

## Historiography and Commentary on the Nepal - India Earthquake of 26 August 1833

Sujit Dasgupta\* and Basab Mukhopadhyay\*\*

(Received 09 June 2014; revised 12 July 2014)

### Abstract

Original descriptive account of data, both from Nepal and India, relating to damage inflicted by the 26<sup>th</sup> August 1833 Nepal Himalaya earthquake have been collated and presented in this communication. The basic objective is to bring all such scattered data and information at a single place to facilitate downstream research on the seismotectonics and seismic hazard assessment of this part of the Himalaya. Attempt has been made to analyze data extracted from Journal of Asiatic Society of Bengal, Calcutta Christian Observer, Asiatic Journal and Monthly Register, Baptist Magazine among others published during 1833-1835. Subsequent publications on this earthquake which was printed in 1843, 1850 and 1883 have also been reproduced. Extracts from a few contemporary research published during the last twenty years are mentioned to highlight current status of knowledge on this earthquake in comparison to the mega earthquake of 1934 that affected the same geographical region.

**Key words:** Archive, 1833 Nepal Himalaya Earthquake, Historiography, Isoseismal map.

### 1. INTRODUCTION

After the battle of Kirtipur (one of the principal towns in the Kathmandu valley) during 1767-1768, Gurkha ruler Prithvi Narayan Shah conquered Kathmandu and laid the foundations for a unified kingdom that came to be known as Nepal. King Rajendra Bikram Shah reigned during the period 1816-1847, though virtually all power was with Bhimsen Thapa, the Prime Minister of Nepal for a long period of time from 1806 to 1837. Border and trade conflicts between British India and Nepal resulted in the Anglo-Nepalese or the Gorkha war (1814-1816) that culminated with the Treaty of Sugauli in 1816, which ceded several areas in the west, south and east (acquired by Nepal through war and illegal occupation during the preceding 20 years) to the British East India Company (during Governor General Francis Edward Rawdon- Hastings).

Despite the defeat of Nepal, Prime Minister Bhimsen Thapa remained in power with the support of the queen regent Tripura Sundari. Nevertheless Kathmandu was forced to accept a British Resident. Brian Houghton Hodgson was Assistant Resident in Nepal during 1825-1832 [Resident: Edward Gardner], and was finally appointed as Resident at the Court of Nepal in January 1833 [during the time of Lord William Bentinck] at a young age of 33 years. By then the queen regent expired in 1832 and the Prime Minister Bhimsen Thapa began to lose his influence; but till then the rulers of Nepal somehow managed to isolate the Resident as effectively as if he was non-existent with calculated restriction on his movement. Dr. A (Archibald or Arthur) Campbell was appointed and attached to the Residency at Nepal, as Surgeon and Assistant Political Agent in 1832. Hodgson was an oriental scholar and naturalist and in no

\* Ex Geological Survey of India, Kolkata, India; email: sujitdasgupta@yahoo.com

\*\*Geological Survey of India, Central Headquarters, 27 J.L. Nehru Road, Kolkata-700016, India, email: basabmukhopadhyay@yahoo.com. (corresponding author)

time Campbell became a confident assistant of Hodgson; and on his recommendation Campbell was appointed Assistant Resident in 1833. At this juncture the severe earthquake of 26<sup>th</sup> August 1833 devastated the Kathmandu valley and adjacent areas including Indian Territory to the south. Hodgson being busy with the political affairs in Nepal along with his inquiries, deputed Campbell to study and report the effects of the earthquake within Nepal, though there was inputs from Hodgson (Campbell, 1833, see table, p. 565). We thus get valuable document written by Campbell, subsequently published in the Asiatic Society of Bengal.

Preceded by two strong foreshocks, the mainshock of the 26 August 1833 was reported from the Kathmandu valley at about 10.58 PM (Nepal time; Campbell, 1833). Subsequent documents refer to Calcutta time as 11.55 PM (Baird-Smith, 1843) or as 11.35 PM (Bilham, 1995). It was reported (Campbell, 1833) that around 414 people died from areas in and around the Kathmandu valley of which maximum casualty of around 200 took place at Bhatgaon, located to the east of the valley. One fourth of the town of Bhatgaon was destroyed including around 2000 houses and six to eight fine temples.

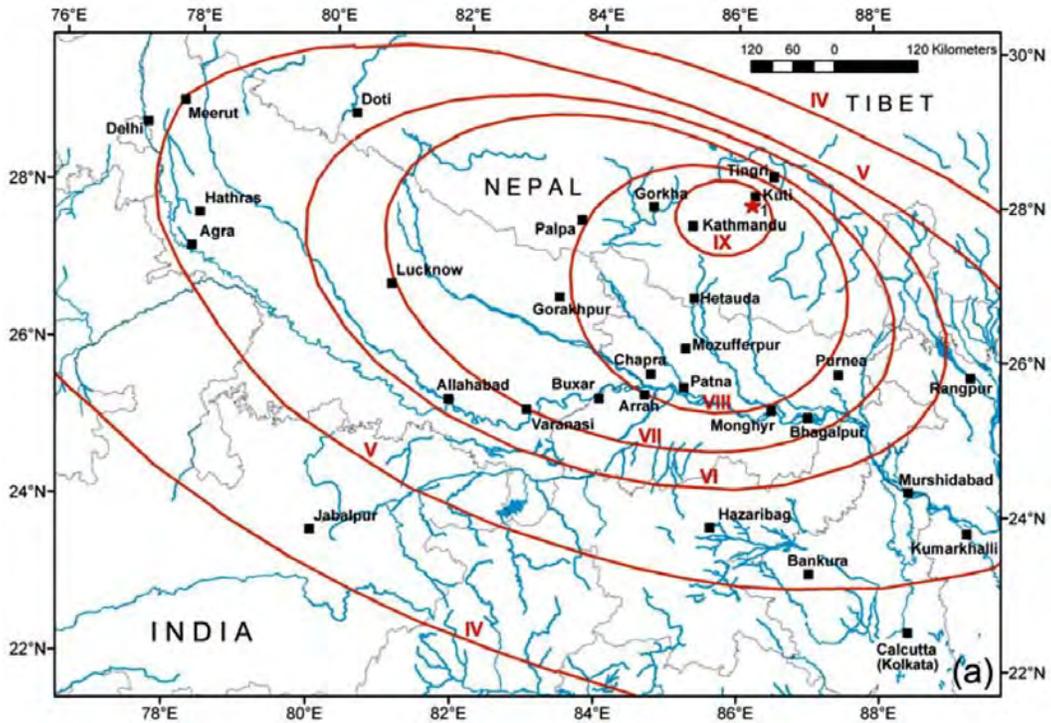
The earthquake being sufficiently strong was felt throughout northern India including loss of life and damage to the property. Summarising from all available documents, Baird-Smith (1843) concluded that the earthquake affected considerable area from latitudes 22° N [Calcutta-Chittagong] to 28°- 29° N [Lohaghat-Tingri] and longitudes 77° E [Delhi] to 92° E [Chittagong] involving an area of around 1 million sq km in northern India (Bilham, 1995).

The objective of the present document is to compile all published, but rare and out of circulation materials on this earthquake, that were printed during the thirties and forties in the nineteenth century to recapitulate the forgotten

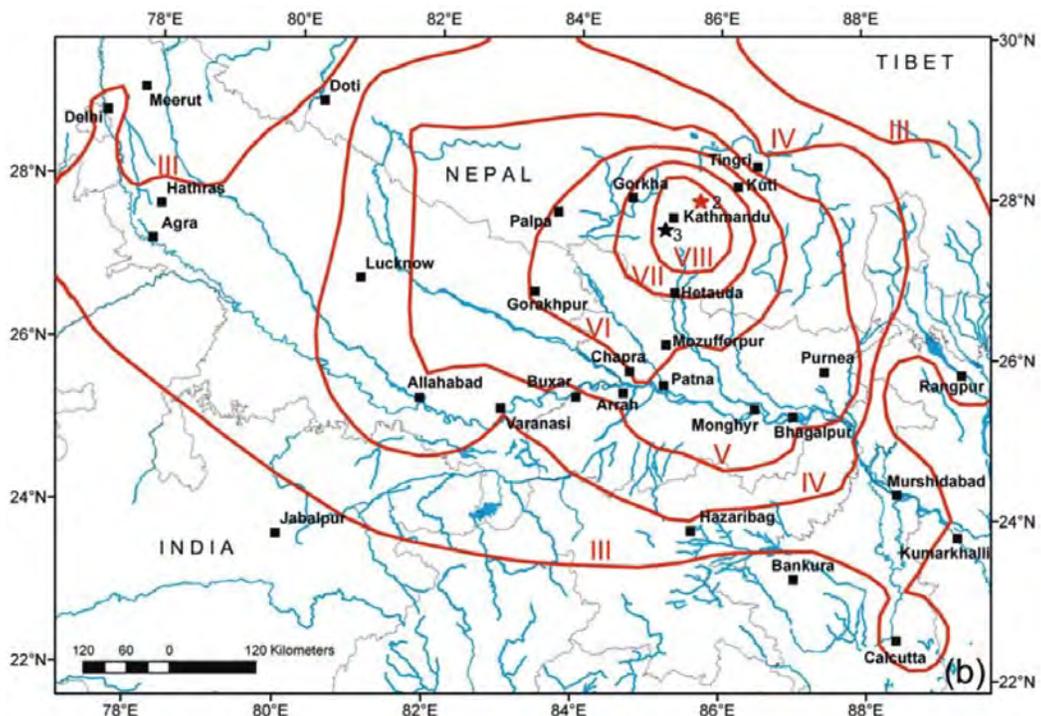
memories of earthquake triggered damages which can recur in future and at the same time to present a compiled document to facilitate future research on earthquake geology. We do not intend to carry out any analyses of the descriptive accounts; instead present a succinct summary on contemporary research that has so far been published on this earthquake during the last twenty years.

## 2. CONTEMPORARY RESEARCH

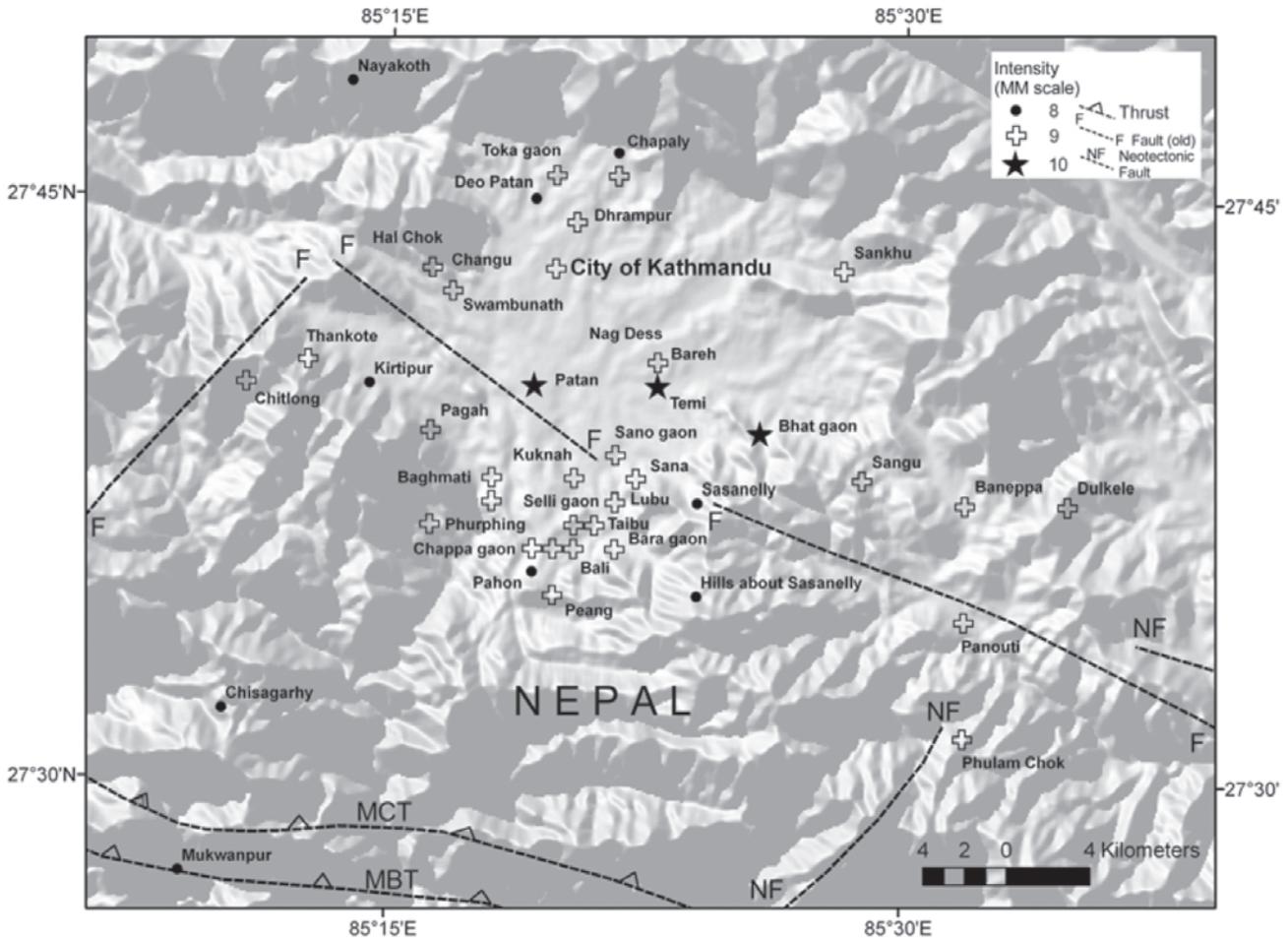
Detail account for the 1833 earthquake was published by Bilham (1995). The author suggests an epicenter located at 28.0°N: 86.0°E with a magnitude  $M_w$  of  $7.7 \pm 2$  (location 1, Fig. 1a). Bilham (1995) assigned intensity values in MM scales to localities both in Nepal and India to construct a smoothed and elliptical isoseismal map (Fig. 1a) for the earthquake which was also published in another subsequent paper (Bilham, Bodin and Jackson, 1995). We have reproduced this map along with the one from Ambraseys and Douglas (2004) (Fig. 1b), who based on 61 site-specific intensity values, re-constructed the isoseismal map in MSK scale. These authors located the epicenter at 27.70°N: 85.70°E and assigned magnitude  $M_w$  7.61 (location 2, Fig. 1b). Based on the account of Campbell (1833) (see below) on the damage pattern at various localities within the Kathmandu valley (**Table 1**) we have prepared a map (Fig. 2) showing such localities (1: 50K map of the valley consulted) with assigned MM intensity values (Bilham, 1995). More recently, Szeliga et al. (2010) published another epicentral location of 27.553°N: 85.112°E (location 3, Fig. 1b) which is about 80 km ESE of Kathmandu with a preferred magnitude of  $M_w$   $7.3 \pm 0.1$ . This latest epicentral latitude of 27.55°N brings the earthquake along the same latitude as that of the 1934 Bihar-Nepal earthquake as adopted by Chen and Molnar (1977). This aspect will be dealt under discussion at the end.



**Fig.1a.** Isoseismal map and epicentral location of 1833 Nepal earthquake. (a) Location of epicenter marked as 1 and smoothed isoseismal on intensity values in MM scale (after Bilham, 1995)



**Fig. 1b.** Location of epicenter marked as 2 and isoseismal with intensity values in MSK scale (after Ambraseys and Douglas, 2004); location of epicenter marked as 3 (after Szeliga et al., 2010)



**Fig. 2:** Map shows assigned MM intensity values (see Bilham, 1995) of localities (taken from 1: 50K map of the valley) based on the account of Campbell (1833) on the damage pattern at various localities within the Kathmandu valley (see Table 1 for details).

### 3. COMMENTARY FROM ARCHIVES

The first formal publication on this earthquake was published by James Prinsep, the editor of the *Journal Asiatic Society of Bengal* (August 1833, volume II, pp. 438-439) where he writes under the title 'Earthquake of the 26th August'... The daily papers have published notices of this phenomenon, as observed at a great many places in the interior of India, with more or less detail, from which the following general facts may be gathered:

The direction of the vibration was from N. E. to S. W.; there were three principal

shocks; the first about half-past six P.M., the second at half-past eleven, and the third, or most severe shock, at about five minutes to twelve (Calcutta time). In the places where it was most felt, slight and continued vibrations seem to have been experienced for the whole of the day following. As the time of the second vibration was accurately noted in Calcutta by the stopping of an astronomical clock, we may assume it as the best point of comparison with the times noted at other distant points. Applying the difference of longitude, a few of them may be thus classed:

Katmandu, Nepal	second shock	10h. 45 m + 12 m	= 10 h 57 m	very severe; loud noise
Rungpur		11. 20 - 2	= 11 h 18 m	many houses injured loud noise
Monghyr		11. 27 + 7	= 11 h 34 m	walls cracked, noise heard
Arrah		11. 15+14	= 11 h 29m	walls injured, noise heard.
Under Rotas hills		11. 10 + 20	= 11h 30m	
Gorakhpur		11. 20 + 19	= 11h 39m	walls cracked
Allahabad (vague)		11. 0 + 28	= 11h 28m	hollow sound of river
Bankura		11. 30+ 4	= 11h 34m	none such since 1814
Calcutta			= 11h 34m 48s	no injury done

At Monghyr, Rungpur, Mozufferpur, Mallai, and other places within the direct line of influence, many houses were destroyed or injured, and the alarm was great. At Katmandu, however, the following extract of a letter from A Campbell, will show that the consequences were more serious; and, judging from the course of the phenomenon, we may reasonably fear some dreadful catastrophe towards Lassa, on the north of the great Himalayan range:

On the evening of the 26th, about six o'clock, the valley and neighbouring hills were visited by a severe shock of an earthquake; it lasted about forty seconds, and during its continuance, there was a distinctly audible noise, as of ordnance passing rapidly over a drawbridge. It seemed to me to come from the east, and I felt that it was travelling with the speed of lightning towards the west, and just under my feet: the houses shook most violently; and trees, shrubs, and the smallest plants were set in motion, not shaking, but waving to and fro from their very roots. No damage was done to life or property. At ¼ to 11 we had a similar shock in severity and duration, and at 11 a most tremendous one. It commenced

gradually, and increased until the houses, trees, and everything on the face of the ground seemed shaken from their foundations. The earth heaved most fearfully; and when the shock was at its worst we heard the clashing of falling tiles and bricks in every direction; and to add to the impressiveness of the scene, a general shout rose from the people in all directions. The murmur of human prayers was carried audibly from the city to our grounds (a mile), and nothing could be more imposing and vast than the scene. In a dead calm, the noise of a hundred cannon burst forth: full grown trees bended in all directions, and houses reeled about like drunken men. In our grounds, no lives were lost; but in Katmandu nineteen persons were buried under the ruins of their own houses, and in the towns of Bhatgaon and Patan many more. This great shock continued for nearly a minute, and during the following hour there were six distinct and strong shocks, the ground in the intervals being scarcely if at all steady; and from this time till yesterday morning, there were upwards of twenty distinct and sharp shocks. The loss of property has been very great; 125 houses fell in Katmandu during the night of the 26th, and nearly as many more have been leveled with the ground. Up to this time, in consequence of the torrents of rain that have come down, finishing the work of destruction commenced by the earthquakes, the city and towns have been evacuated; men, children and women of the *purdah*, rich and poor, have been and still are on the plains about the towns. Innumerable temples have been destroyed, and the very gods of them have been crushed to atoms. A fine and large brick temple (100 feet high), built in imitation of the great one at Jaganath, came down by the run early yesterday morning, and two fine pillars built by Bhim Sen were demolished by the great shock. All yesterday and last night, we had occasional small shakes, and we are still in a state of suspense regarding the finale. In 1829, daily shocks continued to occur for 40 days, but none of them equal to the great one we had on the 26th.

**Table 1:** Location, Number of Lives lost and Buildings destroyed by 1833 Nepal earthquake in the Kathmandu Valley (after Campbell 1833 and Bilham 1995)

Places with (Latitude : Longitude)	Killed	Wounded	Houses	Temples and other buildings
British Residency grounds (27.72 : 85.33)	none	none	1	none
City of Kathmandu (27.72: 85.33)	60	38	400	Two pillars, built by the minister, each upwards 100 feet high; Temple of Jagarnath, built by Ran Bahadur, after seven years of labour, and about a dozen temples, destroyed. The modern- built garden houses of several members of the minister's family have been rendered untenable; one of them a handsome and ornamental edifice, has come to the ground.
<b>South of Capital</b>				
Patan (27.67:85.32)	6	25	285	
Sano gaon (27.64:85.36)	none	0	40	
Harra Siddhi (27.63:85.34)	0	0	20	
Teshu gaon (27.60:85.34)	0	0	25	
Selli gaon (27.61:85.34)	0	0	16	
Pagah (27.65:85.27)	0	0	24	
Kuknah (27.63:85.30)	1	0	130	
Baghmati (27.62:85.30)	0	0	80	A crack in the ground of 20 ft length was observed on the morning of 27 <sup>th</sup> ; the entire number of houses was 206, more than a third of whole destroyed, and about 100 men have been much damaged. The injury sustained here is proportionally greater than in any other part not to the east of Kathmandu.
Phurping (27.61:85.27)	0	0	8	
Chappa gaon (27.60:85.32)	0	0	35	
Peang (27.58:85.33)	0	0	8	
Taibu (27.61:85.35)	0	0	18	
Bara gaon (27.60:85.36)	0	0	35	
Bali (27.60:85.33)	0	0	3	
Pahon (27.59:85.32)	0	0	3	
Sasanelly (27.62:85.40)	0	0	2	
Lubu (27.62:85.36)	0	0	25	
Sana (27.63:85.37)	0	0	7	
Hills about Sasanelly (27.58:85.40)	0	0	20	
<b>East of Kathmandu in the valley</b>				
Deo Patan (27.75:85.32)	3	0	30	At the eastern extreme of Deo Patan is the Temple of Pasupatinath. The building escaped unhurt to the great joy of the rulers and people of land.

Table 1 (continued)

Places with (Latitude : Longitude)	Killed	Wounded	Houses	Temples and other buildings
Handi gaon	0	0	20	
Nag Dess (27.68:85.38)	4	0	20	
Bareh (27.68:85.38)	5	0	20	
Temi (27.67:85.38)	9	0	150	
Gou Karan (27.73:85.73)	0	0	8	
Changu (27.72:85.27)	0	0	20	A fine old temple destroyed.
Sankhu (27.72:85.47)	20	5	45	A handsome Temple of Mahadeo, situated on a hill above Sankhu is reduced nearly to ruins.
Bhat gaon (27.65:85.43)	200	104	2000	Total number of houses in Bhatgaon is 4700; ¼ of the town is said to be destroyed, 2000 is the average of many accounts, six or eight fine temples destroyed, and a statue of Rajah Ranjit Mall, one of the Newar Princes of the Bhatgaon division of the valley.
<b>East of Kathmandu beyond the valley but in the immediate neighbourhood</b>				
Sangu (27.63:85.48)	2	0	8	
Banepa (27.62:85.53)	10	0	20	
Nala gaon	6	0	11	
Panouti (27.57:85.53)	18	0	19	6 persons killed when asleep, under the ruins of one house
Dulkele (27.62:85.58)	10	0	21	
Phulam Chok (27.52:85.53)	60	0	300	A fine temple destroyed here
<b>Northeast of the valley and remote</b>				
In this direction the earthquake was much more severely felt. Kuti, a town on the Bhote frontier, on road to Lassa, is said to have been nearly all destroyed, it contained about 600 houses; 50 of which only remain. S(L)hipa—the country residence of Colonel Runbir Sinh, 20 miles from Kathmandu on the Lassa road, by the Kuti Pass, is seriously injured. Many small houses attached were destroyed and several lives lost				
Dhulaka (27.70:86.10)	0	0	0	
Kan Sing Chok (28.07:86.00)				For five days before the earthquake, noises similar to firing of cannons heard as if underground; in the neighbourhood the high road to Lassa said to be blocked at many places by fallen earth from the mountains.
Kassa (28.00:85.95)				
Kuti (28.15:86.08)	0	0	550	
Listi gaon (27.89:85.94)	0	0	0	At Listi gaon, also on the Bhote frontier, a large portion of a hill came down, and an iron bridge was destroyed

Table 1 (continued)

Places with (Latitude : Longitude)	Killed	Wounded	Houses	Temples and other buildings
<b>West of Kathmandu</b>				
Swambunath (27.71:85.28)	0	0	3	One small temple destroyed, and a larger one—an immense circular mound of brick work, surmounted by a 4-sided spire or jweet—little injured.
Hal Chok (27.72:85.27)	0	0	3	
Narod Devi	0	0	1	
Changu Narayan (27.69:85.87)	0	0	2	
Goorkha Cantonment (28.00:84.60)	0	0	4	The house of a Captain - much injured
Kirtipur (27.67:85.24)	0	0	14	Contains 532 houses built along the ridge and brow of a hill 3ft higher than the surrounding valley; tenements old and frail but escaped devastation; to account for its escape inhabitants say that some nights previous and on night of earthquake a large tiger or leopard paraded several streets without molesting inhabitants and was allowed to continue his protecting visits.. the admiring crowd hailed him as RAMJI, the 'great preserver'
Thankote (27.68:85.21)	0	0	23	
West of the valley				
Duny Byas and neighbouring hills	10	0	40	
Tewanpur	0	0	10	
Nayakoth (27.80:85.23)	0	0	3	
North of Kathmandu				
Dhramtuli (27.76:85.30)	0	0	2	
Mukum gaon	0	0	1	
Toka gaon (27.76:85.33)	0	0	15	
Burha Nil Kanth (27.77:85.36)	0	0	2	
Chapaly (27.76:85.36)	0	0	7	
Dhrampur (27.74:85.34)	0	0	20	
South of the valley				
Chitlong (27.67:85.18)	0	0	14	The fort here much injured; a large portion of the breastwork facing south has fallen and wall in many other places seriously injured.
Chisagarhy (27.53:85.17)	0	0	0	
Mukwanpur (27.46:85.15)	0	0	0	The fort here has also suffered but in a much less degree than the one at Chisapany.
<b>Total</b>	<b>414</b>	<b>172</b>	<b>4040</b>	

A subsequent note from the same gentleman, gives further particulars of this disastrous event:

We still continue to be revisited by occasional shocks of earthquake, all less violent than the great one of the 26th, but sufficiently alarming. This morning (28th August), when at breakfast, we had rather a sharp one: they all seem to come from the same direction that is, from the east and north-east. The places east of Katmandu have suffered most: Bhatgaon, a large town, has been almost entirely destroyed; upwards of 1,000 houses have been levelled with the ground, and few have escaped serious injury: 300 souls have perished in this town (Bhatgaon) alone, and the total number of lives lost throughout the valley, as yet ascertained, is estimated at 500. The unfortunate people in many instances are in sore distress; their stores of grain being buried beneath the ruins of their late dwellings, and without money to purchase other food. The grain shops, as well as all others, are shut, and the people dare not return to their houses, but remain without sleep or shelter in the open air, under torrents of rain. The house of Matabar Sing, (a goodly modern mansion) is quite destroyed; and the large garden houses of Bhim Sen, and his brother, Rau Bir are rendered, for the present, untenable. Scarce a large house in Katmandu has escaped serious injury. The fort at Chiropani, on the road to this from the plains, is much injured, and almost all the Government buildings have sustained great injury.

A number of accounts (commentaries) came out in various journals, for details see Appendix I.

#### 4. DISCUSSION

The 26<sup>th</sup> August 1833 earthquake whose epicentre was located within the Nepal Himalaya is one of the four large to major earthquakes of the nineteenth century that devastated India and adjacent northern territories; these are 1803

Garwhal, 1819 Kutch, 1833 Nepal and 1897 Shillong earthquakes. Except the latter for which comprehensive document was published by GSI, the previous three earthquakes occurred before the establishment of GSI; and thus reports on the earthquakes were published in various journals, newspapers etc., often sketchy and incomplete. By the time during the mid twentieth century when these earthquakes were subjected to scientific review for seismological and tectonic studies materials was not readily available. Researchers often utilized partial information that could be accessed at that point of time, resulting sometimes incomplete appreciation of the problem. We wanted to bridge this gap by collating all published data at a single place to facilitate comprehensive scientific appraisal for such earthquakes and in the present compilation we venture to present all available information on the 1833 earthquake. We however do not attempt to analyze the reports for any downstream analysis.

Information on the effects of the 1833 quake was published by Campbell in phases through Asiatic Society of Bengal and all such reports have been reproduced. Damage was quite extensive in India and descriptive accounts of such effects were published in various newspapers like, *Mofussul Akbar*, *Bengal Hurkaru*, *India Gazette etc.* among others. While we were unable to go through these original newspapers in spite best of our efforts, materials published in those papers were reprinted in some journals like; *Calcutta Christian Observer*, *Asiatic Journal and Monthly Register and Baptist Magazine*. Effects of the earthquake from different localities of India have thus been reproduced.

Size of the 1833 Nepal Himalaya earthquake was almost similar to that of the 1803 Garwhal Himalaya earthquake, descriptive account of which has already been published (Dasgupta and Mukhopadhyay, 2014). Hundred years after the 1833 earthquake, a more severe earthquake popularly known as the Bihar- Nepal

earthquake of 1934 again devastated both India and Nepal. Comparing the epicentral locations of the 1833 and 1934 Bihar- Nepal earthquakes vis-à-vis its tectonic implication has become a difficult task because of a number of different epicentral locations were suggested for the 1934 location through various research papers published since the original work of GSI (Dunn et al., 1939). Different locations for the 1934 with increasing shifting towards NE are: 26.30°N: 86.30°E (GSI, Dunn et al, 1939); 26.50°N: 86.50°E (Abe, 1981); 26.77°N: 86.69°E (Seeber and Armburster, 1981); 26.77°N: 86.76°E (Engdahl and Villasenor, 2002); 27.55°N: 87.09°E (Chen and Molnar, 1977) etc. If we compare the locations for the two earthquakes as estimated by Szeliga et al. (2010) for the 1833 event (see above) and that of Chen and Molnar (1977) for the 1934 earthquake, both locate along the same latitude of 27.55°N with a difference of 2 degrees of longitude (~85-87) and in that case the causative fault for both of the earthquakes would be same, the north dipping Main Frontal Thrust (MFT). Recently, Sapkota et al (2012) documents surface rupture along the MFT to correlate with the 1934 earthquake that corroborates the epicentral location of Chen and Molnar (1977) [compare Fig. 5 of Sapkota et al. (2012)]. We however do not intend to deliberate on the details of 1934 earthquake except mentioning that the damage pattern, extent and intensity of the 1934 and 1833 events as recorded from both India and Nepal do not depict similar pattern.

## APPENDIX 1

### Other commentaries from archives

In the November issue of the same journal (1833, *JASB*, II, 564- 567), A. Campbell published his first account on the earthquake under the title 'Account of the Earthquake at Kathmandu' which we reproduce below:

On the 26th of August last, about 6 o'clock P. M. a smart shock of earthquake

was experienced throughout the valley, and the neighbouring hills, westward in the valley of *Nayakot* and *Duny Byas*; eastward at *Panouti*, *Baneppa*, *Dulkele*, and *Pholam Chok*; and southward at *Chitlong*, *Chisagarhy*, *Etounda*, and *Bissoulea*. The shock was preceded by a rumbling noise from the eastward. The motion of the earth was undulatory, as of a large raft floating on the ocean, and the direction of the swell was from north-east towards southwest. The shock lasted about 1 minute. At 10-45 P.M. (not by chronometer but by a good-going clock, which stopped during the great shock, its pendulum vibrated north and south) [*If the clock was set by the sun, the shock must have been 51m. earlier than in Calcutta.—Ed.*] of the same day another shock of equal duration and of the same character occurred, and at 10-58, a third and most violent one commenced: at first it was a gentle motion of the earth, accompanied by a slight rumbling noise; soon however it increased to a fearful degree, the earth heaved as a ship at sea, the trees waved from their roots, and houses moved to and fro far from the perpendicular. Horses and other cattle, terrified, broke from their stalls, and it was difficult to walk without staggering as a landsman does on ship-board. This shock lasted for about three minutes in its fullest force. And the following is as correct an estimate as can be ascertained (without official documents) of the damage done by it to life and property throughout the great valley and neighbouring districts of Nipal. It is believed that the two first shocks were harmless [*Doctor Campbell's subsequent letters inform us, that there have been frequent shocks of less violence since the above, many of which (on the 4th and 18th Oct. particularly) were felt at Calcutta, Monghyr, Chittagong, Allahabad, and Jabalpur, nearly simultaneously. On the 26th Oct. he writes, "At 10h. 45m. A. M. a sharp shock of the dangerous or undulating kind occurred. The embassy has returned from China, and I am informed that the great shock was not felt*

*at Lassa, so that it would appear to have been confined to India within the Himalaya.*"—Ed.]

The above shows that the earthquake was much more severe to the north and east of the valley than here; and that even within the valley it was much more violent to the east of *Kathmandu* than at the capital itself or other places to the west of it. The town of *Bhat gaon* is not more than eight miles in a straight line from *Kathmandu*, and even there its violence must have greatly exceeded what it was at the latter place. To account for the immense disproportion in the loss of life and property at both places, something may be allowed for the more frail state of the buildings at *Bhatgaon*; but this is not sufficient, and this circumstance must be considered as inexplicable as most others attending this fearful phenomenon. The brahmans of Nipal say (and it is believed with truth) that the occurrence of a more violent earthquake than this is recorded in their histories. It was about 600 years ago, and then the cities of *Mangah*, *Patan* and innumerable towns were utterly destroyed and thousands of their inhabitants killed : the modern capital *Kathmandu* did not then exist.

Dr Campbell published further information in the December issue of the same volume (pp. 636-639) under heading 'Further particulars of the Earthquake in Nepal', reproduced below:

In pursuance of the attempt made before to note the destructive effects of the earthquake of the 26th August last, throughout the valley of Nepal, and its immediate neighbourhood, and with the hope of showing, as correctly as my information will permit, the probable seat or central point of the commotion, I beg to offer the following memoranda of other places at which the shock was experienced, as well as its comparative degree of intensity at each.

The means of estimating the violence of this phenomenon are of course most

defective, if not wholly inadequate to the purpose; but in absence of better data, the ascertained amount of damage done to the frail and perishable works of man, may be received as an index of its intensity at one place, compared with that of another, and in conformity to this mode, it would appear, that the most extreme violence of the shock, as far as its occurrence is as yet known, was expended within a tract of country extending from this side of the great Himalayan range on the north, to the course of the Ganges on the south, and from the *Arun* river (in the Nepal hills) on the east, to the western branches of the *Trisul Ganga* on the west, comprising a space of about 200 miles from north to south, and 150 from east to west. In this space, the valley of Nepal, though not geographically the centre point, is most assuredly the portion that has suffered the greatest violence of the calamity ; and, unless the inexplicable producing causes have been expended in the frequent and severe shocks that have to this day continued to recur, we may from our experience of the progress of earthquakes in other parts of the world, with reason, as we ought with resignation, look forward to further and more violent exhibitions of the same terrible nature.

In the notice of the earthquake by the Secretary of the Asiatic Society, in his Journal for August, he expressed a belief, that the greatest intensity of the shock would be found to have occurred beyond the Himalaya, in the direction of *Lassa*; and judging by the direction from which the shock was felt to have proceeded, and its intensity in the valley of Nepal, such was the probability, though other has turned out to be the fact, and that upon good authority.

The recent return from Pekin of an Embassy from Nepal, to the court of the Celestial Emperor, has furnished authentic information on this subject, which otherwise might have been long wanting; and the whole tenor of it shows that the great Himalayan range itself, and the country on this side of it, was alone

## Register of Earthquakes experienced at Kathmandu from 26th August to 26th November 1833

Date	Time	Remarks
August 26th	One at 5h 55m PM; another at 10h 50m; 10.58 PM was the time the great one commenced, and its duration was three minutes	All of the undulating kind, as well as nine others that occurred during the same night [12 shocks]
27th	4.53 AM; 5.20 AM; 5.26 AM	Also undulatory [3 shocks]
28th	7.15 AM; 4.55 PM	Also undulatory [2 shocks]
30th	4 shocks, one at 9 AM [9 PM]	[all undulating, 4 shocks]
31st	2 during the night	Slight [2 shocks]
Sept 1 to 11th	10 shocks	Slight [10 shocks]
October 4th	7.30 AM, a smart one; one minute duration	This was a severe one, and of the vertical kind; it was felt at Gorakhpur and Allahabad
October 18th	1.55 PM [4.55 PM] severe and ushered in a loud noise	Same character as last one; was felt slightly at Allahabad, lasted here at least a minute.
October 26th	10.37 AM, slight	[1 shock]
November 8th	1.35 AM, slight [3.35 AM]	[1 shock]
16th	At mid night	[1 shock]
26th	11.45 PM severe [full moon] In all 39 shocks have been noted; many slight ones have occurred besides.	This was of up and down kind, lasted a minute and occurring at the full moon when the whole people of Nepal were praying at Pasputinath, excited a great commotion and was the only instance where the prophecies of the Brahmins were realized although a hundred lucky moments had for the last three months been determined on for the occurrence of violent shocks

[Not being satisfied with the table, Captain Robinson got reprinted the table through W. B. Clarke in *The Magazine of Natural History and Journal*, London, Volume 8, page 148; here added in italics]

the theatre of the earthquake's presence, and that it was not even in the slightest degree felt beyond a very short distance on the Tibetan side of those huge mountains. The Embassy was at *Lassa*, on the 26th of August, when and where the shock was not experienced. At *Digarchi*, in the following month, it first received accounts of its occurrence from Nepal; to the inhabitants of that place the circumstance was known only from reports brought from this side of the mountains; along the road from *Digarchi*, the answer to all inquiries was the same, "No earthquake on the 26th of August," and not until its arrival at *Tingri* was it found that the shock had been felt. *Tingri* is a small Chinese post, immediately beyond the great Himalaya, and the first

stage on the table land (as it is called) of Tibet, going from hence to *Lassa*, (by the *Kuti* or eastern pass from the valley of Nepal). From *Tingri* to *Kirung*, a distance of 8 or 10 marches, the route is nearly due west, running along; and through the northern side of the Himalaya, and throughout this tract, though but thinly inhabited, authentic reports of the occurrence of the shock were received. By *Kirung* (the eastern pass from the valley into Bhote), the Mission penetrated the great range, and at each stage (four in number through the pass), intelligence of the occurrence was communicated by the few individuals who inhabit that wild and sterile region. But such information was not required, as its effects were sufficiently manifest; in the village of *Kirung* itself, supposed to contain 400

houses, 60 were fairly demolished, and many more seriously injured; two men had been killed under the ruins of their houses, and about a dozen wounded. From the exit of the pass to *Kathmandu* there are no towns along the route, and scarcely any villages; but at many places, insulated houses of the mountaineers had been thrown down, and the precipitous banks of hills and mountains had been hurled into the subjacent valleys.

This shows the extent of damage done towards the north, and enables us to fix upon the line of *Tingri* (Lat. 28°) as the northern limit, of the earthquake's presence, and reports would show that of *Jabalpur* and *Calcutta* to have been the southern one. *Rangpur* [Mr. WALTERS informs me that it was also felt at *Chittagong*.—ED] defines the east and Dehli the west.

North-east from *Kathmandu*, as far as *Dulka* and *Kuti*, the violence of the shock would seem to have been greater than in the valley. West from *Kathmandu* it diminished at every step. At *Gorkha*, only two houses were destroyed; at *Palpa*, none; and at *Doti*, on the borders of *kemaon*, the shock was felt, but not by any means severely. It will strike every one as remarkable, that while here, the shock was more violent than elsewhere; its effects should not have been felt equally at as great a distance from hence to the north as to the south. Why this? is the natural question, but who can answer where all are in darkness. Other explosive forces spread equally in all directions; this did not; granting that the centre was where the violence was greatest. To the south, the country is a level, uninterrupted plain, calculated to facilitate the rapid transmission of the agitating force, while to the north are the mightiest mountains of the world; it may therefore be supposed, that the quantity of force expended in reaching to the summits of the Himalayan peaks, and in shaking like molehills the whole of the mountain region around, could not be far short in intensity of that required to agitate slightly the plains to the southward, even to the

distance above recorded. In this light, it may be imagined, that the explosive force may have spread itself equally on all sides, the greater surface distance to which it reached towards the south being balanced by the immense vertical spaces it traversed in shaking from their bases to their summits the innumerable hills and mountains of the extensive region lying between the plains of Hindustan and those of Tibet.

I subjoin an accurate register of the shocks which have occurred up to this date, given me by Captain Robinson. Many of them have been severe, and throughout the whole course of these visitations, there have been two distinct varieties observed in the character of the shocks: all those at the commencement were of undulatory or swinging kind; the others wanted this swell, and were a violent up and down shaking, with little lateral, motion. The first may be called the horizontal, the latter the vertical, variety. The former alone have been destructive to property, while the latter, from the greater noise by which they are accompanied, and the more rapid oscillations of the ground, are perhaps the more terrifying.

The above account on the earthquake of 26 August 1833 gives a clear picture on the possible epicentral location, the size and the extent of damage of the earthquake. We shall now proceed to reproduce the effects of the earthquake that was described from different locations in India and published in various newspapers and other sources. Most of the newspaper reports were subsequently published in the '*Asiatic Journal and Monthly Register for British and Foreign India*' (Volume 13, New Series, January-April, 1834; part II- Asiatic Intelligence, 156-159, 195, 241).

On the 26th August, shocks of a very severe earthquake were felt at the presidency and in various parts of the interior. At **Calcutta** there were three shocks, which set hanging lamps in motion; but the oscillations, though very distinct, were not strong enough to do injury to any building.

At **Agra**, the shocks were rapid and strong, lasting a few seconds each, but produced no injury.

At **Lucknow**, there were four shocks, the first about sunset, the others between 11 and 12 p.m. The tremulous motion of two of the shocks resembled the motion felt in a steam-vessel; the rocking caused the beams of the houses to creak, the lamps to swing to and fro, and in one house fragments of a cornice to fall.

Additional information from Lucknow is reproduced from Anon (1834a):

On the 26<sup>th</sup> of August, 1833, the city of Lucknow, the capital of Oude, was visited at midnight by the alarming earthquake which shook India from the snowy mountains of Himalaya, even to the distant ocean. The dreadful scourge of cholera had for some time previous been sent to afflict people....sudden death in an awful form threatened every family, and superadded to the apprehension from this mortal scourge it was very awful to be awake at midnight by an earthquake! The beams of the houses creaked, the lamps and punkas swung to and fro, the walls moved, and a tremulous motion, fearfully distinct, shook the whole earth. The tall minarets trembled in the sky, and the trees were shaken at their base; even the birds in the branches were aroused and evinced their apprehensions by their clamours. The sagacious elephants were awakened, and rose from their lairs, and showed their consciousness by that peculiar hollow noise in their trunks. The people left their houses, now sensibly rocking with the troubled earth, and sought safety in the open air, fearfully awaiting the result, and expecting every moment to hear the crash of falling buildings! The stoutest heart quailed, and at such an awful time, when the earth rocked beneath the feet, there was something peculiarly striking in hearing the sudden simultaneous and loud mingling of prayer from every quarter of the city; from thousands the appeal to the Almighty, *Ullaho Akbar*..... God is great! [CCO, III, 336- 338]

We go back to the original document (Anon, 1834b) to extract and reproduce damage information for more localities.

At **Tirhoot** [26.11N: 85.40E] the earthquake was visited at 6 p.m., of the 26<sup>th</sup>, with a severe shock of an earthquake, which began with a motion from E. to W., and was repeated at 11 and 12 with double violence, continuing at intervals throughout the night until 6, next morning. The two shocks in the middle of the night were most awful, lasting, I should think, each time more than a minute. The bungalow in which I reside was violently shaken, rocking to and fro; the doors and wall-shades were equally agitated, and the walls were rent in many places. The walls of my press-house and drying-house were opened in several parts, and the water in the reservoir four feet deep, and three from the surface, was so much agitated, as to fly over on each side. The atmosphere, during the night, was very dense and warm and the moon nearly obscured. I have been in India many years, and I never experienced any thing half so awful as the shocks during the flight.

**Purneah**, August 27—This place has been visited by the severest shocks of earthquake within the memory of the oldest inhabitant; the following is as correct an account of it as I was able to preserve.

1st shock at ½ past 5 P.M., rather slight; 2d at 11 PM severe; 3d at 18 past 11 PM, most violent.

So great was the undulation, that birds were driven from their nests, men scarcely able to keep their feet, and the cattle running about wild with fright; during this severe shock, several old buildings in the town tottered to pieces, and a part of one in the station partially sunk; a heavy cornice of a newly-erected wall in a gentleman's bungalow came boldly down, and literally smashed a table and some chairs to pieces;—every building has suffered more or less;—a recently-vacated upper-roomed house has not an

arch left, large masses of bricks having actually fallen out; the roof in many places split, and the beams and burgahs separated by an inch or more; the out-offices in this compound are in a heap of ruin.

4th shock at 28 minute past 11 P.M. slight; 5th at 32 m. p. 11 PM: slight; 6<sup>th</sup> at 46 m. p. 11 PM: slight; 7th at 1 AM: slight; 8th at 25 m. p. 3 AM: slight; 9th at 52 m. p. 5 PM: slight; 10th at 8 AM: rather severe.

I am led to infer, from the stoppage of a clock and other testimony that the undulation came from the southward and traversed east. During the third and severest shock, a heavy fell of rain fell to the south, accompanied by much wind.

**Buxar**, August 27.—Last night, several very smart shocks of an earthquake were felt. The first decided one took place at 11h.20m. PM. but the smartest of all at 11h 55m; each continuing for several minutes in a direction apparently from N. to S. The latter was so severe as to cause the members of all the families resident here to run into the open air to secure themselves against the danger which seemed about to overwhelm them. The motion was so strong as to upset several wall-shades and glasses in one of the bungalows here, and the general rattling of doors and windows and the creaking of rafters were really most alarming. The undulating motion of the ground was so great, as to cause horses that were asleep to start up suddenly with every mark of alarm, and the birds roosted upon the trees to rise into the air, uttering wild cries. Strange to say, the violence of the shock *seemed* a good deal bounded by the river; as, at Koruntadhee, immediately opposite to Buxar, the motion of the earth was so little felt as hardly to awaken a single individual; whereas, on the right bank of the river, all were obliged on the instant to evacuate their habitations and run into the open air. The effect on the water, about six miles above Buxar, as described to me, was that of a rocking motion, as if occasioned by a heavy swell consequent on an east wind.

**Monghyr**, August 27th —We were last night visited with a succession of seven shocks of earthquake from five o'clock last night till half-past eight this morning, in which many fine houses have been much injured and some totally destroyed. It was truly awful to hear the cries of the people and crash of houses falling, the ringing of bells, beating of tomtoms, the Mussulmans at prayers, and all the population of Monghyr, of every description, out in the open air; the ground every five minutes shaking and trembling in a frightful manner. There were upwards of twenty-five shocks during the night, and five after day-break, and upon the whole, the night in some degree resembled that awful night in Egypt when there was one dead in every house.

Additional information on damages from Monghyr is from Anon (1833):

Our readers are perhaps aware, that on 26<sup>th</sup> September [*it must be August, as there was no reported aftershock on 26<sup>th</sup> September*], the night of the earthquake, Mrs. Chamberlain, the widow of the late Rev. J. Chamberlain, expired. She did so under circumstances peculiarly afflicting to her friend. The dreadful shocks which followed in quick succession having cracked the walls of the house in which Mr. and Mrs. Leslie with Mrs. Chamberlain resided, the former were obliged to leave the house, and in her dying moments to remove Mrs. C. to the open air, where after a few hours she expired. . . . On the 4<sup>th</sup> October [*there was a smart and severe aftershock also felt at Gorakhpur and Allahabad*] there was experienced another shock of an earthquake at Monghyr, after which Mr. Leslie's residence was deemed, by a survey, so unsafe, as to render residence in it quite dangerous. It will therefore be immediately taken down. The house of the Rev. Mr. Moore and of others at the station has been much injured.

Extract from the original letter of Mr. Leslie (see above) from Monghyr was published in the *Baptist Magazine* Vol. 26, 1834, 178;

relevant portion from the letter is also reproduced below.

....Could I get another I should certainly leave our present abode. I fear, however, that we may soon be compelled to leave it. A violent earthquake occurred 11 o'clock on the night of 26<sup>th</sup> inst. has shattered the walls on every side. Another such shock will level it with the ground. The wall of the room in which I am now sitting was split from head to foot in three places. One of the openings is an inch or an inch and a half wide. Other houses, stronger than ours, have shared the same fate. I never experienced any thing like the awful commotion. The earth literally reeled to and fro, and staggered like a drunken man. There was simultaneous shout of consternation through the whole city. We have often had shocks of earthquakes in this part of India, but never was anything known similar to what has recently occurred....Hearing all the house cracking, and feeling myself violently rocked in bed, I rose up, jumped over a high wall at the back of the house, got round as well as I could to the front, where Mrs. C. and Mrs. L. and a young lady were. We carried Mrs. C out of the room under what is called verandah, and there waited for a number of hours, in awful expectation, amidst shocks which were at intervals of twenty minutes till six in the morning. Since then we have had at longer intervals, shocks extending through two days; but as I have not been sensible of any for the last sixteen or eighteen hours, I should hope they have now ceased..... The shocks of earthquake continued till 5<sup>th</sup> inst. when they ceased. Our house is so much shattered that I fear I shall have to pull it down..... But much as we suffered, we have sustained little injuries compared with some others. One of the largest and best buildings of the station is completely ruined. Others are nearly in the same state. It is reported here that 500 persons were killed in Patna.

**Patna**, August 28.—But now we have recovered from the horror of the earthquake. Its first access was half-past

six on the evening of Monday, and I distinctly felt the shock, but as I was not supported by any observation of a similar tendency, I began to think it must have been fancy. About half-past eleven PM I was awakened by a horrid rattling, and shocks apparently from E. to W. with a rumbling noise, the servants running into the room in great consternation. This was the first of two very severe shocks, the last of which occurred at midnight, and the oldest inhabitants here say, that a severer one they never remembered. It is quite impossible to describe the horrors of these two shocks. Several houses at **Bankipore** have been cracked by the earthquake, amongst which are the magistrate's cutcherry, and in the city, the opium godown has shared the same fate as well as the great gate-way built by Maha Rajah Metre Jeyt Sing, while many of the pukka native dwellings have bodily fallen. At **Dinapore**, the former brigade major's house was split and some houses between Patna and **Diggah**. Eighteen shocks were counted by some, but they appeared continuous. The last was at eight A.M. Almost all the inhabitants left their houses during the continuance of the shocks and remained out the whole night. There was a strange look in the heavens for forty-eight hours preceding the earthquake, and the weather very oppressive; not a breath of wind; the Thermometer 86° 17'.

In another journal (Anon1834c, page 218) one Mr. Lawrence wrote on the earthquake from Digah [*Diggah*]

August 26<sup>th</sup>, 1833: For some days past it has been hot and close, and this evening particularly sultry. About half-past eleven as I was sitting at my desk writing, I suddenly became giddy, and felt as though I could not sit still. For a few seconds I thought that I was taken ill, and was about to rise, unable to account for so singular sensation, when I perceived every thing around me moving, and heard the doors and windows begin gently to clatter. I was then convinced that it was an earthquake. I proceeded to Mrs. L. who was in bed,

and in a few minutes another shock, somewhat more severe than the former, commenced; it lasted scarcely a minute, but it made every thing in the house tremble, and produced a sensation very much resembling sea sickness. There have been several other tremblings of the earth, but they can scarcely be called shocks. This morning (27<sup>th</sup>) I have been informed that the earthquake was felt severely in the bazaar; several houses were thrown down, and many of the natives ran out of their houses in consternation, expecting they would fall upon them.

We retrieved a firsthand account on the earthquake as felt at **Allahabad** from an unlikely source in a book ‘Wanderings of a Pilgrim....’ by Fanny Parks Parlbly (1850). The author was the wife of Charles Crawford Parks, a Bengal Civil Service Official who during the period was posted at Allahabad as Collector (of Customs). *Memsahib* Fanny Parks write (p. 285):

I was sitting in my dressing room, reading and thinking of retiring to rest, when the Khansaman ran to the door and cried out ‘MemShiba, did you feel the earthquake? The dishes and glasses in the almirah (wardrobes) are all rattling’. I heard the rumbling noise, but did not feel the quaking of the earth. About half-past eleven, PM, a very severe shock came on, with a loud and rumbling noise; it sounded at first as if a four-wheeled carriage had driven up to the door, and then the noise appeared to be just under my feet; my chair and table shook visibly, the mirror of the dressing glass swung forwards, and two of the doors nearest my chair opened from the shock. The house shook so much, I felt sick and giddy; I thought I should fall if I were to try to walk; I called out many a times to my husband but he was asleep on the sofa in the next room and heard me not; not liking it at all I ran into the next room, and awoke him; as I sat with him on the sofa, it shook very much from another shock or rather shocks, for there appeared to be many of them; and the table trembled also. My ayha came in from the verandah and said,

‘The river is all in motion, in waves, as if a great wind were blowing against the stream.’ The natives say tiles fell from several houses. A shoeing-horn that was hanging by a string to the side of my dressing glass swung backwards and forwards like the pendulum of a clock. The giddy and sick sensation one experiences during the time of an earthquake is not agreeable; we had one in September, 1831 but it was nothing in comparison to that we have just experienced. Mr. D. and Mr. C. who live nearly three miles off, ran out of their bungalows in alarm.

More information on the 1833 earthquake particularly on its continued aftershocks as appeared in different newspapers and subsequently reprinted in journals are collated; e.g., while discussing the affairs of the *State of Rajpootana* (Anon 1834b, page 195) that earthquake shocks continued to be felt in the various parts of the territories under the presidency and in the month of October, some of them were severe. This suggests that aftershocks were strong enough to be felt as far west as Rajasthan. Descriptive accounts for other places in India continue, and reproduced from page 241 of the same journal.

The *Meerut Observer* reports another earthquake which was not felt in Calcutta: **Meerut** was visited on the night of 20th September [*aftershock*] by a smart shock of an earthquake. It continued for about fifteen seconds, but was not severe enough to do any mischief.

A correspondent, writing from **Goruckpore**, says that that station was visited on the 18th October, at twenty minutes to five A.M., by “a most tremendous earthquake,” which apparently “came from east to west, and lasted for nearly one minute.” He adds that it was much severer than that which was experienced on the 26th of August last.—*Englishman*.

A letter from **Monghyr** dated the 4th instant states: At half past seven, a shock of an earthquake was experienced there,

which lasted one minute and a half! It is described to have been quite as severe as that experienced on the 26th August, and have alarmed the inhabitants so much as to have caused them to quit their houses. Fortunately, however, no damage occurred. The shock felt here on the same morning was very slight indeed, so much so that many did not feel it at all.—*Bengal Hurkaru, Oct. 11.*

**Jionpor.**—Another earthquake was felt here on the 4th, at or about eight in the morning; the shock was sudden and smart, and lasted a few seconds; it shook all the jillmills and doors. What are we to expect? The natives predict a famine as the consequence. The meteor I wrote about last week was seen by a friend of mine, and he describes it thus: “An immense ball of fire, apparently larger than the moon, rose in the east and set in the west, passing with great rapidity; shining most brilliantly, and emitting numerous star-shoots or small meteors as it passed, leaving also a broad whitish light behind it, which rapidly disappeared; it happened between four and five in the morning of the 20th of last month.”—*Mofussil Ukhbar, Oct. 12.*

Further accounts have been received from Nepaul, describing the terrible effects of the earthquake of August at Lassa, where the destruction of lives and buildings has been greatest. A late number of the *Mofussil Ukhbar* has a long article upon the last earthquake, in which the writer concurs with the author of the article in the *Journal of Science*, in tracing the seat of the disturbing cause to some unknown spot among the Himalaya mountains. A fact is mentioned in the Chupra Report, which merits the attention of our geologists, if true, but which we should hesitate to believe without further details, namely, that the earth opened, and a chasm of some depth was formed about two miles from that place.—*Cal. Cour.*

An opinion prevails among the majority of Hindoos, that Benares forms no part of this globe, but is fixed upon the trident of Siva; and that an earthquake, which

may affect the rest of India, will not be felt at that sacred place. This opinion is by the pundits deemed a vulgar error which is now abundantly established by the fact, that the earthquake of the 26th of August last was felt severely at **Benares.**—*Sumachar Durpun*

In addition to certain corrections in the Table provided by Dr Campbell (see above), some information on the aftershocks is provided by W.B. Clarke, within the article ‘On certain recent meteoric phenomena etc’, published in *The Magazine of Natural History and Journal*, London, 1835, 8, 148-152. After printing the table it states:

The undulating shocks were destructive to property; but the vertical shocks were accompanied by a violent noise, and more rapid oscillations of the ground. The shocks of Oct. 4 and 18 were felt nearly at the same moment, at Monghyr, Calcutta, Allahabad, Chittagong and Jubalpoor. At Kat Sing Choke, northeast Nepal there were noises for five days previous, like firing of cannon..... The Brahmans say that about 600 years ago a far more frightful earthquake occurred, doing greater damage far and near. The country shaken by these earthquakes was that comprised between Tingri, Calcutta, Rangpoor and Delhi, a tract of 3000 square miles in and south of the Himalaya range.

We have brought together and reproduced all available published documents with descriptions of effects of the 26 August 1833 earthquake and its aftershocks both from Nepal and India. These are all first hand observations and obviously constitute important datasets for any subsequent analyses and review. After these initial publications at least three compilations were published subsequently by Baird-Smith (1843), Robert Mallet (1855) and Thomas Oldham (1883). So far as the 1833 earthquake is concerned these later publications are also important as these are the basic source which the contemporary researchers have extensively referred. Again these

documents particularly that of the first two, are not easily available in the public domain. We have thus reproduced all three these documents in spite of several repetitions with already that have been presented above.

We reproduce materials published by Baird-Smith (1843, *JASB*, 12, 1046-1054) except the tables that are already reproduced above.

The first shock of this Earthquake was experienced at Katmandu, the modern capital of Nepaul, about 6. P. M. It extended throughout the valley and neighbouring hills, being felt westward in the valley of Nayakot and Duny Byas: eastward at Panouti, Banepa, Dulkele and Pholam Chok; and southward at Chitlong, Chisagarby, Etounda and Bissoules. The shock lasted about 40 seconds, and during its continuance, there was a distinctly audible noise as of ordnance passing rapidly over a drawbridge. This rumbling noise came from the Eastward, and Dr. Campbell says, "I felt it was travelling with the speed of lightning towards the West, and just under my feet: the houses shook most violently, and trees, shrubs, and the smallest plants were set in motion, not shaking, but waving to and fro from their very roots." No injury to life or property was done by this first shock, either in Nepaul or in its course to Calcutta, where it appears to have been experienced at about 6h. 28m., Katmandu time. The motion of the earth was undulatory, as of a large raft floating on the ocean, and the direction of the swell was from North-east towards South-west.

At 10 h. 45m., by a good going clock, a second shock occurred, of the same intensity, equal duration, and like character with the preceding. This also was experienced at Calcutta.

The great shock was felt at Katmandu at about 5 minutes to 12 P. M., Calcutta time. It commenced very gradually by a gentle motion of the earth, accompanied by a slight rumbling noise: soon however it increased to a fearful degree, the earth

heaved as a ship at sea, the trees waved from their roots, and houses moved to and fro from the perpendicular. Horses and other cattle terrified broke loose from their stalls, and it was difficult to walk without staggering as a landsman does on ship-board. Dr. Campbell, as an eye-witness, thus describes the scene: "The earth heaved most fearfully, and when the shock was at its worst, we heard the clashing of falling tiles and bricks in every direction: and to add to the impressiveness of the scene, a general shout rose from the people in all directions. The murmur of human prayers was carried audibly from the city to our grounds, (a mile,) and nothing could be more imposing and vast than the whole scene. In a dead calm, the noise of an hundred cannon burst forth: full grown trees bended in all directions, and houses reeled about like drunken men. In our grounds no lives were lost; but in Katmandu 19 persons were buried under the ruins of their own houses, and in the towns of Bhatgaon and Patan, many more." Dr. Campbell's estimate of the duration of this great shock, varies in his letters and memorandum published in the *Journal of the Asiatic Society*, (Vol. II. p. 439-564). In the former the duration is said to have been one minute, in the latter, three minutes at its fullest force. During the following hour, from 12 to 1 A. M., there were six distinct and strong shocks, the ground in the intervals being scarcely, if at all steady, and from midnight of the 26th to the morning of the 27th, twenty shocks are said to have been felt, while during the whole of the 27th and 28th, the earth was in a constant state of "tremblement"

The comparative intensity of the shock at different points in its course can only be estimated, in the absence of proper instruments, by its destructive effects on buildings when exposed to its influence. Dr. Campbell has furnished me with materials, which in this point of view are valuable, by having collected accounts in detail of injuries sustained by the various towns throughout the valley of Nepaul, arranging these with reference to their

bearing from Katmandu as a central point. This Table I here transcribe:

The table under reference has already been given with the first note of Dr Campbell (see above) and hence not repeated.

The preceding details establish very distinctly, that toward the North and East of the valley, the disturbing force was much more violent in its action than toward the South and West. In the former direction therefore we are to look for the focus of the shock, and it seems probable, from all the facts recorded, that this was situated among the hills which bound the valley of Nepal on the North-eastward. As Dr. Campbell's views on this point coincide with my own, I will take advantage of his remarks upon it: "It would appear," he says, "that the most extreme violence of the shock, so far as its occurrence is as yet known, was expended within a tract of country extending from this side of the great Himalayan range on the North, to the course of the Ganges on the South, and from the Arun river (in the Nepal hills) on the East to the Western branches of the Trisul Ganga on the West, comprising a space of about 200 miles from North to South, and 150 from East to West. In this space, the valley of Nepal, though not geographically the central point, is most assuredly the portion that has suffered the greatest violence of the calamity," and may therefore be fairly considered as the spot whence the shock emanated.

The intensity of the shock to the North-east of Nepal, and the direction of its motion, had led Mr. Prinsep, in his notice of the Earthquake, to anticipate intelligence of some fearful catastrophe in the vicinity of Lassa, in Thibet. By a most fortunate coincidence, Dr. Campbell was enabled to collect some information which elucidated this point in an interesting manner. In the notice of the Earthquake by the Secretary to the Asiatic Society, in the Journal for August (1833) Dr. Campbell remarks: "he expressed a belief that the greatest intensity of the

shock would be found to have occurred beyond the Himalayas, in the direction of Lassa;" and judging by the direction from which the shock was felt to have proceeded, and its intensity in the valley of Nepal, such was the probability, though other has turned out to be the fact, and that upon good authority.

The recent return from Peking of an Embassy from Nepal, to the Court of the Celestial Emperor, has furnished authentic information on this subject, which might otherwise have been long wanting: and the whole tenor of it shows, that the great Himalayan range itself, and the country on this (the South) side of it, was alone the theatre of the Earthquake's presence, and that it was not even in the slightest degree felt beyond a very short distance on the Thibetan side of these huge mountains. The embassy was at Lassa on the 26th August, when and where the shock was not experienced. At Digarchi, in the following month, it first received accounts of its occurrence from Nepal: to the inhabitants of that place the circumstance was however only from reports brought from this side of the mountains: along the road from Digarchi the answer to all enquiries was the same, "no Earthquake on the 26th August," and not until its arrival at Tingri, was it found that the shock had been felt. Tingri is a small Chinese post, immediately beyond the great Himalaya, and the first stage on the table-land (as it is called) of Thibet, going hence to Lassa (by the Kuti or Eastern Pass from the valley of Nepal.) From Tingri to Kirung, a distance of 8 or 10 marches, the route is nearly due West, running along and through the Northern side of the Himalaya; and throughout this tract, though but thinly inhabited, authentic reports of the occurrence of the shock were received. By Kirung (the Eastern Pass from the valley into Bhote) the mission penetrated the great range, and at each stage (four in numbers through the Pass) intelligence of the occurrence was communicated by the few individuals who inhabit that wild and sterile region. But such information was

not required, as its effects were sufficiently manifest: in the village of Kirung, itself, supposed to consist of 400 houses, 60 were fairly demolished, and many more seriously injured : two men had been killed under the ruins of their houses, and about a dozen wounded. From the exit of the Pass to Katmandu there are no towns along the route, and scarcely any villages: but at many places, insulated houses of the mountaineers had been thrown down, and the precipitous banks of hills and mountains had been thrown into the subjacent valleys.

Tingri, therefore, in latitude  $28^{\circ}$  may be fixed upon as the extreme Northern limit of the influence of the shock, and I now proceed to trace its progress in other directions. Before, however, quitting the valley of Nepal, I may mention as an interesting fact, that torrents of rain fell immediately after the Earthquake, washing down many of the walls which had previously been only shaken.

In tracing the course of the Earthquake to the westward of Nepal, the diminution of its intensity is remarkably exhibited. At Gorkha, Dr. Campbell mentions, that only two houses were destroyed; at Palpa farther to the Westward, none; and at Doti on the borders of Kemaon, the shock was felt, but by no means severely. At Lohoozhat in Kemaon, Dr. McClelland states that it was scarcely felt at all, so slightly indeed, that he himself was unconscious of its occurrence, although it was perceived by a friend on whose authority he registered it. In the mountains, therefore, the influence of the Earthquake appears, in so far as shown by the information recorded, to have extended from the meridian of Lohoozhat, about  $80^{\circ}$  E. to that of Tingri, about  $87^{\circ}$  E. or over about  $7^{\circ}$  of longitude. In the plains, however, it extended considerably farther both to East and Westward. In the latter direction, the extreme point appears from the published accounts to have been Delhi, in longitude  $77^{\circ} 16'$  E., or nearly  $3^{\circ}$  farther to the West than Lohoozhat. Toward the East, the

boundary was the meridian of Chittagong,  $91^{\circ} 42'$  E. in the Plains, or nearly  $5^{\circ}$  to the Eastward of Tingri, which so far as we know, formed the corresponding limit in the mountains. The Southern line appears to have been nearly the parallel of  $22^{\circ}$  N. latitude. Thus then the entire range of the Earthquake of August 1833, was from between  $28^{\circ}$  and  $29^{\circ}$  to  $22^{\circ}$  North latitude, and from about  $77^{\circ}$  to  $92^{\circ}$  East longitude, embracing accordingly  $7^{\circ}$  of latitude and  $15^{\circ}$  of longitude; a superficial extent, upwards of four times that of the British Isles, and about twice and a half that of the kingdom of France!

Baird-Smith (1843) further quotes comments of James Prinsep, Editor *JASB* as follows but do not refer to the source. The text is as below:

As all comment on the phenomena of this shock is reserved to a future period, I need only now state, that I am not aware of any Earthquakes having occurred in Nepal since 1833. I ought however before this to have mentioned that in 1829, daily shocks continued to recur for 40 days, although none were equal in intensity to that of the 26th August, 1833. The following Register of the shocks that followed the great one of the 26th was kept at Katmandu by Captain Robinson. Regarding them Dr. Campbell remarks: Many of them have been severe, and throughout the whole course of these visitations, there have been two distinct varieties observed in the character of the shocks, all those at the commencement were of the undulatory or swinging kind: the others wanted the swell, and were a violent up and down shaking, with little lateral motion. The first may be called the horizontal, the latter the vertical variety. The former alone have been destructive to property, while the latter, from the greater noise by which they are accompanied, and the more rapid oscillations of the ground, are perhaps the more terrifying.

We next go to the accounts given by Robert Mallet (1855) for the earthquake of 26 August

1833 and reproduce his notes as contained (pages 238-239) in Third Report on the Facts of Earthquake Phenomena- Catalogue of recorded earthquakes from 1606 BC to AD 1850.

August 26; 5h 30m or 6 PM and again at 11 and 12, the latter being the most violent. The time of the principle shock for several of the places was as follows reducing to Calcutta time— At Calcutta (the second shock) 11h 34m 48s. At Katmandu, 10h 57m; At Rungpur, 11h 18m; At Monghyr, 11h 34m; At Arrah, 11h 29m; In the Rotas Hills, 11h 39m; At Gorackpur, 11h 39m; At Allahabad, 11h 28m; At Bankura (Rampoora?) 11h 34m.

Locality: Calcutta, Agra, Lucknow, Tirhoot, Purneeah, Patna, Buxar, Allahabad, Monghyr, Katmandu, &c.; in fact all over the centre and east of northern India, especially in Nepal. Also felt at Lassa.

A violent earthquake: At Calcutta there were three shocks, at Lucknow four, at Purneeah three, and at each of the other places mentioned, several shocks of great violence, besides numerous slighter ones. The most violent were those at the hours mentioned, but the slighter ones continued to recur at intervals until the following October, some of the shocks during that time being rather severe. Each of the shocks lasted but a short time, generally 3 or 4 secs. but some mentioned of a minute's duration. At Tirhoot the motion was from E to W, at Buxar apparently from N to S, at Calcutta from NE to SW, at Katmandu in Nepal apparently from E to W. All the shocks came from E or NE. At Katmandu the motion lasted about 40 seconds. At Purneeah the direction is given as S to E. At most places the earth was in almost continual agitation for twenty- four hours.

Water in many places (was) thrown out of the tank, as at Tirhoot from a tank of 4 feet deep in which the surface of the water was 3 feet below the edge. Birds were thrown out of their nests, cattle were greatly frightened, and men could scarcely keep their feet. At Buxar the

shocks were felt with great violence on one side of the river, and but very little on the other. Accompanied in many places by loud subterranean noises, especially at Katmandu, where the most violent shock (at 11 PM) was attended by a noise compared to 100 pieces of artillery. Here also (at Katmandu) the trees and even the smallest shrubs waved in the air from their roots. Above 100 houses were leveled in a moment, and at other places still greater loss of buildings and life occurred. At Chupra a chasm opened in the earth of considerable length and depth. Preceded by very close and oppressive weather, and followed in several places by wind and rain.

The last and final document on the 26 August 1833 is from Thomas Oldham (1883) published in GSI Memoir, 19. The transcript is as follows:

1833 August 26<sup>th</sup> - Nepal and all over the centre and east of northern India – At Katmandu, accompanied (11 PM) by a loud subterranean noise, compared with the noise produced by the discharge of 100 pieces of artillery. More than 100 houses were leveled in a moment, and equal or worse destruction in other places. Trees and even the smallest shrubs rocked from their very roots. At Chupra, a chasm of considerable size was said to have been formed in the earth. In Tirhoot, water thrown out of tanks, 4 feet deep; the water of which was 3 feet below the edge. Birds thrown out of their nests; Men could not keep their feet. At Buxar, shocks said to have been felt violently at one side of river and not at the other proceeded by very hot close weather, and in many places succeeded by stormy winds and heavy rain.

The direction of the motion is very variously stated. At Tirhoot, said to have been from east to west; at Baxar, from north to south; at Patna, apparently east to west; at Calcutta from, north-east to south-west; at Katmandu apparently east to west; all shocks came from east to northeast! Each of the shocks lasted only

three or four seconds generally, but some are stated to have lasted one minute. At Lucknow, four shocks are reported; at Calcutta, three; at Purneah, three. In all places, several shocks of greater violence (reported), besides numerous slighter ones. At most of the places, the earth was in almost continuous agitation for 24 hours.

### BIBLIOGRAPHY

- Abe, K. Magnitudes of large earthquakes from 1904 to 1980. *Physics of the Earth and Planetary Interior* 27 (1981): 72- 92.
- Ambraseys, N. & Douglas, J. Magnitude calibration of north Indian earthquakes. *Geophysics Journal International* 159 (2004): 570-582.
- Anon. Additional information from Monghyr and Lucknow. *The Calcutta Christian Observer*, II (1833): 559; III (1834a): 336.
- Anon. Earthquake Reports from different Indian Stations in Newspapers. *Asiatic Journal and Monthly Register for British and Foreign India*, 13, New Series, part-II, (1834b):156-159; 195; 241.
- Anon. Letter of Mr. Leslie from Monghyr and Mr. Lawrence from Digah. *Baptist Magazine*, 26, (1834c): 178, 218.
- Baird-Smith, R. Memoir on Indian Earthquakes. *Journal Asiatic Society of Bengal*, 12, Part II New Series 144 (1843): 1046-1054.
- Bilham, R. Location and magnitude of the 1833 Nepal earthquake and its relation to the rupture zones of contiguous great Himalayan earthquakes. *Current Science*, 69, 2, (1995): 101-128.
- Bilham, R., Bodin, P. & Jackson, M. Entertaining a great earthquake in western Nepal: Historic inactivity and geodetic tests for the development of strain. *Journal of Nepal Geological Society* 11, 1 (1995): 1-25.
- Campbell, A. Account of the Earthquake at Kathmandu. *Journal Asiatic Society of Bengal*, II, (1833): 564-567.
- Campbell, A. Further particulars of the Earthquake in Nepal. *Journal Asiatic Society of Bengal*, II, (1833): 636- 639.
- Chen, W-P & Molnar, P. Seismic moments of major earthquakes and the average rate of slip in central Asia. *Journal Geophysical Research* 82, 20 (1977): 2945-2969.
- Clarke, W.B. On certain recent meteoric phenomena etc. *The Magazine of Natural History and Journal*, London, 8, (1835): 148-152.
- Dasgupta, S. & Mukhopadhyay, B. 1803 earthquake in Garhwal Himalaya- Archival materials with commentary. *Indian Journal of History of Science* 49.1 (2014): 21-33.
- Dunn, J.A., Auden, J.B., Ghosh, A.M.N., Wadia, D.N. & Roy, S.C. The Bihar- Nepal Earthquake of 1934. *Memoirs of the Geological Survey of India*, 73 (1939): 1- 391.
- Engdhal, E.R. & Villasenor, A. Global Seismicity: 1900-1999. *International Handbook of Earthquake and Engineering Seismology* 81A (2000): 665-690.
- Mallet, Robert. Third report on the facts of earthquake phenomena- Catalogue of recorded earthquakes from 1606 BC to AD 1850. (1855): 238-239.
- Oldham, T. A Catalogue of Indian Earthquakes from the earliest time to the end of AD 1869. *Memoirs of the Geological Survey of India* 19 Part 3 (1883).
- Parlby, F.P. Wanderings of a Pilgrim, I, *Pelham Richardson Cornhill, London*, (1850): 285.
- Prinsep, James. Earthquake of the 26th August. *Journal Asiatic Society of Bengal*, II, (1833): 438-439.
- Sapkota, S.N., Bollinger, L., Klinger, Y., Tapponnier, P., Gaudemer, Y. & Tieari, D. Primary surface ruptures of the great Himalayan earthquakes in 1934 and 1255. *Nature Geoscience DOI: 10.1038/NNGEO1669* (2012): 1-6.
- Seeber, L. & Armbruster, J.G. Great detachment earthquakes along the Himalayan arc and long term forecasting. *In Earthquake Prediction- An International Review. Maurice Ewing Series* 4 (1981): 259-277.
- Szeliga, W., Hough, S., Martin, S. & Bilham, R. Intensity, Magnitude, Location, and Attenuation in India for Felt Earthquakes since 1762. *Bulletin of the Seismological Society of America* 100, 2, (2010): 570-584.