

Letters to the Editor.

Seismometric Study of the North Bihar
Earthquake of January 15, 1934
and its Aftershocks.

IN a note on "The Focal Region of the North Bihar Earthquake of January 15, 1934", published in the last May issue of *Current Science*,¹ it was pointed out that the phases P, \bar{P} , \bar{P}^* and S, \bar{S} , \bar{S} were identifiable on the records of the Indian seismic stations lying within an epicentral

distant stations as Bombay ($\Delta = 1610$ kms.), Medan ($\Delta = 2877$ kms.), Batavia ($\Delta = 4255$ kms.) and Amboina ($\Delta = 5617$ kms.). As far as the present writer is aware the phase \bar{P} has not been detected on the seismograms of any previous earthquake shocks at epicentral distances greater than 1000 kms. If the author's reading of the seismograms of the great North Bihar Earthquake is correct, the observation of \bar{P} to a distance of at least about 6000 kms. would be an

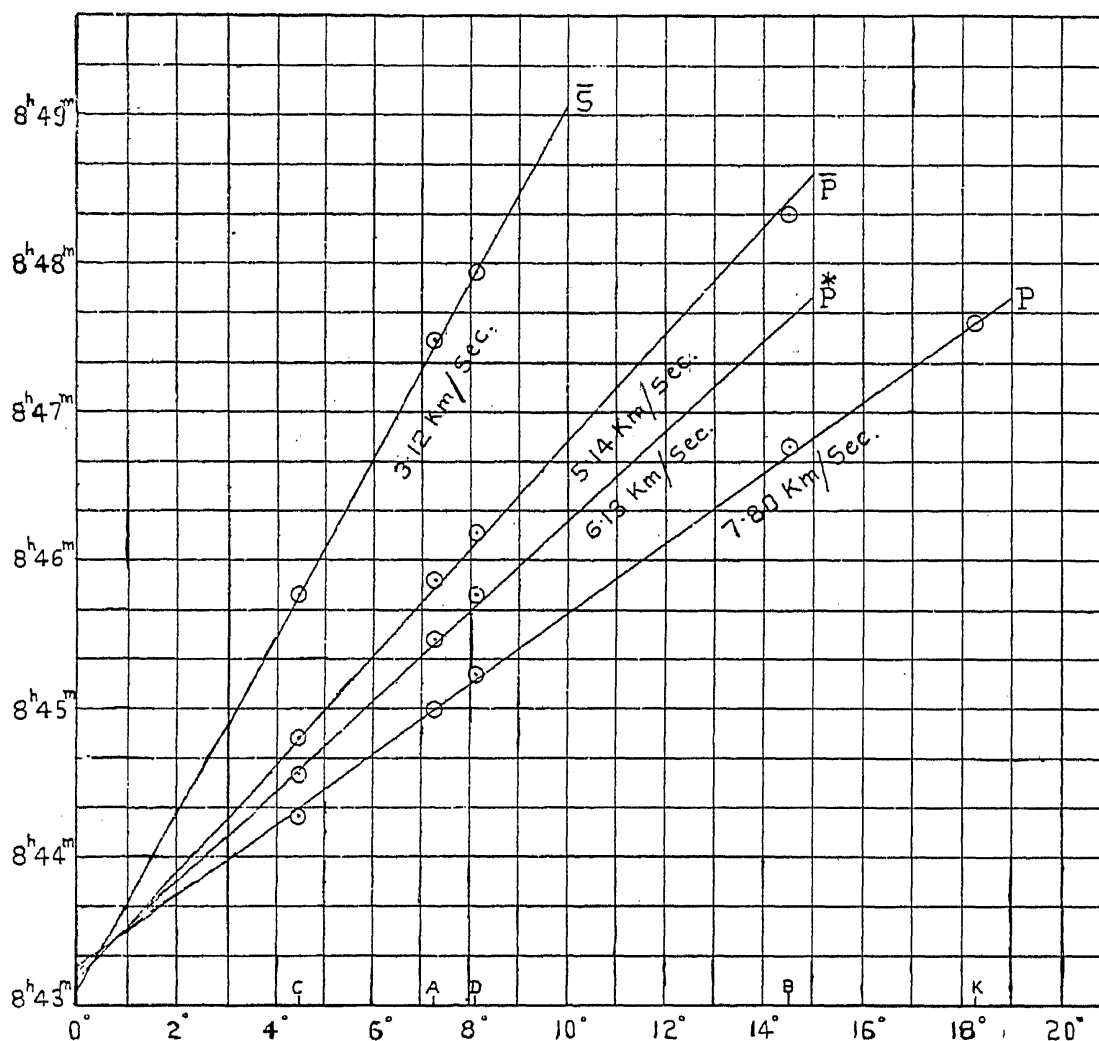


Fig. 1. Jan. 15, 1934.

Epicentre: Lat. $26^{\circ} 36' N.$, Long. $86^{\circ} 12' E.$

Origin Time: $8^h 43^m 16^s$ (G.M.T.) (eP).

distance of about 1000 kms. Since then it has been possible to obtain and study the original seismograms of some Indian stations and also photostat copies of records from the neighbouring extra-Indian stations within a distance of 6000 kms. It may be of interest to note that the phase \bar{P} appears to be identifiable on the seismograms of such

useful addition to the existing knowledge of the time-distance curve of this seismic phase. Another interesting feature of the seismograms of the great shock is that the incidence of the primary wave with definite big impetus (iP) was preceded by emergent small tremors (eP) of a few seconds' duration. The phases eP and iP are seen clearly on all the available records. This character of the P-incidence has also been

¹ *Curr. Sci.*, 1934, 2, 419.

noted independently in the tabulations of the shock by such distant stations as Hong-kong, Nanking and Kew. The duration of the fore-running tremors (eP) is within 6 to 8 seconds at different stations, and may be regarded as constant at all distances. This seismographic observation may be explained by supposing that the major failure which led to the great shock was preceded by a minor failure by about 6 to 8 seconds. The epicentral region of the great shock of January 15 is located near Lat. 26.6° N. and Long. 86.2° E. with origin time of eP as 8 h. 43 m. 16 s. G.M.T. The time-distance curves

of the phases P, P̄, P̄, S, S̄, S̄ of the great shock of January 15 are given in Fig. 1. Similar curves have also been obtained for the aftershocks of January 16 and 19 (Figs. 2 and 3). The average velocities (α) of the

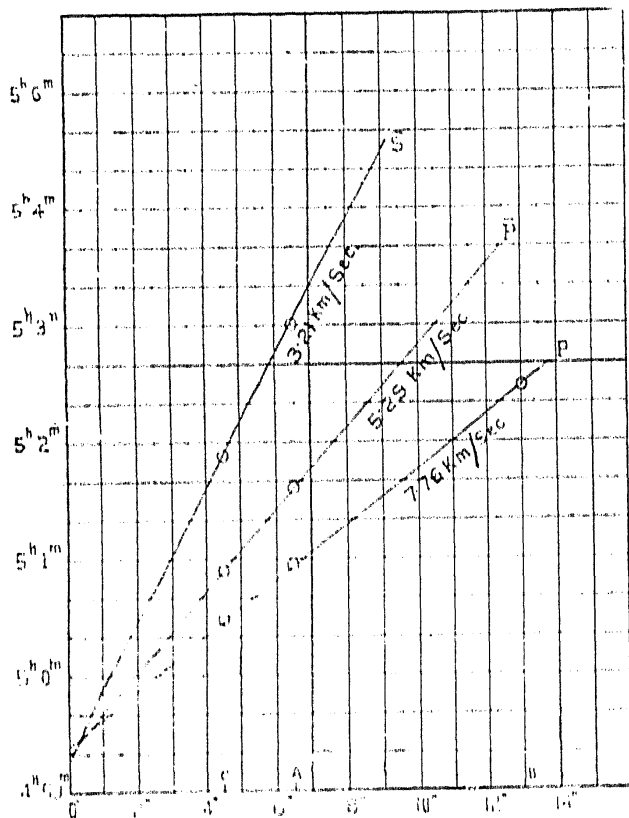


Fig. 2. Jan. 16, 1934.

Epicentre: 26° 12' N., 85° 18' E.

Origin Time: 4h 59m 23s. (P).

three longitudinal waves and those (β) of the three distortional waves calculated from the seismic data of the North Bihar shocks are:

	$\alpha \times 10^{-5}$ (C.G.S.)	$\beta \times 10^{-5}$ (C.G.S.)
Upper layer (Granitic)	5.23 (P̄)	3.17 (S̄)
Intermediate layer (Basaltic)	6.24 (P̄)	3.72 (S̄)
Lower layer (Ultra-basie)	7.78 (P)	4.26 (S)

The bulk-modulus K corresponding to the above velocities are:

$$K/P = (\alpha^2 - \frac{4}{3}\beta^2) \times 10^{10} \text{ C.G.S.}$$

Upper layer	..	14.0	"
Intermediate layer	..	20.5	"
Lower layer	..	36.3	"

These values of bulk-modulus when compared with the laboratory determinations of

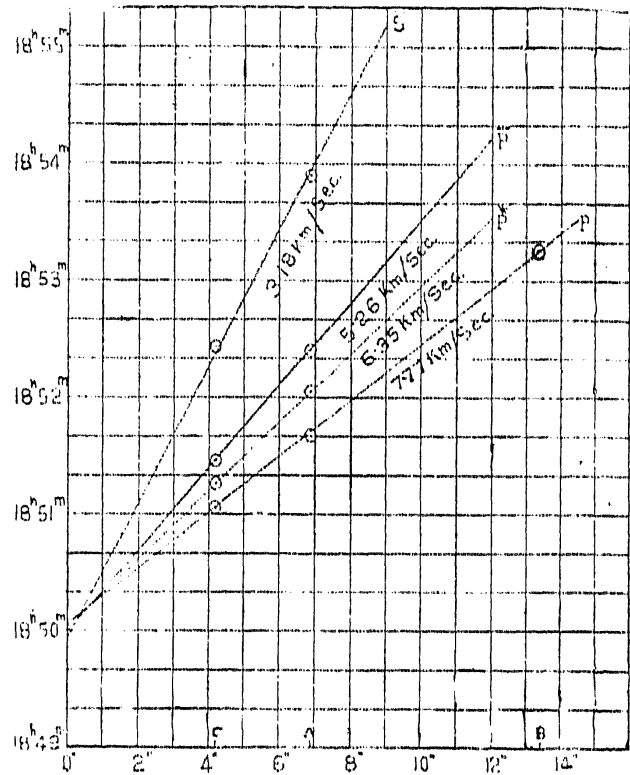


Fig. 3. Jan. 19, 1934.

Epicentre: 26° 12' N., 85° 36' E.

Origin Time: 18h 50m 2s. (P).

elastic constants of Obsidian, Granite, Diorite, Basalts, Dunite, etc., at probable temperatures and pressures at the different layers may throw some light on the constitution² of the outer crust of the earth in Bihar. An extrapolation of the time-

distance curves of P, P̄, P̄, S, S̄, S̄ to the origin show that the apparent delay in start of P̄ with respect to S̄ is 3.3 secs., that of P̄ with respect to P̄ is 1.5 secs., and that of

P with respect to P̄ is 3 secs. From the foregoing data the focal depth of the North Bihar shocks is calculated³ to be about 13 kms. The thickness of the upper layer is estimated to be 13.7 kms., and that of the intermediate layer as 22.2 kms. The focal depth and the thickness of the upper layer suggest that the major failure leading to the

² *The Earth*, by Jeffreys, pp. 101-102.

³ *Loc. cit.*, pp. 97-98.

disastrous earthquake of January 15 occurred near the boundary of the upper and intermediate layer of the earth's crust. A detailed seismometric study of the North Bihar shocks will be published elsewhere.

S. C. ROY.

Colaba Observatory,
Bombay,
December 28, 1934.

Renoflavin and Vitamin B₂.

SINCE we obtained renoflavin from ox-kidney extracts,¹ we have been examining its vitamin B₂-potency by observing its growth-promoting effect, at different stages of purification of the flavin, on rats maintained on a "Vitamin B"-deficient diet, supplemented by a preparation of vitamins B₁ and B₄, obtained from yeast according to Peters' method. It has been found that fairly concentrated fractions of the pigment are unable to promote good growth even in doses considerably larger than the effective dose, reported by Kuhn. In the quest of a possible missing factor we have found that the rate of growth could be very appreciably enhanced by supplementing relatively small doses of the flavin concentrates with the filtrate, left after adsorption of the ox-kidney extract with Fuller's earth, which we had previously heated at pH 9.0 for half an hour in an autoclave at one atmosphere pressure in order to destroy traces of vitamins B₁, B₄ and the flavin. This would indicate an apparent complexity of what is regarded as vitamin B₂ and would show that one of the factors involved, other than the flavin, is a relatively heat- and alkali-stable substance.

B. C. GUHA.

H. G. BISWAS.

Biochemical Laboratory,
Bengal Chemical & Pharmaceutical
Works, Ltd., Calcutta,
November 28, 1934.

The Occurrence of *Isætes* in India.

So far only one species of *Isætes* (*I. coromandelina* L.) has been reported to be found in India. It grows very commonly on the Coromandel Coast; Fyson collected it from Madras and Kashyap from near Seven Pagodas (Madras), as has been recorded by Pfeiffer.² Another place from where

it has been collected is Serampore in Bengal and that was by Griffith, as stated by Prain.³ Ekambaram and Venkatanathan⁴ have also referred to only these two places. It would, therefore, be of some interest to record that the writer collected a species of the plant on the 14th October, 1930, from a shallow pond about a mile or so away from the Benares Hindu University grounds. Subsequently more places were found where it grew. Collections have been made from time to time from various localities, and it has been ascertained that this plant grows very abundantly within a radius of ten miles or so from this University.

The Benares species resembles *I. coromandelina* in practically all respects except that the former has got the preponderance of four-lobed stocks which character has been described by Pfeiffer to be a rarity.

Y. BHARADWAJA.

Department of Botany,
Benares Hindu University,
December 1, 1934.

A Preliminary Note on the Occurrence of Liane Type of Structure in the Stem and Root of *Thylacospermum rupifragrum*, Schrenk.

Thylacospermum rupifragrum, Schrenk. is a plant of the elevated and arid regions of Western Tibet and is characterised by an extremely compact cushion habit. Its young stems and roots possess the usual structure characteristic of dicotyledons; the primary organisation and early secondary growth are of the normal type—the normal or primary cambium developing bast on its outside and wood on its inside in a uniform manner. During later stages of development of both the stem and root some cells of wood parenchyma assume meristematic activity and so constitute strips of secondary cambium on the inside of the normal vascular cylinder. The secondary cambial strips develop xylem on the side facing the xylem formed from the primary cambium and phloem on the side removed from it. Sooner or later vascular tissue resulting from the activity of the different strips becomes distinct from the original vascular tissue by crushing the

³ Prain, D., "The Vegetation of the Districts of Hughly—Howrah and the 24-Pergunnahs," *Rec. Bot. Surv. Ind.*, 1908, 3.

⁴ Ekambaram, T., and Venkatanathan, T. N., "Studies on *Isætes coromandelina* L.," *Journ. Ind. Bot. Soc.*, 1933, 12.

¹ Guha and Biswas, *Curr. Sci.*, 1934, 2, 474.

² Pfeiffer, N. E., "Monograph of the *Isæetaceæ*," *Ann. Miss. Bot. Gard.*, 1922, 9.