conclude that provisions of the code are conservative for zones I to III. Thus, the cost of important structures with provisions for resistance to earthquake forces could be lowered over most parts of India if the codal provisions are relaxed suitably. On the other hand, the existing provisions are not sufficiently conservative for zone IV. This is crucial because Tehri dam site has been assigned to zone IV. In simple terms, if the observation of Jain and Das is applied to Tehri dam, then it follows that the dam built for earthquake resistance according to guidelines for zone IV may be exposed to greater earthquake hazards than those for which it would have been designed. The Uttarkashi earthquake did not provide scope for assessing the codal provisions for zone V.

Two articles by Roy and Hasija deal with geodetic observations. Elevations of bench-marks between Saharanpur and Mussoorie via Dehra Dun measured in 1991 and 1992, before and after the Uttarkashi earthquake, are compared with those measured in 1974–77 in the first article. It appears that bench-marks between Dehra Dun and Mussoorie experienced subsidence of up to 7 cm between 1991 and 1992. The authors attribute the subsidence to the Uttarkashi earthquake. But this conclusion is difficult to accept in the absence of supporting simulations based on the elastic dislocation theory. The bench-marks in question are located 70 to 80 km from the epicentre and the distance may be too large for the observed magnitude of subsidence. The suggestion of the authors that the bench-marks should be occupied regularly should be heeded by the authorities.

The second article deals with geodetic observations elsewhere in the Garhwal Himalaya prior to the Uttarkashi earthquake. This article is a wasted effort scientifically. The dimensions of the survey figures measured were too small. The geographic locations of the figures have been masked. Thus we are not sure about the region of investigation The authors belong to Survey of India whose *raison d'etre* is to determine and disseminate accurate locations of points in the Indian territory. But the maps appearing in the two articles do not have latitude and longitude information.

Dattatrayam and others report analysis of digital data recorded through a seismograph at New Delhi for three aftershocks of the Uttarkashi earthquake. The estimated seismic moments are of the order of 10^{13} Nm and stress drops are in the range of 0.2 to 0.44 MPa. The authors present similar results for two earthquakes occurring 5 and 3 days prior to the Uttarkashi earthquake. They call them foreshocks. But their reported epicentres are so far from the epicentre of the main earthquake that this appellation is unacceptable. The low stress drops deserve note and further scrutiny.

There is an article by Arya entitled 'Long term measures for earthquake protection in Uttranchal Area of Uttar Pradesh, India'. The theme has been exposed by the author earlier for the Dharamsala area of Himachal Pradesh. Arya presents estimates of numbers of houses that may collapse or be damaged if an earthquake of magnitude (*sic*) of 6.5 occurs with its epicentre in one of the eight administrative districts in the hills of west Uttar Pradesh. Arya estimates that Almora and Dehra Dun districts will have maximum numbers of collapsed and damaged houses respectively. It is a pity that he did not check his predictions with the estimates of houses actually damaged or collapsed during the Uttarkashi earthquake.

The later part of the article provides sane advice for the future. Thus, all future constructions in these hill regions should have earthquake-resistant features. The additional cost in the case of the most cheaply constructed houses is estimated to be about 10% of the total cost. Arya notes that strengthing of existing houses is possible but will incur higher percentage of original cost.

Conditions in the affected region immediately after the Uttarkashi earthquake were tough. Efforts of scientists who visited the area for observations in this period deserve appreciation Still the fact remains that the articles which describe the results of these qualitative and mildly quantitative observations are of a routine nature. Many articles contain conjectures about the origin of the earthquake. Extrapolations from surface geological obser-

vations to hypocentral depths of 10 to 12 km appear unwarranted

Perusal of the articles of this volume collectively reveals in graphic detail the relatively low status of seismological studies in India *circa* 1991. Some mitigating factors may be cited. Lack of funds for seismological observations and research on a scale commensurate with the vast size of our country would be at the top of the list. The situation has not improved since 1991 at least in so far as seismological observations in our northern hill regions are concerned. Similarly, progress towards incorporation of earthquake-resistant features in individual houses and dwellings is abysmal. Thus the portents are clear. The death and destruction during the Uttarkashi earthquake will be repeated in all its tragic details during the next major earthquake of the Himalaya.

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MEETINGS/SYMPOSIA/SEMINARS

IAMAS/IAPSO Joint Scientific Assemblies

Date: 1–9 July 1997
Place: World Congress Centre, Melbourne, Australia

Joint assemblies of the International Association of Meteorology and Atmospheric Sciences (IAMAS) and the International Association for the Physical Sciences of the Oceans (IAPSO), two of the associations constituting the International Union of the Geodesy and Geophysics (IUGG) will be held at Australia. In addition, there will be a symposium sponsored by the Tsunami Commission of the IUGG and IUGG associations.

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Australia
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11th Himalayan – Karakoram – Tibet Workshop

Date: 28 April–1 May 1996
Place: Flagstaff, Arizona, USA

There will be three special sessions, Geodynamic Models of the Himalayas and Tibet, Neotectonics and Quaternary Geology of the Himalayas and Tibet and Extensional Tectonics in a Compressional Orogenic System.

Contact: Prof. Allison Macfarlane
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Sixth All India Conference on Cytology and Genetics

Date: 23–25 February 1996
Place: Rohtak

Topics include: Animal cytology and genetics, plant cytology and genetics, cell biology and molecular genetics, genetics and plant breeding, mutagenesis, population genetics, evolutionary genetics and biosystematics.

Contact: Prof. Ravi Prakash
Local Secretary
Department of Biosciences
Maharshi Dayanand University
Rohtak 124 001

DAE Solid State Physics Symposium

Date: 27–31 December 1995
Place: Calcutta

Topics include: Phonon physics, Electron states and electronic properties, Magnetism and magnetic properties, Semiconductor physics, Physics of defects and disordered materials, Transport properties, Superconductivity and superfluidity, Liquids, liquid crystals and plastic crystals, Phase transitions and critical phenomena, Surface and interface physics, Non-equilibrium phenomena in solids, Physics of complex systems, Resonance studies and relaxation phenomena, Solid state devices, techniques and instrumentation.

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