Letters to the Editor

550·341 (548)

THE RATNAGIRI EARTHQUAKE OF 28 SEPTEMBER 1962

According to reports appearing in the press, a mild earthquake shock rocked the town of Ratnagiri for 4 to 5 seconds on the evening of 28 September 1962. A few more places in the neighbouring talukas also experienced the earth-tremors. On enquiry, the collector of Ratnagiri District was kind enough to give the following information—"The shock was felt in the villages in Ratnagiri, Sangameswar, Rajapur and Lanja Mahal talukas. No damage occurred anywhere. The direction of movement was southwest to northeast. The shock was felt for a few seconds shaking the earth and buildings. No loss or damage is reported".

Analysis of Colaba seismograms—The above shock was well recorded by all the seismographs at Colaba Observatory, Bombay. From an analysis of the seismograms, the following data were determined.

Instrument	Component	Phase	Time (GMT) *h m s*	Analysis
Benioff (S.P. and L.P.)	Z	iP_n	12 15 27	South, East, rarefaction
Sprengnether	E			$S_n - P_n$
				$=28^s$
				$=2{\cdot}2°$
Milne Shaw	N,E			$=245$ km
Sprengnether	E	$sP(P^*)$	12 15 34	$P_n - O = 38^s$
Benioff	Z			
Benioff (S.P. and L.P.)	Z			Origin Time
				$12^h\ 14^m\ 49^s$
Sprengnether	E	iS_n	12 15 55	GMT on
Milne-Shaw	N,E			28-9-1962

Direction and location of Epicentre—The epicentre of the shock, as deduced from the initial ground motions, lay in the SE quadrant of Bombay. However, as the *P*-motion in the E.W. component was very much small compared to the corresponding *P*-motion in the N. S. component the epicentre was almost due south of Bombay with a slightly easterly displacement. Exact direction finding was not possible due to uncertainties involved in the measurement of amplitudes and periods of ground motion. The epicentral distance of 2·2° (245 km) could be considered accurate due to clarity of the phases and the precise time determination, particularly so because of the availability of records from the recently installed Benioff (vertical) seismograph. The almost southerly (or more nearly SSE'ly) direction and the distance of 245 km from Bombay, place the epicentre very near Ratnagiri itself. This seems to be supported by an examination of the distribution of the places where the tremor was felt. It was assumed that the maximum limit of perceptibility of the shock was confined to the boundary of the four talukas, *viz.*, Ratnagiri, Sangameswar, Lanja Mahal and Rajapur. This distribution is more or less radial and concentric with respect to a centre near Ratnagiri. If many more observations were available, the isoseismal distribution would also in all probability indicate the epicentre in the vicinity of Ratnagiri. Lack of more seismic data and sufficient field reports do not permit us to give more than an indication of the location of the epicentre.

Magnitude of the shock

Using the formula (Gutenberg and Richter 1936),

$$M = \log A - \log A_0$$

where,

$$A = \frac{V}{1000[(\mu^2-1)^2+4h^2\mu^2]^{\frac{1}{2}}} \cdot a$$

and A_0 is a function of $\triangle$

$V = 2800$ (Static magnification)

$h = 0{\cdot}8$ (damping coefficient)

$\mu = T/T_0$, $T_0 = 0{\cdot}8$ sec

T = earthwave period

a = Maximum ground motion in microns computed from E-W and N-S records

The magnitude of the shock was determined to be about 4·3. This corresponds to a max. intensity of nearly 5 in the M-M scale of intensity. Considering the uncertainties, this estimate appears to be in reasonable agreement with the report of the Collector, Ratnagiri. At any rate, in the absence of more detailed reports, we may take the above value of Magnitude/Intensity as the upper limit for the shock. It is relevant to quote here the following remarks by Gutenberg and Richter (1936)—"In the region of Pasadena,....the damage in the epicentral region begins to occur about Magnitude 4·5". Apparently, the present shock was well below this limit as confirmed by our determinations.

The average distance from Ratnagiri (as epicentre) of the boundaries of the 4 talukas is of the order of 60 km. This may be considered as the radius of perceptibility, r, for this shock, though probably this may be the maximum limit of perceptibility. From the relation between Magnitude M, Intensity I_0 in M-M scale, Energy E in ergs and radius of perceptibility r, it is seen that against r=60 km, M and I_0 come out to be nearly 4·3 and 5 respectively.

Depth of Focus of the shock

Employing the following formulae (Gutenberg and Richter 1942),

$$6 \log r/h = I_0 - 1{\cdot}5 \qquad (1)$$

$$3{\cdot}6 \log r/h = M - 2{\cdot}2 \qquad (2)$$

where r=radius of perceptibility, h=depth of focus, I_0 = Maximum intensity in M-M scale and M = magnitude, and using the values r= 60 km, I_0 =5, M=4·3 (as previously determined by us), we get the depth of focus h as 16 km. This value of depth is supported if the phase occurring 7 seconds after P_n can be identified as sP, although the appearance of PP about the same time is not precluded.

KARAN SINGH
K. SETHUMADHAVAN

Colaba Observatory,
Bombay
January 4, 1963

REFERENCES

Gutenberg, B. and Richter, C. F.	1936	*Beitr. Geophys.*, **47**, pp. 73-131.
	1942	*Bull. seismol. Soc. Amer.*, **32**, pp. 163-191.
Smith, W. E. T.	1962	*Publ. Dom. Obsy.* Ottawa, **26**, 5, p. 273.