

Remarks on Two Hindukush Earthquake Shocks

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(Received 27th June 1949)

ABSTRACT. Results of Coulson's study of two Hindukush earthquakes of February, 1929 and November, 1939, given in a number of his publications during 1929-41, are critically analysed in the light of seismic and macroseismic data and information obtained from his papers and various other sources. Additional materials now available enable the delineation of complete isoseismals of the first shock, presumably for the first time, for any Hindukush earthquake. From seismological evidence and the isoseismals drawn in this paper, large discrepancies of locations of the epicentres and the isoseismals drawn by Coulson and a few other fallacies in his arguments, are pointed out. The area shaken by the moderately large earthquake of February, 1929, is found to be half that shaken by the largest historic earthquake of June, 1897 and about 8 times that due to the disastrous Quetta Earthquake of May, 1935.

1. *The earthquake shock of 1st February, 1929 (17 h. 14 m. GMT).*

From reports received from Meteorological Observers who felt the shock Coulson^{1,2} has drawn isoseismals and placed the epicentral tract of the shock of the 1st February 1929, between Rawalpindi, Peshawar, Srinagar, Gurez and Drosh. Based on seismological data and siesmograms from the Indian Observatories, the epicentre has been located at about 25 miles north-west of Abbottabad within the epicentral tract. This position is some 200 miles to the south-east of the epi-

centre $36^{\circ}.5$ N., $70^{\circ}.5$ E. given in the International Seismological Summary (I.S.S.)³ from an analysis of the seismological data from the different observatories of the world. This epicentre has been accepted by various investigators,^{4,8} either in connection with their investigations on deep focus earthquakes in general or a special study of this shock. Nevertheless, Coulson in his concluding remarks about this earthquake has retained the same old position of the epicentre in his later publications^{9,10} as well. The author has analysed the seismological data from the I.S.S.³ using the latest travel-time tables by

Jeffreys and Bullen¹¹ and finds no reason for substantial change of the epicentre from the position $36^{\circ}.5$ N. and $70^{\circ}.5$ E. Perhaps a shift of this position by some 25 miles to a south-easterly direction is suggested from the P-residuals. The primary object of this note is to point out the discrepancy of the epicentre which has been incorporated in all the four publications by Coulson^{1,2,9,10}.

The depth of focus of the shock has been given in the I.S.S. as 200 km., by Jeffreys⁵ as 212 km. and Gutenberg and Richter⁸ as 220 km. The author gets a value 220 km. and the time of origin is calculated as 17h. 14m. 29s. GMT. This shock belongs to a series of deep ones that occurred in the Hindukush at or very near the same epicentre ($36^{\circ}.5$ N. and $70^{\circ}.5$ E.) and depth of focus (200-250 km.) at the rate of about 2 per year^{12,16}. The stronger ones occur in the cold season and the weaker ones at any part of the year. The characteristics of these shocks, seismic and macroseismic, are repeated nearly in every case indicating the same mechanism in the production of these shocks and the existence of a unique condition in the Hindukush region.

Author's isoseismals of this shock are shown in Rossi-Forrel (RF) scale in Fig. 1. The isoseismal corresponding to VIII has been slightly exaggerated and it should pass through Peshawar, Rawalpindi and Srinagar with the dotted line. Those by Coulson are also shown in R. F. scale by dotted lines in the same figure for readily appreciating the difference that exists between the two systems. The same meteorological observers' reports as those used by Coulson, were received by the India Meteorological Department, and the intensities estimated in R.F. scale have been published.¹³ These values have been used by the author after correcting the figures from 7, 7, 6 and 5 as published for Drosh, Peshawar, Cherat and Skardu to 9, 8, 7 and 6, on the basis of the descriptions of the effects of the shock as experienced at these places and given by Coulson¹. It is stated that the intensities due to the shock at Drosh, Rawalpindi, Peshawar, Srinagar and Gurez were sufficient to crack the walls of buildings and even to cause greater damage. The pinnacle of the biggest Jama Mosque and several houses were reported as being damaged at Peshawar; a portion of the tower of the Lower Drosh Fort and a part of the wall inside the Upper Drosh Fort fell down. This clearly indicates an intensity corresponding to 9 in R.F. Scale at Drosh

and when this value is taken, the isoseismals fit in reasonably well with the instrumental epicentre, $36^{\circ}.5$ N. and $70^{\circ}.5$ E. The nature of distribution of the intensities indicates, in a general way, a pattern which is to be expected in a deep focus shock.

As a result of subsequent searches, following additional macroseismic information regarding this shock has also been received from other sources.

"Samarkand, Tajikistan, U.S.S.R. February 1, 1929—This section of Central Asia was shaken by a strong earthquake lasting 20 seconds at Samarkand on February 1. No great damage was done at Samarkand but reports from the north-west indicate that several villages were destroyed. A number of persons were injured when buildings fell at Dushamb and Kullabah. Tashkent also reported as being shaken for two minutes".¹¹

"An earthquake shock of moderate intensity was recorded at Kew Observatory at 17 h. 23m. 9s. G.M.T. on February 1. The epicentre is estimated to have been in Afghanistan. A message from Bombay states that a shock was felt in Delhi...".¹⁵

This additional information provides valuable data for delineation of the isoseismals of the shock of February 1, 1929, more or less in a complete manner, probably for the first time for any shock from the Hindukush region.

According to this picture the earthquake was felt over an area of about 782,000 sq. miles over Central Asia, Afghanistan, North-West India, Kashmir, and the West Sin-Kiang Province. This is about 8 times the area over which the disastrous Quetta earthquake of May, 1935, was felt and nearly half of that shaken by the Great Assam earthquake of 1897 or the Kangra earthquake of 1905. Reports from press about this earthquake are not available with the author to show which was the farthest place from the epicentre where the shock was felt except a report from Bombay, as already stated, that the shock was felt at Delhi. As the earthquake occurred near about midnight in winter, not many reports can ordinarily be expected to be received from places near about the outermost limit of the felt area as indicated by dotted line in Fig. 1. This can, therefore, be considered to represent approximately the outermost isoseismal due to this shock.

The strongest shocks from North-West India (except those from Baluchistan) and Afghanistan are those which originate in the Hindukush area at or very near the epicentre

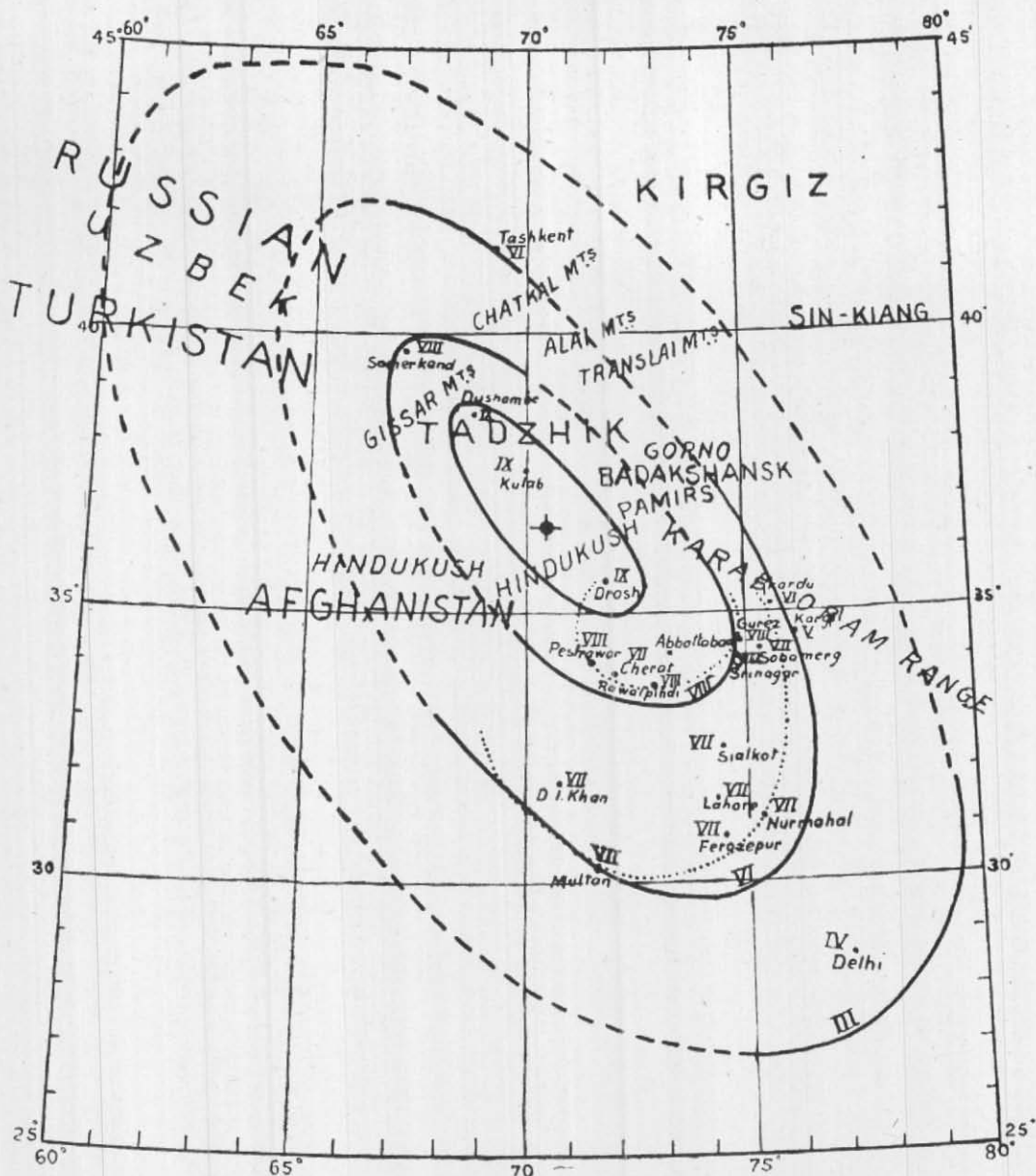


Fig. 1.

ISOSEISMALS OF THE HINDUKUSH EARTHQUAKE, 1st FEBRUARY 1929.

$36^{\circ}.5$ N. and $70^{\circ}.5$ E. and depth 200-250 Km. These are mainly responsible for occasional shakings, felt in varying degrees of intensity over smaller or larger areas of this part of the country. Due to the depth and largeness of the shocks these shakings extend in a few

cases, up to Central Rajputana and east U.P. Of this series of shocks, the most important ones on record are those of November 15, 1921, November 14, 1937, March 4, 1949, and presumably also the one of February 19, 1842. Though, from seismological evidence,

the shock of February 1, 1929, was not as large as these, the area shaken by this earthquake was comparable with those shaken by the stronger ones and appears to be somewhat less than the area over which the strongest shock of the series, namely, that of March 4, 1949 was felt. As to the destructivity, no comparative report is available so far.

The author has drawn isoseismals of most of the important Hindukush shocks from voluntary meteorological observers' reports collected and published by the India Meteorological Department from 1909,¹⁷ for publication elsewhere. It is found that the shape and dispositions of the isoseismals are nearly the same in every case and similar to those of the shock of February 1, 1929. The difference lies mainly in the difference in the areas enclosed by the different isoseismals.

2. *The earthquake shock of November 21, 1939 (11 h. 01 m. G.M.T.)*

Coulson has drawn the isoseismals of this shock also from the meteorological observers' reports and placed the epicentre approximately at $36^{\circ}.5N.$ and $74^{\circ}E.$ in the Great Pamir Mountains. As this position is over 200 miles to the east of the instrumental epicentre, it is desirable to call attention to this discrepancy. The epicentre, based on a preliminary analysis of the readings of the Indian seismograms was obtained at $36^{\circ}.5N.$ and $70^{\circ}.5E.$ and this was supplied to Coulson from the Colaba Observatory. On the basis of a critical study made later, the author's location is $36^{\circ}.2 N.$ and $70^{\circ}.9 E.$ ¹² and Gutenberg and Richter¹⁶ give $36^{\circ}.5 N.$ and $70^{\circ}.5 E.$ The author gets 210 ± 14 Km. for the depth of focus and Gutenberg and Richter get 220 Km. There is, therefore, no doubt that very little or no change of the position of the epicentre, $36^{\circ}.5 N.$ and $70^{\circ}.5 E.$, supplied to Coulson by the Colaba Observatory, is warranted. But, in accepting his position as correct, Coulson¹⁰ (pp. 8) considered this position discrepant and criticised this location on the ground that Mr. E.R. Gee, who returned from Badakhshan after this earthquake, found no evidence of that place being the epicentral tract of a moderately great or great earthquake on November 21, 1939. The author is not quite sure of the position of Badakhshan. This has been shown, in different sources,^{10,18} at various distances (50-200 miles) from east-north-east through north up to south-west of the position $36^{\circ}.5 N.$ and $70^{\circ}.5 E.$ If

the location is to the north-east as given in the Citizen's Atlas of the World (1944) or "The Times" Atlas, and shown in Fig. 2, then this region was outside the zone of considerable damage due to this earthquake. Even if the epicentre were very near Badakhshan, various points have to be considered before it can be decided whether this area was the epicentral tract due to the earthquake or not. These are the types of structures, their foundations and particularly what of those actually remained standing for damage after the series of previous semi-destructive and destructive earthquakes in that area, particularly those of November 15, 1921, and November 14, 1937. It has also to be kept in mind that the zones of destruction due to deep quakes are not confined to narrow tracts as in the case of shallow ones, for instance, the destructive Quetta earthquake of May 1935. This may partially explain why no report of damage is available from places near about the epicentre in the Hindukush, such as Faizabad, even in cases when the destructivity extends as far as four to five hundred miles away from the epicentre. At any rate this shock of November 21, 1939, apparently was not of such a magnitude as to leave marks of earth-fissures, extensive rock falls from mountains and other visible effects as to enable one to differentiate the appearance of the region from what it was before the earthquake.

Author's isoseismals of this shock in Rossi-Forrel scale, are given in Fig. 2. These are based on meteorological observers' reports used by Coulson and also published by the India Meteorological Department.¹⁹ The author changed the figures of intensity 9, 8 and 3 given for Srinagar, Rawalpindi and Kargil in the India Meteorological Department publication to 8, 7-8 and 5 after Coulson. The isoseismals drawn with these values agree very well with the instrumental epicentre. The four innermost isoseismals by Coulson corresponding to 9, 8, 7 and 6 in R.F. scale, are also given in dotted lines in the same figure to bring out the general difference with the author's isoseismals.

The difficulty that led to Coulson's discrepant position of the epicentre was mainly due to non-availability of the report from Drosch and want of proper appreciation of the implications that arise in drawing isoseismals from inadequate macroseismic data, particularly when these are not available from different

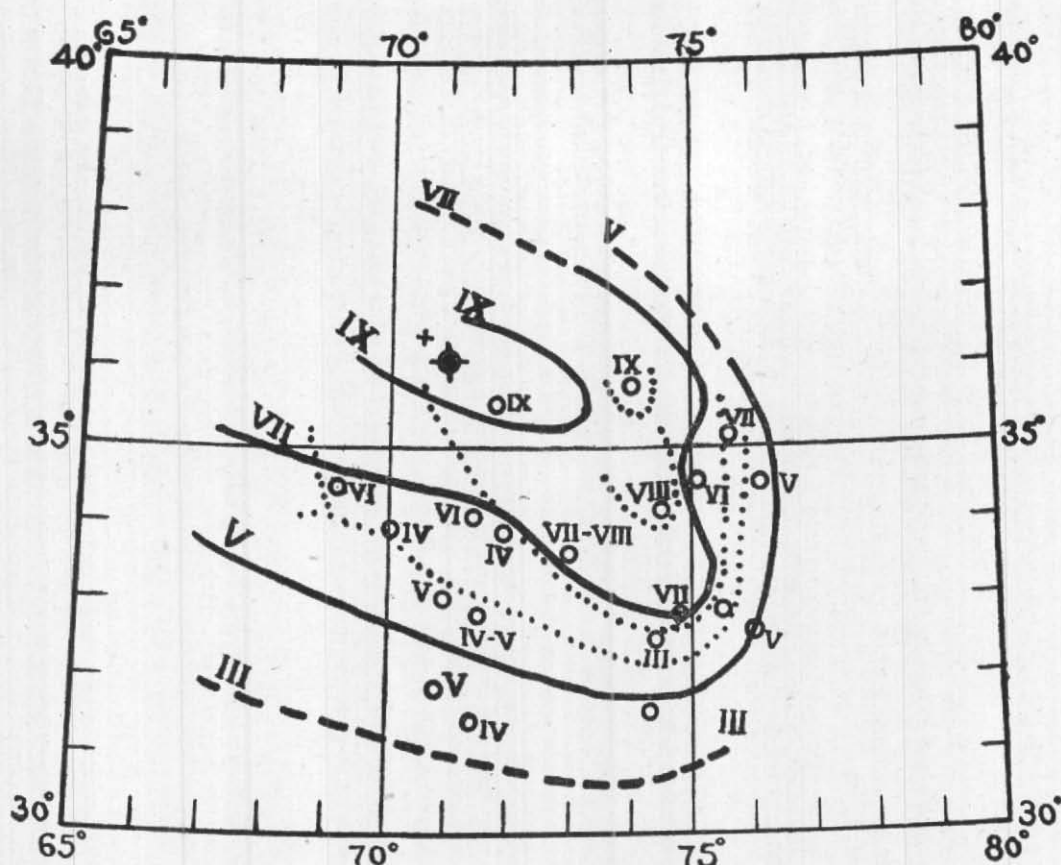


Fig. 2.

ISOSEISMALS OF THE HINDUKUSH EARTHQUAKE, 21ST NOVEMBER 1939.

directions of the epicentre. Keeping the various factors in view, it should be possible to adjust the macroseismic and seismic data of the Hindukush shocks.

A few other points raised in the four publications by Coulson, under reference, are intended to be dealt with in a future communication.

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