MEMOIRS

OF

THE GEOLOGICAL SURVEY OF INDIA.

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GEOLOGICAL SURVEY OF INDIA.

VOL. XXX.

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CALCUTTA :
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THE GEOLOGICAL SURVEY OF INDIA.

List *of* Aftershocks *of the* Great Earthquake *of* 12th June 1897, *compiled by* R. D. Oldham, A. R. S. M., F. G. S., *Superintendent, Geological Survey of India.*

After the great earthquake of 12th June a few persons kept records of the aftershocks felt by them. At a later date I was able to interest a large number of observers and obtained a tolerably complete record of aftershocks. In the following pages so much of the data received as seemed desirable to publish has been printed.

These records necessarily lack the completeness and constancy of standard of an instrumental one but such as they are, they seem worthy of publication as the influence of lunar and solar attraction, if it has any appreciable influence, should be much more marked at a place where the earth crust was in a state of strain verging on the breaking point and a time when earthquakes were of constant occurrence, than at a more quiescent period or in a more stable locality.

The principal faults of the records printed are the inevitable one, of incompleteness during the hours of the night and inaccuracy of time. The continuous records at Mairang, Maophlang, and Tura are all from places where, in the absence of a telegraph station, accurate time keeping is impossible, and the records quoted in the general list No. XIV show how divergent may be the recorded times even at places where exact time is procurable.

In addition to the records printed I received, through the kindness of Major E. F. H. Dobson, I. M. S., Civil Surgeon of Dhubri, a record kept by the hospital assistants at the dispensaries in the Goalpara district. This is too bulky to print, but the data were of great service, especially in determining the extent of the epifocal area.

I.

Statement of the number of shocks felt from 12th June to 17th July at Rangmahal, North Gauhati.

This statement, for which I am indebted to Mr. H. J. Cotton, C. S. I., Chief Commissioner of Assam, is translated from the *Assam* newspaper of 21st July 1897 and purports to show the number of shocks, as registered by a correspondent, at Rangmahal, North Gauhati.

FROM "ASSAM," 21ST JULY 1897.

Statement of the number of the shocks felt from the 12th June to the 17th July 1897 at Rangmahal, North Gauhati, from a correspondent.

Date.	Time.	No. of shocks felt.	Remarks.
12-6-97	From about 5½ P.M., when the earthquake commenced, till 7 P.M.	25	The first shock lasted five minutes and came from the south-west. Less severe ones.
	Night . .	350	Some at intervals of 5 to 15 minutes.
	Day . .	54	Of these 5 were somewhat severe, and each lasted for 6 or 7 seconds.
13-6-97	Night . .	73	
	Day . .	29	
14-6-97	Night . .	13	
	Day . .	10	2 of these were severe.
15-6-97	Night . .	7	2 of these were severe. People began to plough.
	Day . .	7	
16-6-97	Night . .	11	
	Day . .	5	All were distinctly perceivable.
17-6-97	Night . .	3	
	Day . .	6	
18-6-97	Night . .	4	
	Day . .	3	The biggest shock occurred this day since the 12th.
19-6-97	Night . .	4	
	Day . .	4	2 more were felt, but they were very faint.
20-6-97	Night . .	2	
	Day . .	5	Weather not good and very warm.
21-6-97	Night . .	7	
	Day . .	4	
22-6-97	Night . .	3	1 of these was severe; there were many other small ones not worth counting.
	Day . .	3	There were many almost imperceptible ones.
23-6-97	Night . .	4	One of these was severe. Much rain during both the day and night.

Date.	Time.	No. of shocks felt.	Remarks.
24-6-97	Day . .	5	One of these was severe.
	Night . .	7	
25-6-97	Day . .	3	
	Night . .	2	
22-6-97	Day . .	...	There were several very faint shocks, but I did not count them.
	Night . .	1	One only worth counting.
27-6-97	Day . .	2	With many slight ones. The severe one was felt at 10 P.M., when clock stopped. There were rain and high wind in the evening.
	Night . .	1	
28-6-97	Day . .	3	
	Night . .	10	
29-6-97	Day . .	4	One of these in the morning was severe, lasting for about a minute.
	Night . .	2	
30-6-97	Day . .	3	People apprehended one severe shhock this day (but there was none).
	Night . .	5	
1-7-97	Day . .	2	
	Night . .	5	
2-7-97	Day . .	3	
	Night . .	2	
3-7-97	Day . .	2	Both at about 11 A.M.
	Night . .	2	One was severe.
4-7-97	Day . .	2	
	Night . .	4	
5-7-97	Day . .	3	
	Night . .	3	
6-7-97	Day . .	2	
	Night . .	2	One only worth counting.
7-7-97	Day . .	1	
	Night . .	1	
8-7-97	Day . .	3	
	Night . .	5	
9-7-97	Day . .	5	
	Night . .	3	
10 7-97	Day . .	4	
	Night . .	3	
11-7-97	Day . .	3	
	Night . .	5	
12-7-97	Day . .	2	
	Night . .	3	
13-7-97	Day . .	2	
	Night . .	3	
14-7-97	Day . .	2	
	Night .	2	
15-7-97	Day . .	2	
	Night . .	3	
16-7-97	Day . .	3	
	Night . .	4	Amidst rain and high wind.
17-7-97	Day . .	2	Rain and wind throughout the whole day.
	Night . .	3	

II.

Record of earthquakes, kept by the Station Master at Kaunia, from 12th June to 3rd July 1897.

(Times are Railway or Madras.)

After the severe shock 15 more shocks felt up to 24th., night, but particular time was not taken ; each felt more than ½ a minute duration on the same date, the 12-6-1897.

On the 13th June 1897	.	1	shock felt at	0-6 hour ;	duration of ½ minute.
		1	,, ,,	8-0 ,,	,, 1 ,,
		1	,, ,,	8-40 ,,	,, ½ ,,
		1	,, ,,	9-20 ,,	,, 1 ,,
		1	,, ,,	12-12 ,,	,, 10 seconds.
		1	,, ,,	16-25 ,,	,, 1 minute.
		1	,, ,,	22-10 ,,	,, 20 seconds.
		1	,, ,,	23-12 ,,	,, 1 minute.
Total	.	8	shocks.		
On the 14th June 1897	.	1	severe shock at	7-12 ;	duration of 1½ minutes.
		1	shock at	9-40 ,,	5 seconds.
		1	,,	11-50 ,,	½ minute.
		1	,,	16-20 ,,	10 seconds.
		1	,,	17-25 ,,	3 ,,
		1	,,	17-40 ,,	2 ,,
		1	,,	18-10 ,,	6 ,,
Total	.	7	shocks.		
On the 15th June 1897	.	1	severe shock at	2-15 to 2-17 ;	duration of full 2 minutes.
		1	shock at	3-5 ;	duration of 3 seconds.
		1	,,	4-40 ,,	4 ,,
		1	,,	5-35 ,,	3 ,,
		1	,,	11-20 ,,	2 ,,
		1	,,	12-30 ,,	5 ,,
		1	,,	16-31 ,,	2 ,,
		1	,,	17-30 ,,	2 ,,
		1	,,	17-51 ,,	3 ,,
		1	,,	19-0 ,,	4 ,,
		1	,,	20-50 ,,	½ minute.
Total	.	11	shocks.		
Date, 16th June 1897	.	1	shock at	1-2 ;	duration of 3 seconds.
		1	,,	3-55 ,,	2 ,,
		1	,,	8-13 ,,	4 ,,
		1	,,	10-55 ,,	2 ,,
		1	,,	11-30 ,,	3 ,,
		1	,,	12-10 ,,	2 ,,
		1	,,	14-20 ,,	3 ,,
		1	heavy shock	23-14 ,,	1 ,,
Total	.	8	shocks.		
Date, 17th June 1897	.	1	shock at	1-55 ;	duration of 2 seconds.
		1	,,	4-30 ,,	1 ,,
		1	,,	10-11 ,,	2 ,,
		1	,,	21-30 ,,	3 ,,
Total	.	4	shocks.		

Date, 18th June 1897	1 shock at	1-12	duration of	2 seconds.
	1 ,,	2-30	,,	3 ,,
	1 ,,	8-4	,,	2 ,,
	1 ,,	8-30	,,	4 ,,
	1 ,,	10-12	,,	2 ,,
	1 ,,	15-44	,,	1 ,,
	1 ,,	17-46	,,	2 ,,
	1 ,,	19-5	,,	3 ,,
Total	8 shocks.			
Date, 19th June 1897	1 shock at	5-20	duration of	4 seconds.
	1 heavy shock	5-35	,,	1 minute.
	1 shock	10-57	,,	3 seconds.
	1 ,,	18-0	,,	2 ,,
	1 ,,	19-30	,,	1 ,,
	1 ,,	22-55	,,	3 ,,
	1 heavy shock	23-40	,,	1½ minutes.
Total	7 shocks.			
Date, 20th June 1897	1 shock at	2-10	duration of	3 seconds.
	1 ,,	6-50	,,	5 ,,
	1 ,,	21-25	,,	2 ,,
	1 ,,	22-25	,,	1 ,,
	1 ,,	23-40	,,	3 ,,
Total	5 shocks.			
Date, 21st June 1897	1 shock at	13-27	duration of	1 second.
	1 ,,	16	,,	2 ,,
	1 ,,	16-25	,,	1 ,,
Total	3 shocks.			
Date, 22nd June 1897	1 shock at	5-30	duration of	1 second.
	1 heavy shock	13-0	,,	½ minute.
	1 ,, ,,	18-52	,,	full 3 minutes.
Total	3 shocks only.			
Date, 23rd June 1897	1 shock at	1-15	duration of	2 seconds.
	1 ,,	9-40	,,	3 ,,
	1 ,,	12-39	,,	2 ,,
	1 ,,	18-0	,,	1 ,,
	1 ,,	18-50	,,	3 ,,
Total	5 shocks.			
Date, 24th June 1897	1 shock at	12-0	duration of	2 seconds.
	1 ,,	13-0	,,	1 ,,
	1 ,,	13-20	,,	3 ,,
	1 ,,	15-33	,,	2 ,,
	1 ,,	23-7	,,	3 ,,
Total	5 shocks.			
Date, 25th June 1897	1 shock at	8-40	duration of	2 seconds.
	1 ,,	8-45	,,	2 ,,
	1 ,,	23-15	,,	3 ,,
Total	3 shocks.			
Date, 26th June 1897	1 shock at	12-39	duration of	3 seconds.
Date, 27th June 1897	1 shock at	21-55	duration of	2 seconds.

Date, 28th June 1897 .	1 shock at	15-30; duration of	2 seconds.
	1 ,,	23-45 ,,	3 ,,
Total .	2 shocks.		
Date, 29th June 1897 .	1 shock at	15-30; duration of	1 second.
	1 ,,	15-30 ,,	2 seconds.
Total .	2 shocks.		

Date, 30th June 1897 . No shocks felt.
Date, 1st July 1897 . No shocks felt.
Date, 2nd July 1897 . 1 shock from 10-29 to 10-31 of duration of full 2 minutes but in slight motion.
Date, 3rd July 1897 . 1 shock felt at 5-0 duration of 2 seconds.
The shocks felt with a train motion sound all the times.

III.

Record of earthquake shocks at Kuch Bihar from 12th June to 15th July 1897.

[Extracted from the official report of Mr. D. R. Lyall, C.S.I., Superintendent of the State.]

Date.	Hour.	Date.	Hour.	Date.	Hour.	Date.	Hour.
12th June	5 P. M.	16th June	2-21 A. M.	19th June	9-34 P. M.	2nd July	1-15 P. M.
13th ,,	9 A. M.	,, ,,	2-51 A. M.	20th ,,	1 A. M.	3rd ,,	11-30 A. M.
,, ,,	1 P. M.	,, ,,	3-4 A. M.	,, ,,	7-20 A. M.	,, ,,	2-35 P. M.
,, ,,	4-45 P. M.	,, ,,	3-45 A. M.	,, ,,	2 P. M.	,, ,,	7 P. M.
14th ,,	7 A. M.	,, ,,	4-26 A. M.	21st ,,	1-20 A. M.	4th ,,	8-15 A. M.
,, ,,	7-30 A. M.	,, ,,	11-25 A. M.	22nd ,,	8 P. M.	,, ,,	8-15 P. M.
,, ,,	11 A. M.	,, ,,	11-52 A. M.	23rd ,,	1-20 A. M.	5th ,,	5-30 A. M.
,, ,,	11-30 A. M.	,, ,,	1-52 P. M.	,, ,,	6 P. M	,, ,,	7-45 P. M.
,, ,,	12 P. M.	,, ,,	2-15 P. M.	,, ,,	7-5 P. M.	6th ,,	11-40 A. M.
,, ,,	12-15 P. M.	,, ,,	2-45 P. M.	24th ,,	4-10 P. M.	,, ,,	1-30 P. M.
,, ,,	12-45 P. M.	,, ,,	8 P. M.	25th ,,	9 P. M.	7th ,,	4-30 A. M.
,, ,,	1-30 P. M.	,, ,,	9-30 P. M.	,, ,,	9-10 P. M.	,, ,,	1-12 P. M.
,, ,,	2-30 P. M.	,, ,,	11-5 P. M.	26th ,,	1-30 P. M.	,, ,,	9 P. M.
,, ,,	4-30 P. M.	,, ,,	11-15 P. M.	,, ,,	1-33 P. M.	8th ,,	3 A. M.
15th ,,	6 A. M.	,, ,,	11-40 P. M.	27th ,,	10 P. M.	,, ,,	7-25 A. M.
,, ,,	7 A. M.	17th ,,	3-10 A. M.	28th ,,	3-10 A. M.	,, ,,	8 A. M.
,, ,,	10-45 A. M.	,, ,,	3-25 A. M.	,, ,,	7-55 A. M.	9th ,,	12-30 P. M.
,, ,,	2 P. M.	,, ,,	4-25 A. M.	,, ,,	1-30 P. M.	10th ,,	5-30 A. M.
,, ,,	5 P. M.	,, ,,	8 A. M.	,, ,,	3 P. M.	,, ,,	5-40 A. M.
,, ,,	6 P. M.	,, ,,	11 A. M.	,, ,,	3-43 P. M.	12th ,,	1 A. M.
,, ,,	7-50 P. M.	,, ,,	7 P. M.	,, ,,	10-30 P. M.	,, ,,	7-45 A. M.
,, ,,	10-35 P. M.	18th ,,	1-40 A. M.	29th ,,	2-53 P. M.	,, ,,	11 A. M.
,, ,,	10-45 P. M	,, ,,	5-45 A. M.	,, ,,	3 P. M.	,, ,,	2-30 P. M.
,, ,,	11 P. M.	,, ,,	8-30 A. M.	,, ,,	12 midnt.	13th ,,	4 A. M.
,, ,,	11-55 P. M.	,, ,,	12 noon.	30th ,,	2-30 A. M.	14th ,,	2-45 P. M.
16th ,,	12-3 A. M	,, ,,	6 P. M.	,, ,,	10-30 A. M.	,, ,,	3-30 P. M.
,, ,,	12-8 A. M.	,, ,,	7 P. M.	,, ,,	10-45 A. M.	,, ,,	5 P. M.
,, ,,	1-15 A. M.	19th ,,	5 A. M.	,, ,,	11-35 A. M.	,, ,,	8 P. M.
,, ,,	1-33 A. M	,, ,,	6-18 A. M.	,, ,,	1-30 P. M.	15th ,,	8 A. M.
,, ,,	2 A. M.	,, ,,	8-30 P. M.	1st July	11-15 A. M.	,, ,,	10-20 P. M.

IV.

Record of the number of earthquake shocks felt at Maimansingh from 12th June to 17th July, by Babu Subal Chandra Laha, Meteorological Observer.

The following statement has been communicated by the Meteorological Reporter to the Government of Bengal. Previous to the 17th July the Meteorological Observer had only kept a record of the number of shocks felt, and not of the time, duration, or nature. After that date these particulars were recorded and the observations have been incorporated in the general list printed below :—

June	12,	35	shocks.	July	1,	2	shocks.
,,	13,	25	,,	,,	2,	4	,,
,,	14,	15	,,	,,	3,	5	,,
,,	15,	8	,,	,,	4,	3	,,
,,	16,	6	,,	,,	5,	2	,,
,,	17,	5	,,	,,	6,	3	,,
,,	18,	4	,,	,,	7,	2	,,
,,	19,	10	,,	,,	8,	4	,,
,,	20,	3	,,	,,	9,	3	,,
,,	21,	2	,,	,,	10,	2	,,
,,	22,	3	,,	,,	11,	3	,,
,,	23,	2	,,	,,	12,	4	,,
,,	24,	3	,,	,,	13,	2	,,
,,	25,	3	,,	,,	14,	3	,,
,,	26,	1	,,	,,	15,	4	,,
,,	27,	2	,,	,,	16,	2	,,
,,	28,	2	,,	,,	17,	2	,,
,,	29,	3	,,				
,,	30,	3	,,				

V.

Record of earthquakes felt at Shillong between the hours of 9-10 p.m. of 19th June and 1-45 a.m. of 21st June, and between 10-44 p.m. of 21st June and 1-20 a.m. of 22nd June; kept by Mrs. J. W. Welsh.

This record is interesting as the only detailed record kept in Shillong during the early days following on the earthquake, and serves to show their frequency from 7 to 9 days later. The times are local, Shillong time minutes 47 fast on Madras time.

From 9-10 P.M. June 19th and 1-45 A.M. June 20th. Between these shocks numb er less tremors were felt.

P. M.

9·10 Tremors.
9-17 Prolonged.
9-19 Slight (with a report like a gun).
9·54 Slight.
16-10 Slight (with a loud report).
10-24 Slight.
10-31 Bad shock.
10-47 Slight.
10-50 Steady tremor.
10-57 ,, ,,
11-8 ,, ,,
11-15 ,, ,,
11-21 ,, ,,
11-26 With a loud report.
11-29 Tremor.
11-33 ,,
11-38 ,, steady.
11-41 Tremor.
11-54 ,,
12-0 ,,

A. M.

12- 5 Tremor, steady.
12-12
12-17 Stronger than usual.
12-27
12-31 Sharp, quick movement.
12-45
1-30
1-31
1-32 With a loud report.
1-35 Worse than the last.
1-36
1-40
1-45

From 10-44 P. M. on night of 21st June to 1-19 on morning of 22nd June.

P.M.

10-44 Sharp shock.
10-45 Prolonged shock.
11-3
11-16
11-31
11-53

A. M.

12-19
12-20
12-31
12-47 Sharp shock.
1-19 With a loud report.

VI.

Earthquakes observed at Dhubri and Goalpara by Surgeon-Major E. F. H. Dobson, M.B.

(Local time)

Dhubri, 18th June.

9-30
12-15
13-45
13-55
16-6
18-20
19-26
22-30
23-55

19th June.

3-0
5-15
6-8 Very severe.
6-34
10-23
11-20
Three between this time and the next were felt by others, but the times were not recorded.
21-0
21-20
22-15

20th June.

7-0
9-45
11-35
13-15
13-50
22-30

21st June.

1-55
7-0
7-12
11-45
11-47

I then left Dhubri by steamer at 3-30 P.M. for Goalpara.

Goalpara, 22nd June.

5-46 I was out in the open at the time.
6-48 Severe.
7-36
7-39
8-7
8-20
8-35
10-7
10-11
11-37
11-43
11-49, 12-55 } Between these two shocks I was out in the open.
13-7
13-14
13-34
14-57
15-18
17-22
17-34, 17-43, 17-55 } Severe.
18-31
18-35
18-42
19-5 Very long and severe. Within 10 minutes after this I embarked on board the mail steamer for Dhubri.

VII.

List of earthquake shocks observed during tour by Mr. T. D. LaTouche.

(Times are all local.)

Place.	Date.	Time.	Remarks.
Dhubri	25-6-97	21-11	
Goalpara	29-6-97	3-0	
,,	,,	4-34	
,,	,,	4-39	Accompanied by low booming sound apparently coming from south.
,,	,,	8-47	
,,	,,	12-29	
,,	,,	12-54-30	Accompanied by much noise.
,,	,,	13-32	Lead pencil set up as a seismoscope fell towards N 34°E.
,,	,,	14-0	Pencil fell to S 20°W.
,,	,,	14-33	
,,	,,	14-38	
,,	,,	14-45	Lasted about 15 seconds.
,,	,,	15-24	Preceded by low booming sound.
,,	,,	15-46	
,,	,,	15-47	
,,	,,	15-57-30	
,,	,,	18-19	
,,	,,	19-27	
,,	,,	21-59	
,,	,,	22-49	Accompanied by low booming sound.
,,	30-6-97	5-7-30	
,,	,,	5-26	
,,	,,	7-9-30	
,,	,,	7-40	
,,	,,	8-53	
,,	,,	9-24	
,,	,,	10-21	No noise accompanied the shock.
,,	,,	10-48-30	
,,	,,	12-26	
,,	,,	13-13-30	
,,	,,	13-40	
,,	,,	13-54	
,,	,,	14-33	
,,	,,	14-40	Accompanied by low booming sound.
,,	,,	16-11-30	
,,	,,	16-1	
,,	,,	16-10	
,,	,,	16-24-30	
,,	,,	16-34	
,,	,,	16-54	
,,	,,	17-36	
Gauhati	4-7-97	3-45	Lasted about 15 seconds. No noise perceptible.
Nungpo	6-7-97	12-7-30	Appeared to pass from south to north. No sound accompanying.
Shillong	14-7-97	14-28	Preceded by booming sound from south.
,,	,,	15-53	No sound accompanying shock, but one was heard 30 seconds later.

Place.	Date.	Time.	Remarks.
Shillong .	14-7-97 .	17-15 .	} Preceded by slight booming sound.
,, .	,, .	19-2 .	
,, .	15-7-97 .	6-13 .	Short, but very distinct.
,, .	,, .	13-16-30.	Preceded by several booming sounds.
,, .	16-7-97 .	7-21-30 .	
,, .	,, .	8-7-30 .	
,, .	17-7-97 .	Betw. 3 and 4.	Very sudden, accompanied by a loud explosive sound.
,, .	,, .	7-38 .	Sound heard several seconds before shock.
,, .	18-7-97 .	20-45 .	
,, .	19-7-97 .	1-39 .	Rather severe shock accompanied by low explosive sound.
,, .	,, .	6-50 .	Shock lasted several seconds.
,, .	,, .	Betw. 13 and 14.	Two shocks occurred.
,, .	,, .	15-46 .	
,, .	,, .	18-0 .	
,, .	20-7-97 .	6-55 .	Rather severe shock.
,, .	,, .	16-27 .	Very slight.
,, .	21-7-97 .	2-50 .	Very slight.
,, .	,, .	6-15 .	,,
,, .	22-7-97 .	7-4 .	Slight.
,, .	,, .	12-29 .	,,
,, .	,, .	13-5 .	,,
,, .	,, .	18-26 .	,,
,, .	,, .	20 28 .	,,
,, .	,, .	22-58 .	,,
,, .	23-7-97 .	7-4 .	Very slight.
,, .	,, .	7-24 .	,,
,, .	,, .	13-25-30.	Slight.
,, .	,, .	16-31 .	Very slight.
,, .	24-7-97 .	6-11 .	Slight.
,, .	,, .	8-40 .	,,
,, .	,, .	8-52 .	,,
,, .	,, .	15-18-30.	,,
,, .	,, .	16-45 .	A rather loud sound, but very slight shock.
,, .	,, .	21-22 .	Slight.
,, .	25-7-97 .	2-0 .	,,
,, .	,, .	9-45 .	,,
,, .	,, .	13-15 .	,,
,, .	,, .	18-11 .	,,
,, .	26-7-97 .	12-0 .	,,
,, .	,, .	14-58 .	,,
,, .	,, .	16-35 .	,,
,, .	,, .	16-44 .	,,
,, .	,, .	19-15 .	,,
Cherra-punji.	29-7-97 .	13-38 .	One sudden shock preceded and followed for several seconds by booming sound.
,, .	30-7-97 .	5-26 .	
,, .	31-7-97 .	5-0 .	Rather severe. Felt severely at Tharia Ghat.
Chattuck.	2-8-97 .	20-30 .	A very severe shock. Felt on board steamer.

VIII.

Record of earthquakes at Goalpara, kept by Revd. S. A. D. Boggs, from 18th July 1897 to 10th September 1897, and by Revd. A.E. Stephen, from 22nd September 1897 to 15th December 1897.

Date.	Time.	Duration.	Nature.
July 18	6-10	...	feeble.
	6-20	...	,,
	10-32	...	,,
	12-29	...	,,
	14-41	...	,,
	15-21	...	,,
	15-34	...	,,
	16-9	...	,,
	16-56	...	,,
	17-11	...	,,
19	5-25	...	,,
	6-52	...	,,
	9-23	...	,,
	10-13	...	,,
	11-4	...	,,
	11-36	...	,,
	11-38	...	,,
	11-44		,,
	11-56	...	,,
	12-15	...	,,
	13-48	...	,,
	14-30	...	,,
	14-40	...	,,
	16-40	...	,,
	17-37	...	,,
	18-3	...	,,
	18-18	...	,,
	18-58	...	,,
	20-44	1 m.	smart.
	20-57	...	feeble.
20	6-54	...	,,
	8-42	...	,,
	9-24	...	,,
	9-59	...	,,
	11-55	...	,,
	1-46	...	,,
	16-25	...	,,
	16-43	...	,,
	17-29	...	,,
	17-34	...	,,
	18-56	...	,,
	19-2	...	,,
21	5-10	...	,,
	5-38	...	,,
	6-18	...	,,
	8-56	...	,,
July 21	12-13	...	feeble.
	13-38	...	,,
	14-39	55 s.	smart.
	17-40	...	feeble.
	18-10	...	,,
	19-2	...	,,
	19-14	...	,,
	21-44	33 s.	smart.
22	11-43	...	feeble.
	12-49	...	,,
	16-47	...	,,
	18-26	...	,,
	19-32	...	,,
	19-38	...	,,
	21-5	...	,,
	21-24	...	,,
	21-58	...	,,
23	7-23		,,
	8-45		slight.
	9-34		feeble.
	11-36		slight.
	11-52		feeble.
	12-30		,,
	13-41		,,
	14-40		,,
	15-9		,,
	15-30		,,
	16-3		,,
	16-47		slight.
	17-18		feeble.
	19-30		,,
	21-5		,,
	21-35		,,
	22-22		slight.
24	5-44		feeble.
	6-9		,,
	7-51		,,
	9-17		,,
	10-24		slight.
	11-10		feeble.
	12-26		,,
	12-55		,,
	13-33		,,
	17-45		,,
	18-37		,,
	21-7		,,

Duration from 3 to 20 seconds.

Date.	Time.	Duration.	Nature.
July 25	6-19	3 s.	feeble.
	7-10	10 ,,	,,
	8-0	2 ,,	,,
	9-5	4 ,,	,,
	9-42	5 ,,	slight.
	10-1	6 ,,	feeble.
	12-21	45 ,,	,,
	12-24	27 ,,	,,
	12-42	2 ,,	,,
	13-4	4 ,,	,,
	18-9	3 ,,	,,
	21-43	2 ,,	,,
26	3-55	2 m.	smart.
	8-26	22 s.	feeble.
	13-53	3 ,,	,,
	14-35	2 ,,	,,
	16-37	1 ,,	,,
	21-19	15 ,,	,,
27	8-13	5 ,,	,,
	8-24	18 ,,	,,
	9-5	1 ,,	,,
	9-53	10 ,,	,,
	11-19	25 ,,	,,
	14-12	25 ,,	,,
	18-6	5 ,,	,,
	19-1	1 ,,	,,
	20-33	1 ,,	,,
	21-36	1 ,,	,,
	21-40	1 ,,	,,
28	7-42	7 ,,	slight.
	7-48	1 ,,	feeble.
	8-37	1 ,,	,,
	9-18	2 ,,	,,
	10-1	1 ,,	,,
	11-54	11 ,,	,,
	12-20	30 ,,	,,
	12-36	12 ,,	,,
	12-59	2 ,,	,,
	13-36	3 ,,	,,
	14-40	5 ,,	,,
	16-35	10 ,,	,,
	18-37	3 ,,	,,
29	6-0	2 ,,	,,
	8-19	3 ,,	,,
	13-28	1 ,,	,,
30	2-57	1 m.	smart.

Following the "Smart" shock at 3-55 A.M. July 26 were a number of sharp explosions accompanied by tremors.

The "Feeble" shock at 16-37 on same day seemed to be an explosion directly under Goalpara Hill.

Date.	Time.	Duration.	Nature.
July			
30	6-44	1 s.	feeble.
	7-19	25 ,,	,,
	8-21	2 ,,	,,
	8-42	10 ,,	,,
	10-12	2 ,,	,,
	10-23	13 ,,	,,
	14-43	5 ,,	,,
	16-24	4 ,,	,,
	16-49	2 ,,	,,
	18-13	1 ,,	,,
	20-33	2 ,,	slight.
	21-24	1 ,,	feeble.
	22-0	1 ,,	,,
31	8-57	12 ,,	,,
	14-28	2 ,,	,,
	14-33	1 ,,	,,
	14-37	1 ,,	,,
	15-4	11 ,,	,,
	19-15	1 ,,	,,
	20-8	4 ,,	,,
	20-32	3 ,,	,,
	22-2	1 ,,	,,
Aug.			
1	9-13	20 s.	feeble.
	11-37	10 ,,	,,
	11-53	1 ,,	,,
	12-49	7 ,,	,,
	14-32	1 ,,	,,
	15-21	1 ,,	,,
	17-28	1 ,,	,,
	17-43	1 ,,	,,
	18-38	27 ,,	slight.
	21-45	3 ,,	feeble.
	22-9	13 ,,	slight.
	6-9	2 ,,	feeble.
	6-45	1 ,,	,,
	13-26	2 ,,	,,
	14-45	47 ,,	smart.
	14-55	2 ,,	feeble.
	15-49	1 ,,	,,
	16-6	3 ,,	,,
	16-20	1 ,,	,,
	16-33	27 ,,	slight.
	21-8	3 m.	severe.
	21-37	1 s.	feeble
	22-6	37 ,,	slight.
3	6-44	4 ,,	feeble.
	9-12	2 ,,	,,
	11-15	3 ,,	,,
	11-30	1 ,,	,,
	11-33	5 ,,	,,
	11-57	2 ,,	,,
	15-13	1 ,,	,,
	15-57	1 ,,	,,
	16-33	2 ,,	,,
	17-34	1 ,,	,,
	7-12	1 ,,	,,

Date.	Time.	Duration.	Nature.
August			
3	8-5	1 s.	feeble.
	9-15	33 ,,	slight.
	9-20	2 ,,	feeble.
	9-29	50 ,,	smart.
4	6-22	1 ,,	feeble.
	6-54	2 ,,	,,
	9-15	4 ,,	,,
	9-25	2 ,,	,,
	9-29	1 ,,	,,
	13-0	1 ,,	,,
	13-11	2 ,,	,,
	13-29	3 ,,	,,
	13-37	2 ,,	,,
	14-44	2 ,,	,,
	21-35	1 ,,	,,
5	5-59	2 ,,	,,
	6-12	1 ,,	,,
	7-35	1 ,,	,,
	11-29	1 ,,	,,
	13-12	1 ,,	,,
	14-19	2 ,,	,,
	14-50	1 ,,	,,
	18-6	1 ,,	,,
	18-24	8 ,,	,,
	18-52	1 ,,	,,
	22-18	2 ,,	,,
6	5-48	4 ,,	slight.
	6-5	1 ,,	feeble.
	9-32	1 ,,	,,
	11-37	1 m.	slight.
	12-59	19 s.	,,
	14-15	1 ,,	feeble.
	14-42	3 s.	,,
	16-58	1 ,,	,,
	17-13	1 ,,	,,
	17-47	1 ,,	,,
	19-3	2 ,,	,,
7	6-18	13 ,,	,,
	8-12	3 ,,	,,
	9-54	2 ,,	,,
	11-6	6 ,,	,,
	12-0	1 ,,	,,
	13-23	43 ,,	slight.
	18-36	4 ,,	feeble.
	18-53	2 ,,	,,
	19-53	2 ,,	,,
	20-4	1 ,,	,,
8	6-53	4 ,,	slight.
	8-24	11 ,,	,,
	8-54	2 ,,	feeble.
	11-55	1 ,,	,,
	12-5	4 ,,	,,
	14-10	2 ,,	,,
	17-11	3 ,,	,,
	19-20	2 ,,	,,
	19-47	2 ,,	,,
9	7-4	2 ,,	,,

Date.	Time.	Duration.	Nature.
August			feeble.
9	10-37	3 s.	,,
	11-30	2 ,,	,,
	12-10	13 ,,	,,
	13-17	13 ,,	,,
	14-56	2 ,,	,,
	19-8	3 ,,	,,
10	7-50	1 ,,	,,
	9-33	2 ,,	,,
	10-16	1 ,,	,,
	15-44	9 ,,	,,
	15-54	1 ,,	,,
	16-9	3 ,,	,,
	17-11	8 ,,	,,
	17-42	2 ,,	,,
11	7-12	3 ,,	,,
	7-44	16 ,,	,,
	8-46	1 ,,	,,
	9-13	2 ,,	,,
	9-21	9 ,,	,,
	10-42	3 ,,	,,
	12-50	2 ,,	,,
	14-12	2 ,,	,,
	15-32	4 ,,	,,
	22-4	6 ,,	,,
12	6-45	2 ,,	,,
	6-47	2 ,,	,,
	8-53	1 ,,	,,
	17-3	2 ,,	,,
	18-29	2 ,,	,,
	19-45	1 ,,	,,
13	10-13	2 ,,	,,
	10-55	1 ,,	,,
	11-32	1 ,,	,,
	14-10	2 ,,	,,
	14-24	3 ,,	,,
	15-43	4 ,,	,,
	16-13	3 ,,	,,
	18-39	3 ,,	,,
	19-30	1 ,,	,,
	20-0	20 ,,	smart
	21-12	4 ,,	feeble.
14	7-4	1 ,,	,,
	7-50	1 ,,	,,
	9-2	1 ,,	,,
	9-34	2 ,,	,,
	12-25	1 ,,	,,
	12-48	6 ,,	,,
	12-55	4 ,,	,,
	14-37	2 ,,	,,
	20-28	10 ,,	,,
	20-59	2 ,,	,,
	21-52	8 ,,	,,
15	6-1	1 ,,	,,
	7-19	1 ,,	,,
	10-46	1 ,,	,,
	12-22	9 ,,	,,
	12-55	2 ,,	,,

Date.	Time.	Duration.	Nature.	Date.	Time.	Duration.	Nature	Date.	Time.	Duration.	Nature.
August				August				August			
15	15-17	3 s.	slight.	21	13-21	12 s.	feeble.	28	15-50	3 s.	feeble.
	16-48	2 ,,	feeble.		13-51	8 ,,	,,		16-48	2 ,,	,,
	18-24	1 ,,	,,		14-5	7 ,,	,,		17-2	1 ,,	,,
16	5-44	1 ,,	,,		14-10	2 ,,	,,	29	7-12	15 ,,	slight.
	6-24	1 ,,	,,		14-24	26 ,,	,,		7-28	3 ,,	feeble.
	7-6	1 ,,	,,		15-22	3 ,,	,,		8-19	1 ,,	,,
	7-32	2 ,,	,,		15-29	4 ,,	,,		10-11	21 ,,	,,
	7-41	2 ,,	,,		16-23	2 ,,	,,		11-6	2 ,,	,,
	16-33	1 ,,	,,		18-9	6 ,,	,,		14-54	2 ,,	,,
	20-45	1 ,,	,,		21-55	2 ,,	,,		15-56	4 ,,	,,
17	5-34	1 ,,	,,		22-16	3 ,,	,,		16-13	2 ,,	,,
	10-36	1 ,,	,,	22	7-24	2 ,,	,,		16-45	1 ,,	,,
	11-45	2 ,,	,,		8-50	1 ,,	,,		19-37	9 ,,	smart.
	13-32	1 ,,	,,		10-8	2 ,,	,,		20-11	2 ,,	feeble.
	13-37	1 ,,	,,		10-34	25 ,,	,,		21-1	2 ,,	,,
	13-54	1 ,,	,,		13-51	9 ,,	,,		21-51	8 ,,	slight.
	15-8	9 ,,	,,		14-43	13 ,,	,,	30	9-9	1 ,,	feeble.
	17-6	2 ,,	,,		15-53	4 ,,	,,		10-49	1 ,,	,,
	17-54	1 ,,	,,		16-44	2 ,,	,,		13-20	1 ,,	,,
18	5-30	1 ,,	,,		17-18	26 ,,	slight.		13-40	1 ,,	,,
	5-42	14 ,,	,,	23	7-33	1 ,,	feeble.		20-28	5 ,,	,,
	5-33	1 ,,	,,		7-58	12 ,,	,,	31	6-37	2 ,,	,,
	6-13	9 ,,	,,		11-40	1 ,,	,,		8-43	1 ,,	,,
	6-37	65 ,,	smart.		14-55	1 ,,	,,		10-23	3 ,,	,,
	7-16	5 ,,	feeble.		14-59	1 ,,	,,		10-55	2 ,,	,,
	7-38	1 ,,	,,		15-9	1 ,,	,,		11-33	2 ,,	,,
	7-49	1 ,,	,,		18-2	1 ,,	,,		14-14	1 ,,	,,
	8-20	4 ,,	,,	24	6-5	1 ,,	,,		16-23	44 ,,	slight.
	10-16	4 ,,	,,		6-52	2 ,,	,,		17-39	1 ,,	feeble.
	10-47	1 ,,	,,		10-17	8 ,,	slight.	Sept.			
	12-4	1 ,,	,,		10-31	2 ,,	feeble.	1	7-47	2 ,,	feeble.
	12-6	4 ,,	,,		12-33	2 ,,	,,		7-50	1 ,,	,,
	12-56	4 ,,	,,		12-35	2 ,,	,,		10-35	2 ,,	,,
	12-59	3 ,,	,,		18-55	2 ,,	slight.		11-28	1 ,,	,,
	15-3	28 ,,	smart.	25	6-18	2 ,,	feeble.		14-41	1 ,,	,,
	15-14	4 ,,	feeble.		10-16	1 ,,	,,		15-28	48 ,,	smart.
	16-22	2 ,,	,,		15-6	8 ,,	,,		16-13	2 ,,	feeble.
	16-38	2 ,,	,,		15-53	1 ,,	,,		17-23	1 ,,	,,
	17-27	1 ,,	,,		19-59	14 ,,	slight.	2	6-45	2 ,,	,,
	18-15	1 ,,	,,		20-8	2 ,,	feeble.		9-1	1 ,,	,,
	21-48	3 ,,	,,	26	7-35	2 ,,	,,		13-18	1 ,,	,,
	21-57	4 ,,	,,		10-2	1 ,,	,,		13-20	1 ,,	,,
19	6-13	1 ,,	,,		13-21	2 ,,	,,		19-53	1 ,,	,,
	11-42	1 ,,	,,		15-20	1 ,,	,,	3	7-0	1 ,,	,,
	11-59	4 ,,	,,		21-13	1 ,,	,,		8-48	1 ,,	,,
	12-16	4 ,,	,,	27	6-22	2 ,,	,,		12-46	1 ,,	,,
	12-57	2 ,,	,,		9-10	3 ,,	,,		12-48	2 ,,	,,
20	9-8	5 ,,	slight.		11-22	42 ,,	slight.		15-21	2 ,,	,,
	9-14	3 ,,	,,		13-46	2 ,,	feeble.		21-4	2 ,,	,,
	9-50	2 ,,	feeble.		14-43	2 ,,	,,		21-32	3 ,,	,,
	12-57	3 ,,	slight.		16-38	2 ,,	,,	4	13-0	6 ,,	,,
21	7-7	2 ,,	feeble.	28	6-46	26 ,,	slight.		21-27	2 ,,	,,
	9-0	1 ,,	,,		6-49	1 ,,	feeble.	5	7-43	1 ,,	,,
	10-11	4 ,,	,,		7-38	2 ,,	,,		11-55	2 ,,	,,
	10-20	3 ,,	,,		8-58	1 ,,	,,		12-1	1 ,,	,,
	11-8	14 ,,	slight,		14-2	4 ,,	slight.		12-7	8 ,,	,,
	12-43	1 ,,	,,		14-51	9 ,,	,,		13-45	6 ,,	,,

Date.	Time.	Duration.	Nature.
Sept.			
5	16-42	2 s.	feeble.
6	9-44	2 ,,	,,
	10-18	1 ,,	,,
7	8-8	1 ,,	,,
	11-38	2 ,,	,,
	17-31	8 ,,	,,
8	9-8	2 ,,	,,
	12-5	4 ,,	,,
9	13-27	2 ,,	,,
	16-56	1 ,,	,,
	17-29	1 ,,	,,
10	14-0	2 ,,	,,
	18-13	1 ,,	,,

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22	9-40	3 s.	feeble.
	10-31	4 ,,	,,
	13-2	2 ,,	,,
	13-41	4 ,,	,,
	14-23	23 ,,	slight.
	16-52	3 ,,	feeble.
	21-27	6 ,,	,,
	21-45	2 ,,	,,
23	8-23	6 ,,	slight.
	10-1	4 ,,	feeble.
	13-22	8 ,,	,,
	13-40	6 ,,	slight.
	14-10	2 ,,	feeble.
	18-49	5 ,,	,,
	21-16	2 ,,	,,
24	4-55	2 ,,	,,
	6-46	2 ,,	,,
	8-45	20 ,,	,,
	9-24	3 ,,	,,
	18-43	5 ,,	,,
25	11-9	2 ,,	,,
	11-39	12 ,,	,,
	12-33	15 ,,	,,
	12-35	4 ,,	,,
	12-37	5 ,,	,,
	14-0	5 ,,	,,
	15-50	22 ,,	slight.
26	20-16	12 ,,	,,
27	3-15	24 ,,	,,
	6-50	3 ,,	feeble.
	9-43	9 ,,	,,
	13-18	4 ,,	,,
	14-15	10 ,,	,,
	14-40	8 ,,	,,
	15-4	24 ,,	slight.
	17-28	3 ,,	feeble.
	21-5	4 ,,	,,
	22-14	30 ,,	smart.
28	7-31	8 ,,	,,
	9-40	3 ,,	,,

Date.	Time.	Duration.	Nature.
Sept.			
28	14-19	5 s.	feeble.
	19-20	2 ,,	,,
29	13-11	2 ,,	,,
	13-45	2 ,,	,,
	17-28	2 ,,	,,
	19-25	1 ,,	,,
30	7-30	10 ,,	,,
	8-12	3 ,,	,,
	8-31	2 ,,	,,
	11-35	4 ,,	,,
	13-14	5 ,,	,,
	13-16	2 ,,	,,
	17-44	13 ,,	,,
	19-11	6 ,,	,,
Oct.			
1	7-7	10 s.	feeble.
	7-46	7 ,,	,,
	10-12	3 ,,	,,
	16-28	4 ,,	,,
2	9-56	6 ,,	,,
	13-41	2 ,,	,,
	18-55	2 ,,	,,
	19-6	2 ,,	,,
3	7-40	10 ,,	,,
	9-25	2 ,,	,,
	17-22	1 ,,	,,
4	6-42	1 ,,	,,
	9-41	3 ,,	,,
	14-29	1 ,,	,,
	14-50	4 ,,	,,
	19-22	2 ,,	,,
5	10-30	6 ,,	,,
	10-43	1 ,,	,,
	13-55	1 ,,	,,
	13-57	3 ,,	,,
	14-15	1 ,,	,,
	20-50	5 ,,	,,
6	6-35	2 ,,	,,
	10-50	2 ,,	,,
	18-13	1 ,,	,,
	18-19	2 ,,	,,
	18-37	1 ,,	,,
	19-27	1 ,,	,,
7	11-0	2 ,,	,,
	14-55	4 ,,	,,
	17-52	1 ,,	,,
8	6-1	4 ,,	slight.
	11-34	1 ,,	feeble.
	15-2	2 ,,	,,
	18-20	1 ,,	,,
9	1-45	25 ,,	smart.
	1-49	4 ,,	feeble.
	1-52	2 ,,	,,
	2-21	1 ,,	,,
	2-29	4 ,,	,,
	4-5	Not timed.	,,
	4-25	Not timed.	,,

Date.	Time.	Duration.	Nature.
Oct.			
9	6-47	1 s.	feeble.
	11-1	2 ,,	,,
	11-55	1 ,,	,,
	13-42	1 ,,	,,
	15-50	6 ,,	,,
	16-30	1 ,,	,,
	18-30	3 ,,	,,
10	8-26	10 ,,	,,
	One during meeting.		
	10-15	1 s.	,,
	12-4	4 ,,	,,
	13-15	2 ,,	,,
	14-14	3 ,,	,,
	15-2	4 ,,	,,
	15-17	4 ,,	,,
	17-15	3 ,,	,,
	19-40	8 ,,	,,
	20-49	5 ,,	,,
11	4-40	20 ,,	slight.
	4-54	3 ,,	feeble.
	11-35	4 ,,	slight.
	12-24	1 ,,	feeble.
	13-22	3 ,,	,,
11	17-47	2 ,,	,,
12	6-22	2 ,,	,,
	12-25	1 ,,	,,
	13-28	1 ,,	,,
	14-39	2 ,,	,,
	21-11	8 ,,	,,
13	6-27	2 ,,	,,
	11-42	1 ,,	,,
	12-56	1 ,,	,,
	13-38	2 ,,	,,
	15-28	15 ,,	,,
	20-56	5 ,,	,,
14	8-22	4 ,,	,,
	9-0	5 ,,	,,
	11-53	3 ,,	,,
	15-58	1 ,,	,,
	19-10	4 ,,	,,
	20-30	1 ,,	,,
15	9-40	1 ,,	,,
	12-56	4 ,,	,,
	13-23	5 ,,	,,
	13-59	2 ,,	,,
	18-21	16 ,,	,,
	19-55	2 ,,	,,
16	7-55	3 ,,	,,
	8-36	2 ,,	,,
	12-24	1 ,,	,,
	12-25	20 ,,	slight.
	13-51	1 ,,	feeble.
	16-26	2 ,,	,,
	20-44	1 ,,	,,
17	6-28	12 ,,	,,
	6-30	12 ,,	,,

Date.	Time	Duration.	Nature.
Oct.			
17	16-7	1 s.	feeble.
	17-53	2 ,,	,,
18	18-0	6 ,,	,,
	11-12	8 ,,	,,
	20-16	1 ,,	,,
	20-19	1 ,,	,,
19	12-25	3 ,,	,,
	14-11	2 ,,	,,
	17-1	1 ,,	,,
	18-2	2 ,,	,,
	20-14	15 ,,	,,
	20-57	3 ,,	feeble.
20	12-20	2 ,,	,,
	12-35	2 ,,	,,
	18-48	3 ,,	,,
21	6-10	1 ,,	,,
	12-29	1 ,,	,,
	14-17	2 ,,	,,
	18-59	1 ,,	,,
22	3-45	15 ,,	smart.
	8-58	2 ,,	feeble.
	10-8	10 ,,	,,
	10-17	1 ,,	,,
	12-0	...	,,
	12-12	12 ,,	slight.
	14-20	...	feeble.
	16-0	12 ,,	slight.
	17-56	15 ,,	,,
23	9-35	1 ,,	feeble.
	14-30	8 ,,	slight.
24	7-56	1 ,,	feeble.
	12-28	1 ,,	,,
	20-51	1 ,,	,,
	20-54	1 ,,	,,
25	5-59	1 ,,	,,
	10-32	2 ,,	,,
	14-40	1 ,,	,,
	10-45	20 ,,	slight.
26	12-45	6 ,,	feeble.
	14-48	1 ,,	,,
	16-23	8 ,,	,,
27	13-6	4 ,,	,,
	18-35	4 ,,	,,
	20-59	3 ,,	,,
28	7-58	1 ,,	,,
	12-59	3 ,,	,,
	13-43	1 ,,	,,
	20-26	1 ,,	,,
29	8-20	1 ,,	,,
	12-12	2 ,,	,,
	12-49	3 ,,	,,
	15-24	2 ,,	,,
	16-51	1 ,,	,,
	17-2	1 ,,	,,
	18-7	1 ,,	,,
30	18-19	1 ,,	,,
	11-30	4 ,,	,,
Oct.			
30	12-27	2 s.	feeble-
	14-17	1 ,,	,,
	18-35	1 ,,	,,
	17-1	1 ,,	,,
	17-12	1 ,,	,,
Nov.			
1	6-40	3 s.	feeble.
	13-50	1 ,,	,,
2	11-35	1 ,,	,,
	11-36	1 m.	slight.
	11-55	2 s.	feeble.
	12-30	10 ,,	slight.
	13-40	6 ,,	,,
	15-9	1 ,,	feeble.
	19-5	1 ,,	,,
	20-40	1 ,,	,,
3	13-23	2 ,,	,,
4	11-25	2 ,,	,,
	13-1	1 ,,	,,
	15-42	1 ,,	,,
	20-29	10 ,,	slight.
5	14-37	1 ,,	feeble.
	15-33	2 ,,	slight.
	16-40	1 ,,	feeble.
	18-19	1 ,,	,,
6	5-45	4 ,,	slight.
	8-28	2 ,,	feeble.
	16-20	1 ,,	,,
	20-28	1 ,,	,,
	20-31	1 ,,	,,
7	One during 9-		meeting 10 A.M.
	One during 7-30—		meeting 8-30 P.M.
8	15-40	4 s.	slight.
	17-6	3 ,,	feeble.
	17-7	2 ,,	,,
	18-40	1 ,,	,,
	19-23	1 ,,	,,
9	10-46	19 ,,	,,
	15-47	1 ,,	,,
	16-43	1 ,,	,,
	19-33	10 ,,	slight.
	19-35	1 ,,	feeble.
10	6-51	1 ,,	,,
	12-3	1 ,,	,,
	13-58	1 ,,	,,
	One during 6 to 7 P.M.		meeting
	19-18	1 ,,	feeble.
	19-45	1 ,,	,,
11	6-6	1 ,,	,,
	7-40	2 ,,	slight.
	17-23	1 ,,	feeble.
	18-31	1 ,,	,,
	18-55	1 ,,	,,
Nov.			
11	19-0	2 s.	feeble.
	19-5	1 ,,	,,
	20-47	1 ,,	,,
12	11-43	1 ,,	,,
	14-48	4 ,,	,,
	16-16	1 ,,	,,
13	9-30	1 ,,	,,
	11-47	1 ,,	,,
	12-9	2 ,,	,,
	13-58	2 ,,	,,
	17-58	1 ,,	,,
14	12-25	2 ,,	,,
	12-35	2 ,,	,,
	17-27	1 ,,	,,
	18-50	1 ,,	,,
	19-35	1 ,,	,,
15	18-9	3 ,,	,,
	18-54	1 ,,	...
	19-59	2 ,,	...
16	12-15	1 ,,	feeble.
	20-15	1 ,,	,,
17	10-22	2 ,,	,,
	11-5	3 ,,	slight.
	15-10	1 ,,	feeble.
	17-34	1 ,,	,,
	21-15	40 ,,	slight.
18	11-16	2 ,,	feeble.
	17-27	2 ,,	,,
	18-4	2 ,,	,,
19	13-20	2 ,,	,,
	17-13	1 ,,	,,
	18-21	2 ,,	,,
	19-0	2 ,,	,,
	20-57	1 ,,	,,
	21-1	3 ,,	,,
20	18-10	1 ,,	,,
21	8-15	2 ,,	,,
	9-47	15 ,,	slight.
	10-24	1 ,,	feeble.
	14-38	2 ,,	,,
	17-27	1 ,,	,,
	19-55	1 ,,	,,
22	Record lost		...
23	8-36	3 s.	feeble.
	11-15	1 ,,	,,
	18-22	2 ,,	,,
	20-50	1 ,,	,,
24	8-50	1 ,,	,,
25	15-4	7 ,,	...
	18-20	10 ,,	...
26	10-53	...	slight.
	13-40	2 ,,	feeble.
	15-3	5 ,,	,,
	15-31	1 ,,	,,
	17-54	1 ,,	,,
	19-19	2 ,,	,,
	19-51	1 ,,	,,

Date.	Time.	Duration.	Nature.	Date.	Time.	Duration.	Nature.	Date.	Time.	Duration.	Nature.
Nov.				Nov.				Dec.			
27	14-37	1 s.	feeble.	5	13-40	1 s.	feeble.	9	21-5	2 s.	feeble.
	15-26	1 ,,	,,		15-40	1 ,,	,,	10	7-0	1 ,,	,,
	19-19	2 ,,	,,	6	14-9	1 ,,	,,		7-9	10 ,,	slight.
28	10-34	1 ,,	,,		14-15	1 ,,	,,		13-12	1 ,,	feeble.
	11-11	1 ,,	,,		17-8	1 ,,	,,		20-30	1 ,,	,,
	16-50	1 ,,	,,		19-28	1 ,,	,,	12	7-21	6 ,,	,,
29	15-0	9 ,,	slight.	7	13-34	40 ,,	slight.		7-50	2 ,,	,,
	16-38	1 ,,	feeble.		17-40	1 ,,	feeble.		11-40	1 ,,	,,
30	19-51	1 ,,	,,		18-17	1 ,,	,,		14-25	2 ,,	,,
Dec.				8	10-34	1 ,,	,,		15-54	1 ,,	,,
2	8-30	1 ,,	,,		15-0	15 ,,	slight.		18-11	1 ,,	,,
	8-40	1 ,,	,,		19-0	6 ,,	,,	13	8-45	3 ,,	slight.
	8-54	1 ,,	,,	9	17-55	3 ,,	,,	14	14-0	1 ,,	feeble.
3	7-34	18 ,,	slight.		18-19	1 ,,	feeble.		18-6	1 ,,	,,
	6-35	1 ,,	feeble		20-48	1 ,,	,,	15	11-45	1 ,,	,,
	7-51	3 ,,	,,								

IX.

List of earthquakes recorded by the pendulum seismograph at Shillong from 4th August 1897 to 31st December 1898.

This instrument was constructed under the supervision of Mr. La Touche and set up in the office of Mr. G. K. Watts, Executive Engineer, by whose direction the records were kept. The instrument is a simple pendulum with a pointer giving an amplification of about 5 times to record the movements on a piece of smoked glass. The movement of the pendulum is not controlled in any way, and the diagrams are consequently a combination of the movement of the ground and the motion communicated to the pendulum; they serve, however, to give a fair idea of the comparative range of motion in the earthquakes recorded by the instrument. Besides these there were at least four or five times as many, distinctly sensible to any one sitting or lying down, but not of sufficient range of motion to affect the instrument.

The range of motion is approximately the actual movement of the ground in millimetres (25 mm.= about 1 inch). Where the measurement is given as ·1, it means practically that the movement was visible but too small to measure. Where two shocks are bracketed together it means that the recording surface was not renewed between them and that the records of the two or more shocks cannot be separated from each other.

Date.	Time.	Range of motion.		Date.	Time.	Range of motion.		Date.	Time.	Range of motion.	
		N—S.	E—W.			N—S.	E—W.			N—S.	E—W.
Aug.				Sept.				Oct.			
4	5-30	·5	·25	24	5-10	·5	·75	13	3-15	·1	1·0
	9-25	·5	1·00	25	7-12	·7	·7		11-45	·25	·5
	18-10	·5	·2		16-30	·15	·8		15-10	·75	·75
	19-40	·5	·5	26	13-25	·6	1·0	14	12-20	·5	·25
5	3-30	2·0	·75	30	7-45	·5	·5		17-0	·5	·25
	8-20	·0	·75		20-30	·8	·7	15	5-38	1·0	1·5
	11-0	·2	·5	Oct.					19-10	·5	·5
6	16-35	1·5	1·0	1	22-0	1·0	1·0	16	3-12	2·0	1·0
7	5-35	·75	·5		23-45	1·0	1·0		19-10	1·0	·75
	6-25	1·25	·4	2	9-45	·2	·4		23-30	·0	·5
8	19-45	2·5	2·0	3	4-10	·4	·2	17	21-5	1·5	3·0
10	16-53	1·0	·5	4	7-10	·3	·5	19	15-28	·6	·6
13	5-30	1·0	·3	5	17-5	·75	·5	20	4-30	·5	·0
	14-10	·5	·5		17-45	·6	·2	21	3-52	1·0	·75
14	7-14	·25	·5	8	4-25	·75	·75	22	4-40	·75	·5
	20-20	·5	·5		23-2	1·0	1·75		16-5	·25	·0
18	13-0	·75	·75	10	7-20	·5	1·0		16-20	·25	·25
	21-45	·5	·5		11-5	1·0	·5		23-30	2·0	1·5
	23-50	2·5	4·0		23-5	1·5	·5	23	20-45	·75	·25
20	20-10	·3	·5	11	13-30	1·0	·5	24	11-10	·25	·25
	22-45	1·25	2·0	12	6-25	·5	·5	25	5-15	1·2	1·2
21	3-45	·5	·75		10-30	·5	·5		6-30	·75	·5
	14-25	1·0	·5		21-0	1·0	1·0		10-20	·5	·25
22	12-35	·25	·2	13	13·0	·5	·3		23-0	·5	·25
	14-45	4·0	1·25		15-0	·5	1·0	26	18-30	1·5	·5
23	18-10	·5	.1		15-30	1·25	1·50		21-30	·75	·5
24	9-35	·2	·5	14	9-5	1·5	·75	28	9-50	·25	·5
26	23-30	·2	2·0		16-45	·0	·5		19-10	·5	1·0
27	13-0	·5	·5	16	6-35	·25	1·0	29	22-50	·5	1·0
	23-2	·75	·5	17	8-45	·2	·4	30	21-50	1·5	1·0
28	10-50	·75	·75	18	19-0	1·0	1·0	Dec.			
31	6-40	1·0	·75	19	7-0	·5	·5	1	3-5	·75	·5
Sept.					9-55	·2	·75		20-40	1·0	·75
1	15-25	2·5	2·0	21	5-0	·5	1·0	3	7-55	1·25	1·0
2	6-55	·4	·6	22	4-20	·5	1·0	4	0-10	·25	·5
	17-45	1·25	·6		10-25	·25	·5		2-10	·25	·75
5	4-45	·6	·6	26	13-25	·3	·3	5	7-30	·5	·25
6	6-20	·75	·5	27	6-30	2·0	·5	6	2-0	·25	·0
	19-5	·1	2·0		13-18	·25	1·0		9-25	1·25	1·0
8	6-35	·5	·75		18-50	·1	·5	7	19·25	·5	·5
10	3-5	·75	.5	28	0-25	·5	·75	8	1-30	1·0	1·0
	4-0	.75	·5		9-0	·25	·5	9	2-0	1·0	·75
11	12-30	·2	·1	31	1-10	2·0	1·5		5-15	1·0	·75
	23-30	·25	·5	Nov.					18-50	·75	·75
13	4-0	1·0	·5	2	12-45	·5	·75	10	2-45	.5	1·0
	16-45	·5	·25	3	1-45	1·0	·25	12	0-55	·5	·75
16	10-30	1·0	·75	4	7-25	·25	1·0		4-55	1·0	·75
	11-13	1·0	·75	6	2-30	1·0	1·0		6-40	1·5	1·25
17	8-10	2·0	·2		4-20	1·0	1·0	13	5-15	·75	2·25
	9-45	.2	·5		16-50	·5	1·0		14-20	·5	·5
19	18-45	·75	·5	8	2-0	·75	·5	14	6-30	·5	·5
	20-25	·4	·5	9	23-15	·5	·5		20-15	1·1	·75
20	11-30	·5	1·0	10	9-50	·5	·25	15	6-50	·5	·5
	13-0	·5	·5		16-48	·25	·2		7-50	·25	·5
21	20-5	·7	·5		17-48	·25	·5	17	8-35	1·0	.75
22	1-15	·75	·0		21-55	1·2	1·2		12-20	·5	·25
	22-25	·3	·5	12	22-15	·0	·5		14-25	·25	·25

Date.	Time.	Range of motion.		Date.	Time.	Range of motion.		Date.	Time.	Range of motion.	
		N—S.	E—W.			N—S.	E—W.			N—S.	E - W.
Dec.				Feb.				Mar.			
18	6-40	·75	·25	5	9-0	1·0	1·0	6	10-25	1·0	1·0
	22-20	·5	·5		22-40	1·75	1·0		10-50	1·0	1·0
20	21-50	1·0	·25	6	3-15	·5	·75		16-10	1·0	·5
21	9-0	·1	·1		19-45	·5	·5		22-15	1·0	1·0
22	10-50	·25	·25	7	11-0	·25	·25	7	4-30	1·0	1·0
	11-0	·2	·2		18-20	·25	·25		11-25	3·0	4·5
	22-10	·5	·5		22-40	·1	·5	8	4-15	1·0	1·0
23	20-50	·1	·2	8	15-50	·75	·5		5-0	1·0	1·0
24	3-0	2·0	2·0		22-30	·25	·25		10-45	·75	1·0
	6-35	1·0	·2	10	5-55	·75	2·0	8	18-30	·1	·1
25	9-45	·2	·2		14-45	·5	1·0		22-50	3·0	·5
28	5-25	·75	·75		15-45	·75	·75		23-40	3·0	·5
	22-55	1·5	·25	11	0-25	·75	·5	9	5-3	·75	·75
31	0-30	1·0	·5		14-40	·5	·5		11-10	·5	·25
	6-30	·75	·5		16-45	·5	·25	10	15-0	·1	·1
	15-20	·75	·5		20-15	1·0	·5	11	12-55	1·0	1·25
	18-30	·75	·2	12	0-40	1·0	1·0		19-30	1·0	1·25
	22-5	·5	·2		10-30	·5	·75	12	4-15	1·5	·75
Jan.				13	0-45	·5	·5		10-25	1·0	·75
1	7-30	1·25	·5		11-45	1·0	1·0		18-15	·1	·1
4	22-50	·5	·2		17-55	·75	·75	13	11-52	4·5	2·0
5	4-30	·1	·1	14	14-35	1·0	1·0	14	7-0	1·0	·5
8	6-0	·1	·1		16-14	·25	·5	15	7-0	·75	·75
9	8-25	·2	·2	16	12-15	·25	·25		15-0	·1	·1
	21-0	4·0	2·5		14-25	·1	·1	16	19-0	·1	·1
10	10-25	·2	·2	17	1-15	·75	·5		20-30	·1	·1
	11-15	·2	·1	18	5-30	3·5	2·5		21-0	·1	·1
	18-30	·2	·2	19	5·0	·1	·1	17	14-30	1·75	·75
11	22-20	·2	·1		22-30	·25	·25	18	4-0	1·0	1·0
12	20-40	·75	·75	20	18-0	·25	·5	19	2·3	2·2	·5
13	6-20	·5	·5	21	5-45	1·5	1·0		10-15	2·0	1·2
	12-40	·5	·5	22	4-30	1·0	·75		18-55	·1	·1
14	22-50	2·0	1·0		18-0	·25	·25	21	20-15	1·75	1·5
15	20-10	·5	·1	23	11-15	·25	·25		22-0		
16	1-50	1·5	·5	24	7-30	·25	·25	22	21-15	·1	·1
	11-20	·75	·1	25	19-0	1·0	1·5	23	17-0	·1	·1
	12-25	·5	·5	27	7-50	·25	·25	24	16-30	1·0	1·0
20	0-35	·2	·1		13-15	·5	·25	25	16-20	3·75	2·6
23	0-30	·1	·1		20-15	·25	·25	26	4-15	·9	1·2
25	23-5	3·0	2·0	28	17-30	·1	·1		6-30		
26	4-40	1·0	1·0		18-20	1·0	·75	27	16-0	·1	·1
	7-0	·2	·1		19-30	·25	·25		21-45	·1	·1
27	24-0	·3	·2		22-0	·25	·25	28	4-0	·1	·1
28	8-30	·2	·3	Mar.					6-30	·1	·1
30	2-50	1·75	1·25	1	15-30	·25	·25		13-0	2·6	1·0
	7-30	·75	·75		22-15	2·0	2·0	29	3-30	·1	·1
31	19-20	·75	·25	2	20-40	1·5	1·0	30	19-30	·8	·5
	21-15	1·5	·75		21-5	2·0	·5		20-0		
Feb.				3	7-0	·25	·25	31	18-5	2·6	·2
1	2-55	·75	·5		21-30	·25	·25		21-40	2·8	1 8
2	2-50	·5	1·0	5	1-30	2·0	1·5	April			
	5-40	·1	·1		7-0	·25	·5	2	18-0	·1	·1
3	0-25	·2	·2		9-30	·1	·1	3	1-0	·1	·1
	16-35	·2	·5		20-25	1·5	2·0		18-0	2·5	1·0
	20-20	·25	·5	6	3-45	2·5	1·0		22-0	·8	·4
4	6-20	·5	·2		5-0	2·5	1·0	5	2-0	·1	·1
	14-0	·2	·1		9-55	·25	·25				
5	1-40	·5	·75								

Date.	Time.	Range of motion.		Date.	Time.	Range of motion.		Date.	Time.	Range of motion.	
		N—S.	E—W.			N—S.	E—W.			N—S.	
April				May				June			
5	4-0	·1	·1	1	7-25	·6	1·2	12	12-10	1·3	·8
	8-40	·1	·1		9-30	1·0	·8		13-30	1·5	·8
	11-25	·1	·1		7-30	·6	·8		15-25	·4	·4
	14-30	·1	·1		13-40	1·8	1·6		16-45	·8	·6
	16-18	·1	·1	3	19-0	1·4	·9		17-50	·6·	·8
	21-0	·9	1·0		21-45	1·4	1·6		18-0		
	21-25			4	6-15	·7	·6		23-50	1·2	·5
6	5-0	1·0	·8	5	21-0	1·6	3·2	13	22-5	1·2	·7
	15-55	1·4	2·0		22-10	·6	1·0	16	5-45	·7	·6
	21-28	·1	·1	7	14-0	6·4	4·8		16-40	·6	·6
7	3-30	1·4	·6	8	1-15	2·2	1·8	17	2-40	1·8	1·0
	4-40	1·0	·9		10-20	·4	·6	18	1-35	2·0	1·0
	6-0				15-40	1·0	·6		17-35	·6	·6
	20-40	·9	1·0		21-0	1·6	·6	20	21-45	2·1	1·4
8	3-30	·1	·1	9	0-15	1·0	·8	21	8-40	·6	·5
	10-35	1·0	·5	11	19-45	2·2	1·0	23	22-50	·9	·8
	20-30	·1	·1		20-35	·8	·4	24	6-25	1·2	·8
9	3-30	1·1	·8	12	5-45	·7	·4		20-55	1.2	·6
	16-50	2·9	1·2	14	1-45	1·8	1·6		22-25	1·2	1·0
	18-30	·1	·1	15	14-45	·6	·5	25	6-2		
10	8-30	·1	·1		17-15	·8	·6		20-40	·8	·6
	12-0	2·4	2·0	16	7-55	·8	·5	27	4-45	1·2	·8
11	22-30	·1	·1		9-45	1·0	·8		12-40	·6	·3
12	2-30	·1	·1	17	19-40	·6	·8	29	5-25	·8	·8
	16-50	1·4	1·8	18	10-45	·6	·6	30	19-45	·5	·6
13	1-10	·1	·1	19	19-45	1·2	1·1	July			
	23-0	1·6	1·4		20-15			1	22'10	1·4	·6
14	2-30	2·1	2·0	20	1-35	·6	·6	2	8-15	·6	·4
	6-30	·1	·1		3-55	1·6	1·2	3	21-50	1·1	·6
	21-0	·1	·1		4-10			9	9-30	·1	·1
	23-30	1·5	·7		21-10	1·4	·8	10	10-5	1·2	1·2
15	10-15	1·4	1·4	21	6-20	6·4	4·4	11	8-43	1·3	1·2
17	14-30	·1	·1	24	6-0	·6	·3	12	3-30	·6	1·2
18	12-45	2·0	2·2		15-5	·8	·4		20-40	·8	·7
19	3-30	·1	·1		20-0	1·5	1·0	13	4-5	3·3	2·6
	5-0	2·2	2·9	25	4-45	·4	·4		15-55	·5	8
	12-3	1·6	1·4		13-25	2·6	2·2	14	17-35	1·2	1·4
	19-0	·1	·1		16-55	1·2	1·0	15	21-30	·8	·6
20	2-30	1·2	1·4	28	16-5	1·8	1·0	16	20-25	·8	·7
	5-0			June				17	13-20	1·0	·4
	3-30	·1	·1	1	1-40	·8	·8	18	11-50	1·0	·4
	21-30	1·5	1·4		5.6	3·6	1·8	19	12-5	·7	·5
	24-0				17-45	·3	·3	20	5-0	1·3	·8
23	8-15	·1	·1		22-35	·8	1·4	21	6-26	·1	·1
	19-40	·1	·1	2	6-5	1·3	·8		14-5	2·4	1·1
24	0-5	1.0	1·0	3	6-40	1·2	·6	22	18-25	1·8	1·1
25	1-30	2·1	1·2		16-41	·6	·4		21-10		
	23-45	·1	·1		23-5	1.8	1·2	23	11-10	1·4	1·2
26	2-30				23-6			24	16-25	·1	·1
	6-16	7·5	8·2	4	0-45	·6	·6	25	6-10	1·5	·6
	8-0	·1	·1	5	5.5	·4	·6		12-55	1·2	·7
27	1-15	1·0	1·7		14-35	·6	·6	26	2-20	1·1	·3
	14-10	1·2	1·1		16-55	·5	·4	27	21-25	2·5	1·4
28	17-20	·1	·1		21-47	1·4	1·0	Aug.			
29	6-20	·1	·1	9	1-35	1·8	1·4	1	12-25	1·6	·8
	11-25	·1	·1	10	2-10	2·7	1·4		13-0	·4	·4
30	6-45	·1	·1		8-20	·7	·6		22-32	·8	1·2
	17-30	1·1	·5	12	5-25	·8	·6	2	10-30	1·0	·4

Date.	Time.	Range of motion.		Date.	Time.	Range of motion.		Date.	Time.	Range of motion.	
		N—S.	E—W.			N—S.	E—W.			N—S.	E—W.
Aug.				Sept.				Nov.			
4	0-12	2·4	1·6	17	19-0	1·2	·8	8	13-15	·2	·1
	11-25	·8	·8	18	5-30	1·6	·4		22-20	2·5	2·0
9	18-35	1·2	·8		13-30	·6	·4	9	5-10	2·0	3·0
11	23-45	1·2	·8		15-30	·4	·4	10	23-5	1·0	·75
12	2-10			19	4-15	2·4	1·6	11	21-35	·8	·7
	8-10	·4	·4	20	18-25	·8	·4	12	17-55	1·5	1·75
13	1-5	·4	·4	22	23-32	1·6	·8		23-35	·5	·25
14	3-5	3·2	3·2	23	3-55	·1	·1	13	19-25	1·0	1·0
	4-55				16-30	1·2	·8	16	23-50	1·2	·6
	8-20	2·0	1·0	26	22-50	·4	·4	17	23-45	·75	·75
	15-50	8·4	4·8	28	23-5	·8	·4	18	1-25		
	19-45	·8	·6	29	20-10	·4	·4		17-28	1·0	·4
	23-10	2·0	1·2	30	6-35	·4	·4	20	7-5	·75	·75
15	1-40	2·8	2·4		9-42	10·8	13·2		7-10		
	4-15				10-45	·4	·4	21	19-40	·8	·5
	12-12	1·6	1·8		19-10	·8	·8	22	21-50	1·0	·75
18	8-10	·1	·1	Oct.				23	13-30	·5	·25
	22-20	1·0	·4	1	7·5	·8	1·0	26	3-55	·6	·3
19	10-5	1·0	·6	2	8-5	·8	·4		16-35	1·5	·75
20	8-10	·4	·4	3	4-10	·4	·4		17-10	·7	·5
	22-50	1·2	1·2		21-20	1·0	·8	28	18-0	2·5	1·75
22	21-20	·8	·8	4	15-45	·8	·6	29	3-30	1·25	1·0
23	9-30	·4	·8	5	18-50	1·2	1·0		4·0		
	23-30	·8	·4	6	3-25	1·4	1·2		18-30	·6	·75
24	10-54	·8	·8		13-45	2·4	1·4	30	18-45	·5	·5
25	7-5	1·2	·4		20-20	·1	·1		19-0		
	11-30	·8	·4	8	16-15	·8	·8	Dec.			
26	5-10	·8	·4	9	9-10	2·8	2·0	1	5-30	3·0	2·25
	12-45	1·2	·8		9-25	·4	·2		7-0		
27	6-30	·8	·8		17-35	1·4	·6		21-10	1·5	·75
	11-40	·6	·6	10	0-15	·6	·4	4	4-30	·75	·4
29	10-30	·4	·4		1-20			7	12-25	·4	·25
31	6-30	·1	·1		2-30			8	2-2	3·6	·25
	8-45	·4	·4	11	6-5	·4	·4		5-50	·5	·75
	19-30	·4	·4		8-12	·6	·4		9-17	?	?
Sept.					16-20	·8	·8	10	4·5	·2	·2
1	0·55	2·0	·8		16-50	·6	1·2	11	20-55	1·1	·9
2	20-45	·4	·4	12	14-14	·4	·6	12	12-15	·75	·9
3	5-0	·4	·4	18	13-10	·4	·4	13	2-20	·75	·75
5	14-30	1·6	·4	20	10-20	·6	·4	15	8-25	·5	·2
	17-45	·6	·4	23	23-45	·4	·4	16	21-30	1·0	·5
	22-20	·8	·4	25	23-45	·8	·6	17	6-45	·75	·5
	23-45	·8	·8	29	12-15	·8	·4	18	16-30	·5	·5
6	6-15	2·0	1·2		17-20	·8	·8	19	20-50	1·0	·5
7	1-52	·1	·1		22-50	·8	·4	22	3-32	1·0	·5
	12-20	6·4	2·4	30	6-40	·8	·3		4-20		
	13-0	·4	·4	31	3-20	1·2	1·0	23	3-50	·75	·5
	13-13	·4	·4		8-10	1·0	·2	24	10-5	1·0	·75
	21-15	·8	·8	Nov.					19-45	·5	·2
9	21-55	·4	·4	1	0-40	0·6	1·0	25	0-30	1·0	1·0
11	23-35	·8	·4	2	21·55	1·1	0·5		23-30	·75	·5
12	22-20	1·6	1·2	3	19-20	·75	·5	27	3-30	1·0	·5
13	4-0				21-25	1·0	·75		22-35	2·0	1·0
14	6-50	·4	·4	4	9-50	·5	·75	28	2-35	1·25	·5
15	2-20	1·2	·8	6	7-15	·5	·5		5-40	1·5	1·0
17	5-40	·1	·1		22-40	·5	·75		18-10	1·5	·75
	15-30	·8	·4	7	22-20	1·0	·3				

September 30, 9-42. A remarkable diagram. The movement was mainly E-W.; the pointer went off the glass and after returning traced some straggling lines; the principal part of the diagram, before the pointer left the glass, represents a movement of only 2 mm. from N. to S. while the E. to W. range is 9 mm.

X.

List of earthquakes observed at Maophlang in the Khasi Hills by the Rev. R. Evans from 12th September 1897 to 7th October 1898.

Date.	Time.	Nature.	Date.	Time.	Nature.	Date	Time.	Nature.	Date.	Time.	Nature.
Sept.			Sept.			Sept.			Oct.		
12	3-45	smart.	21	3-0	smart.	29	14-53	smart.	12	21-5	smart.
	8-0	slight.		5-30	,,		22-50	feeble.		21-29	slight.
	9-0	smart.		12-0	slight.		22-58	smart.	13	6-42	smart.
	15-0	,,		13-0	smart.	30	8-0	slight.		7-21	slight.
	17-0	slight.		15-15	slight.		9-35	,,		7-30	,,
13	0-40	,,		17-0	smart.		10-0	feeble.		8-51	,,
	14-30	,,		18-30	,,		12-10	,,		12-53	,,
	15-10	,,		20-10	slight.		19-35	smart.		15-4	,,
	16-40	smart.		21-15	,,		20-55	,,		15-37	smart.
	19-35	slight.	22	7-0	,,	Oct.				19-32	,,
14	2-10	,,		11-0	,,	1	4-8	smart.		20-8	slight.
	4-10	feeble.		15-0	,,		8-35	feeble.		21-9	,,
	4-45	,,		22-40	,,		10-35	,,	14	3-10	smart.
	9-15	slight.	23	2-45	smart.		10-37	,,		8-35	slight.
	9-45	,,		7-0	,,		12-37	,,		9-9	,,
	10-10	,,		12-50	,,		12-55	,,		16-50	,,
	21-10	smart.		15-0	slight.		21-0	,,	16	6-35	,,
15	9-0	slight.		19-0	,,		22-19	,,		8-15	,,
	14-0	feeble.		22-0	feeble.		23-15	,,		20-15	,,
	21-0	slight.	24	7-0	smart.	2	10-0	,,		21-16	smart.
16	7-0	feeble.		8-30	slight.		10-47	smart.	17	2-37	slight.
	13-0	smart.		9-50	smart.		14-4	,,		6-50	,,
	18-0	,,		13-5	slight.		14-12	,,		8-44	,,
	18-30	,,		16-0	smart.		14-25	,,		9-0	,,
	19-45	,,		19-0	slight.	3	20-30	,,		19-40	smart.
	20-30	,,		22-10	,,	4	5-5	,,		20-56	slight.
	21-15	,,		23-0	smart.		5-30	slight.		22-11	,,
17	15-45	,,	25	6-20	,,		7-0	,,		23-39	smart.
	16-0	slight.		7-30	,,		8-30	,,	18	4-9	,,
	21-0	,,		9-40	slight.		19-15	,,		11-31	,,
18	3-30	,,		11-0	,,		23-10	,,		13-26	slight.
	9-0	feeble.		18-50	smart.	5	16-40	smart.		15-40	,,
	9-45	slight.		22-30	,,		21-15	feeble.		16-46	,,
19	19-0	smart.	26	21-30	slight.	9	20-45	smart.		17-31	,,
	21-0	slight.	27	13-30	,,	10	6-45	,,		19-11	,,
	21-15	,,		13-50	,,		8-40	,,	19	1-20	,,
	22-30	smart.		16-0	,,		13-5	slight.		7-10	smart.
20	0-30	,,		19-50	feeble.		18-33	,,		10-14	slight.
	2-30	slight.		20-30	,,		19-43	,,		11-31	smart.
	9-50	smart.		22-30	slight.		19-55	,,		14-1	slight.
	10-10	slight.		22-40	smart.	11	10-17	smart.		16-17	,,
	10-55	smart.	28	8-30	feeble.		13-37	,,		20-3	,,
	11-5	slight.		8-45	smart.	12	6-35	,,	20	8-49	,,
	11-55	,,	29	4-0	slight.		8-17	,,		11-34	,,
	13-50	smart.		6-0	smart.		9-51	slight.		12-45	,,
	15-45	feeble.		7-20	feeble.		10-34	,,		23-8	,,
	18-0	slight.		8-7	smart.		19-29	,,	21	6-20	,,
	19-30	smart.		9-25	slight.		19-32	,,		10-36	,,
	21-0	slight.		13-48	feeble.		20-48	,,		13-0	,,

Date.	Time.	Nature.	Date.	Time.	Nature	Date.	Time.	Nature.	Date.	Time.	Nature.
Oct.			Nov.			Dec.			Jan.		
21	14-46	smart.	12	20-45	slight.	3	0-40	smart.		10-20	slight.
	17-29	,,		22-8	,,		3-55	,,		20-0	,,
22	10-37	severe.		23-11	smart.		6-53	slight.		21-30	,,
	12-2	slight.	13	1-55	slight.		9-35	smart.	2	16-0	,,
	17-33	severe.		7-1	smart.	7	20-10	slight.		21-10	smart.
	18-26	smart.		7-21	slight.	8	19-25	smart.		23-30	feeble.
	21-13	,,		17-0	,,	9	8-30	slight.	3	13-40	smart.
23	14-45	slight.	14	6-41	,,		18-15	smart.		16-0	slight.
	21-39	,,		6-54	,,		18-20	slight.		16-20	feeble.
	22-1	,,		11-59	,,	12	1-45	smart.		18-40	slight.
	22-59	smart.		12-51	smart.		7-40	slight.	4	22-0	,,
24	3-24	slight		13-3	slight.		9-50	smart.		22-9	smart.
	9-11	,,	15	6-4	smart.		21-35	,,	5	20-5	slight.
	23-19	,,		7-24	slight.	13	16-50	slight.		21-15	,,
25	6-54	,,	16	15-44	smart.	14	15-0	,,	6	10-32	,,
	7-16	,,		22-37	,,		19-50	,,		21-30	smart.
	15-38	,,	17	21-39	severe.		20-20	smart.	7	6-20	,,
	23-1	smart.	19	16-0	smart.	15	11-5	slight.		13-12	slight.
26	19-7	slight.		19-15	slight.		12-36	feeble.		17-16	smart.
	21-15	smart.		20-28	smart.		17-37	,,		18-50	feeble.
	21-16	,,	20	8-57	slight.		19-45	slight.		20-11	,,
27	6-6	slight.		9-0	,,		20-44	,,		20-24	slight.
	10-47	,,	21	2-42	smart.	17	8-35	smart.		20-37	,,
	13-35	smart.		5-25	,,		8-52	slight.	8	8-42	feeble.
	16-45	slight.		6-28	slight.		9-33	smart.		18-41	,,
	19-50	,,	22	1-30	smart.		15-50	,,		20-6	slight.
	22-0	smart.		5-22	,,		18-50	,,		20-25	smart.
28	9-0	slight.		8-45	slight.		21-50	slight.	9	7-48	slight.
29	12-0	,,		11-14	,,	18	8-50	severe.		8-30	smart.
	14-0	smart.		14-29	,,		12-55	,,		14-15	slight.
	23-20	,,		16-53	,,		16-0	slight.		15-35	,,
30	8-50	slight.		18-41	,,	19	21-0	,,		18-8	,,
31	1-40	severe.		24-0	smart.	20	14-0	smart.		21-8	smart.
	2-53	slight.	23	2-17	slight		21-0	slight.	10	20-49	feeble.
	8-26	smart.		14-8	smart.	21	8-45	smart.	11	1-30	slight.
	10-7	slight.		15-57	slight.		13-15	slight.		4-45	smart.
Nov.				21-48	,,	22	10-44	,,		8-41	,,
1	23-55	,,	24	11-43	smart.		10-56	,,		16-15	slight.
2	10-35	,,		17-10	,,		22-13	very sm.		16-30	,,
	10-47	,,		21-30	,,	23	20-50	slight.		23-20	,,
	11-55	smart.	25	4-55	slight.	24	2-23	severe.	12	1-0	,,
	12-43	,,		16-45	smart.		8-47	slight.		11-15	,,
	20-37	,,		22-0	slight.	25	9-45	smart.	13	12-30	,,
	21-18	,,	26	10-30	smart.	27	22-45	,,		13-0	,,
	22-23	slight.		19-30	,,	29	18-30	feeble.	14	17-19	,,
	23-30	severe.	27	22-20	,,		20-15	slight.	15	16-56	,,
3	13-36	slight.	28	17-0	,,		20-58	,,		22-0	,,
6	8-30	,,	29	9-40	slight.	30	6-15	,,		22-45	,,
7	17-0	smart.		23-0	,,		9-15	,,	16	2-1	smart.
	19-0	slight.	30	6-10	feeble.		10-51	,,		2-3	slight.
8	20-30	,,		17-28	,,		13-56	,,		22-0	feeble.
9	15-30	smart.		18-14	,,		21-58	,,		22-15	smart.
10	1-0	severe.	Dec.			31	12-41	smart.	17	15-0	,,
	22-30	smart.	1	18-34	,,		16-0	feeble.		21-10	slight.
11	7-0	,,	1	19-33	,,		20-10	smart.		23-0	,,
	22-25	slight.	2	10-0	,,	Jan.				8-0	,,
12	20-2	,,		11-15	slight.	1	8-0	feeble.	18	19-10	smart.

Date.	Time.	Nature.	Date	Time.	Nature.	Date.	Time.	Nature.	Date.	Time.	Nature.
Jan.			Feb.			Mar.			Mar.		
			6	14-55	slight.	2	21-0	severe.	16	19-58	slight.
19	1-35	slight.		17-55	,,	14	13-53	,,		20-0	,,
	15-15	,,		22-35	,,		21-23	feeble.	17	8-7	smart.
	22-45	,,	7	18-20	,,	5	20-8	smart.		9-57	,,
20	7-15	,,		22-40	smart.	6	9-48	feeble.		10-13	slight.
	13-20	feeble.	8	15-55	,,		12-52	slight.		11-34	,,
	17-50	,,	9	10-55	feeble.		22-12	,,		11-41	feeble.
	22-37	smart.	10	2-35	v. smart.		23-21	,,		13-17	slight.
	23-35	slight.	11	4-30	smart.	7	12-22	severe.		13-43	smart.
21	9-50	smart.		8-40	slight.	8	6-10	slight.		17-48	,,
	12-46	,,		11-50	smart.		17-36	,,		18-10	,,
	16-47	,,		14-50	,,		20-52	feeble.		21-39	severe.
22	11-0	,,		15-30	v. smart.		22-46	slight.		21-47	smart.
	13-3	feeble.		22-30	smart.	9	0-5	smart.		22-16	slight.
	20-30	slight.	13	14-0	slight.		12-10	slight.	18	10-21	smart.
23	17-20	feeble.		21-0	,,		20-5	,,		19-15	,,
	22-45	smart.	14	14-5	,,		22-55	,,		22-45	severe.
24	6-35	,,		15-45	smart.	10	14-47	,,	19	23-8	smart.
	9-22	slight.	15	17-16	,,	11	12-28	,,		9-30	slight.
	22-45	feeble.		20-37	feeble.		12-52	,,		10-13	severe.
25	19-59	smart.	16	14-17	smart.		15-38	,,		12-26	feeble.
	23-49	,,		14-58	,,		20-38	,,		15-10	,,
26	10-13	slight.		20-45	,,		20-42	smart.		18-3	smart.
	10-21	smart.	17	7-30	slight.	12	21-43	,,		18-50	severe.
	18-5	slight.		11-20	,,		10-15	,,		22-50	slight.
27	19-35	,,		16-15	,,		18-0	,,		22-55	smart.
	21-35	smart.		23-20	smart.		18-38	,,	20	1-10	,,
28	6-30	slight.	18	2-20	,,		19-5	slight.		15-30	slight.
	7-30	,,		4-15	slight.		19-20	,,		21-36	,,
	19-15	,,	19	23-0	smart.		21-30	smart.		21-38	feeble.
29	7-30	feeble.	20	20-15	,,		22-15	,,		22-0	smart.
	17-15	,,	21	1-40	,,	13	21-27	feeble.	21	6-7	slight.
30	0-0	smart.		12-0	feeble.		21-34	smart.		6-8	,,
	14-0	slight.	22	18-40	slight.		22-15	,,		17-38	feeble.
	16-40	,,	23	9-38	,,		22-18	feeble.		19-29	,,
31	6-45	feeble.		11-10	,,		22-40	smart.		21-12	smart.
	11-40	slight.	24	24-0	,,	14	6-8	slight.		22-7	severe.
	15-0	smart.	25	2-10	,,		6-52	smart.	22	3-0	smart.
	16-15	slight.		13-40	,,		6-58	feeble.		3-30	,,
Feb.			26	10-2	smart.		12-42	,,		3-49	slight.
1	2-15	feeble.		13-11	slight.		13-37	,,		3-55	,,
	2-45	smart.		21-8	,,		19-42	slight.		7-12	smart.
	3-15	feeble.		21-24	,,		20-28	,,		16-22	feeble.
	14-0	slight.	27	13-7	smart.		21-22	,,		21-6	severe.
	15-15	feeble.		13-45	slight.	15	6-13	,,		21-56	smart.
3	21-36	slight.		20-45	smart.		6-56	severe.	24	3-55	slight.
4	8-35	,,		21-15	slight.		8-20	smart.		6-0	smart.
	9-50	,,	28	11-6	,,		14-0	slight.		11-5	slight.
	14-10	smart.		12-35	smart.		19-2	,,		13-0	feeble.
	16-30	slight.		12-49	slight.		20-45	,,		14-20	,,
	19-30	smart.		18-12	smart.		23-1	,,	25	8-20	,,
	19-31	feeble.		19-40	slight.	16	1-37	,,		8-40	slight.
	20-5	,,		19-44	smart.		3-22	smart.		15-20	,,
	20-56	slight.	Mar.				13-50	,,		16-15	,,
	21-31	smart.	1	15-35	severe.		16-57	slight.		20-0	feeble.
5	9-0	,,		22-12	,,		19-51	feeble.	26	5-10	smart.
	22-45	,,	2	20-43	smart.		19-55	slight.		7-0	,,

Date.	Time.	Nature.	Date.	Time.	Nature.	Date.	Time.	Nature.	Date.	Time.	Nature.
Mar.			April			April			May		
26	12-50	severe.	8	10-50	smart.	22	9-30	slight.			
	16-56	,,		12-1	slight.		20-42	,,	2	3-30	smart.
	19-27	smart.		14-40	smart.		21-51	,,		4-3	,,
	21-28	slight.	9	17-0	,,	23	8-0	,,		4-8	slight.
27	5-30	smart.		21-12	slight.		9-27	,,		4-45	,,
	6-42	slight.	10	11-0	smart.		20-30	,,		4-50	,,
	10-41	,,		12-37	slight.		20-42	smart.		5-55	,,
	11-26	,,		13-36	,,	24	22-30	,,		12-3	smart.
	16-2	,,		17-22	,,	25	2-20	,,		15-45	slight.
	17-3	feeble.		19-58	smart.		12-35	slight.		21-30	,,
	17-49	slight.	11	1-30	,,		16-25	,,		22-13	smart.
	22-20	severe.		12-32	slight.		19-23	,,	3	4-45	,,
	23-13	smart.		14-28	,,		19-50	,,		5-45	,,
28	0-47	slight.		16-56	smart.		22-14	,,		6-47	slight.
	1-25	,,		19-53	slight.		22-52	smart.		8-35	feeble.
	23-28	severe.	12	8-13	,,	26	2-20	,,		18-57	smart.
29	11-58	slight.		9-45	,,		2-40	slight.		19-9	slight.
	18-15	smart.		14-50	smart.		6-20	severe.	4	2-20	smart.
30	7-27	,,		17-1	,,		6-58	smart.		4-20	slight.
	17-59	feeble.		21-59	feeble.		16-38	,,		18-46	,,
	19-27	,,	13	14-56	slight.	27	1-15	,,	5	2-0	smart.
	20-37	,,		18-47	,,		1-17	,,		4-10	slight.
	21-12	severe.		21-37	,,		1-52	slight.		11-27	,,
31	6-30	slight.	14	1-30	severe.		14-15	severe.		20-15	,,
	8-52	,,		6-20	slight.	28	12-30	smart.		20-41	severe.
	18-28	smart.		6-22	,,		14-0	feeble.		21-14	slight.
	22-15	,,		7-16	smart.	29	6-30	smart.		21-41	smart
April				12-10	slight.		6-52	slight.		21-43	,,
1	1-46	slight.		16-2	,,		11-27	smart.	6	5-20	,,
	6-59	,,		16-56	feeble.		11-45	slight.		6-23	,,
	12-27	smart.		20-45	slight.		13-44	smart.		11-7	,,
2	6-2	slight.		21-17	smart.		14-35	slight.		17-45	slight.
	7-27	,,	15	5-20	slight.		22-20	,,		21-26	,,
	9-5	,,		12-10	,,		22-26	,,		22-4	,,
	17-55	,,		21-20	smart.	30	2-5	smart.		22-50	smart.
3	2-0	,,	17	0-40	,,		6-59	,,		23-15	slight.
	4-15	,,		7-5	,,		7-12	slight.	7	13-43	v. sev.
	9-10	,,		9-55	,,		13-12	feeble.		13-57	smart.
	12-50	,,	18	6-52	feeble.		14-7	slight.		17-0	,,
	14-5	,,		8-7	smart.		16-8	smart.		19-15	slight.
	19-10	smart.		10-53	,,		16-56	,,		19-19	,,
4	3-15	,,		12-54	severe.		17-0	,,		22-0	smart.
	3-50	slight.		15-30	slight.		21-20	feeble.	8	6-30	slight.
	7-30	,,	19	4-21	smart.		23-10	smart.		6-55	feeble.
5	11-20	smart.		5-42	,,	May				9-55	slight.
	12-5	slight.		6-10	slight.	1	2-20	,,		14-45	,,
	19-1	smart.		7-11	smart.		4-20	,,		15-24	smart.
	19-50	,,		12-14	severe.		7-1	,,		16-45	slight.
6	11-30	,,		20-10	smart.		7-35	slight.		23-20	smart.
	12-0	,,	20	2-10	,,		7-50	smart.		24-0	slight.
	13-17	,,		2-20	feeble.		17-0	,,	9	9-23	,,
	14-17	,,		6-10	smart.		17-17	,,		12-5	,,
	15-13	,,		16-10	,,		19-19	,,		20-45	smart.
	19-25	slight.		21-0	,,		21-0	,,		22-20	slight.
	21-49	smart.	22	4-20	,,		21-3	,,	10	8-8	feeble.
8	5-35	,,		5-42	slight.		21-57	slight		8-45	,,
	6-6	slight.		6-55	smart.		23-10	smart.	11	9-3	smart.

Date.	Time.	Nature.	Date.	Time.	Nature.	Date.	Time.	Nature.	Date.	Time.	Nature.
May			May			July			Aug.		
11	20-15	slight.	25	16-8	v. sev.	22	11-24	smart.	11	13-41	slight.
12	5-15	smart.		21-30	slight.		21-0	,,		15-42	,,
	9-0	severe.	27	5-0	smart.		22-26	,,		17-45	,,
	22-0	slight.		7-30	,,	23	11-8	,,	18	5-48	smart.
13	9-31	smart.		17-10	,,		11-35	,,	20	6-58	,,
	13-5	,,	28	4-12	slight.		13-46	,,	21	24-0	,,
	13-21	,,		21-35	smart.		14-10	,,	22	1-30	slight.
	19-14	,,		21-47	,,	24	16-21	,,		2-0	,,
	20-52	slight.		22-18	,,		19-25	,,		7-17	,,
	20-58	,,		22-22	,,	25	5-0	,,		13-20	,,
	21-37	,,	29	5-13	,,		13-51	,,		13-55	feeble.
	23-50	smart.		5-47	,,		19-39	,,	23	0-35	smart.
14	4-0	,,	30	22-22	feeble.		21-38	slight.		1-50	,,
	13-0	slight.		22-47	severe.		21-40	,,		7-37	,,
	18-30	smart.		23-19	,,	26	13-18	feeble.		10-59	,,
	24-0	,,		23-12	,,	28	6-33	smart.		14-32	,,
15	4-2	,,		23-15	,,		6-46	,,		18-17	feeble.
	15-30	,,	31	5-57	,,		7-43	feeble.	24	3-0	smart.
	24-0	,,		7-4	,,		21-45	slight.		10-25	,,
16	7-30	,,		11-54	,,	30	6-56	smart.		16-3	slight.
	17-23	,,	June				21-15	slight.		16-23	smart.
	22-10	slight.	1	17-47	smart.	31	16-41	smart.	26	6-27	,,
17	18-45	smart.		22-10	,,		16-45	slight.		10-34	feeble.
18	16-30	feeble.		23-30	slight.		20-20	smart.		22-32	smart.
	17-6	slight.	2	13-7	smart.		21-30	slight.	27	6-30	,,
	17-19	,,	3	11-56	feeble.	Aug.				11-42	,,
19	5-12	smart.		12-20	slight.	1	10-15	smart.	29	15-55	,,
	7-23	slight.		15-39	smart.		18-11	,,		16-36	,,
	17-43	,,		16-20	,,		22-30	,,		22-33	slight.
	18-38	smart.		21-10	,,	2	6-15	,,	31	15-30	,,
	19-14	,,		22-30	,,		9-56	,,		18-5	,,
	19-36	,,		22-35	,,		13-18	,,	Sept.		
	20-53	feeble.	4	17-22	slight.		15-0	slight.	2	15-17	smart.
20	17-10	slight.		19-36	smart.		15-20	smart.	3	16-21	slight.
	20-5	smart.		20-50	,,		24-0	,,	4	23-37	,,
	20-33	,,	5	6-47	,,	3	6-38	slight.	5	1-35	smart.
	22-55	,,		7-43	,,		16-45	smart.		15-20	,,
21	1-20	,,		12-49	,,		23-25	,,		22-2	,,
	5-45	,,		14-22	,,	4	11-13	slight.	6	6-20	,,
	7-30	,,		16-40	,,		20-58	smart.		6-42	slight.
	8-0	slight.		16-54	slight.		21-3	feeble.	7	2-30	smart.
	8-47	smart.		21-26	smart.		23-54	smart.		12-30	,,
22	1-50	,,	7	4-37	,,	5	5-20	slight.		13-7	,,
	3-45	,,		19-30	,,		7-25	smart.		13-25	slight.
	21-45	,,		21-52	slight.		9-35	,,		13-41	,,
23	17-30	smart.					9-55	slight.		16-2	smart.
	18-50	slight.	*	*	*	6	2-11	,,		21-30	,,
	21-5	smart.	July.				2-23	,,	8	14-48	,,
	21-27	,,	16	21-30	smart.		3-55	,,		17-18	feeble.
24	6-5	,,	17	13-22	,,		11-18	feeble.		20-23	smart.
	19-58	,,		20-50	slight.	7	12-50	smart.		21-2	feeble.
	21-10	,,	18	9-44	feeble.		21-45	,,	9	10-5	smart.
25	5-58	,,		12-2	smart.	8	8-44	slight.		10-11	slight.
	8-12	,,		17-17	,,		13-13	smart.	10	8-52	,,
	2-37	severe.	20	2-0	slight.		22-15	,,		11-17	,,
	12-38	,,		15-37	smart.	9	14-10	slight.	10	16-4	feeble.
	14-8	slight.	21	14-2	,,		18-17	,,	11	8-30	slight.

Date.	Time.	Nature.	Date.	Time.	Nature.	Date.	Time.	Nature.	Date.	Time.	Nature.
Sept.			Sept.			Sept.			Oct.		
12	22-30	smart.	20	13-21	slight.	29	23-15	smart.	2	8-0	smart.
13	9-20	slight.		18-32	,,	30	2-27	,,		24-0	slight.
	9-30	feeble.		18-52	smart.		7-29	slight.	3	2-30	smart.
14	6-54	slight.	21	19-17	slight.		10-20	severe.		12-47	slight.
	7-6	feeble.	22	9-50	,,		12-32	slight.		21-55	,,
	8-44	slight.		21-24	,,		10-37	,,		22-18	feeble.
15	18-35	,,		23-40	,,		11-26	smart.		22-20	slight.
	22-3	feeble.	23	2-30	smart.		13-32	slight.	4	7-45	,,
16	17-57	slight.		9-22	,,		16-42	,,		8-37	feeble.
	21-19	smart.		17-22	,,		17-4	feeble.		10-56	,,
	22-8	slight.		18-8	,,		18-2	,,		12-3	slight.
17	15-37	smart.		21-10	,,		18-14	slight.	5	15-40	,,
	18-42	,,	24	15-44	,,		20-4	,,		16-38	feeble.
	19-9	,,		16-18	slight.		20-27	,,		20-4	slight.
	20-45	feeble.	25	15-12	feeble.		21-51	feeble.		20-58	,,
	21-13	slight.		18-4	smart.		22-15	slight.		21-50	,,
18	9-3	,,		20-56	,,	Oct.				21-58	feeble.
	13-16	smart.	26	22-0	,,	1	7-46	smart.	6	1-45	smart.
	15-20	feeble.		23-25	,,		14-40	feeble.		10-0	,,
	15-33	slight.	27	0-11	,,		16-57	slight.		13-47	,,
	19-56	feeble.		2-32	,,		22-17	,,		15-19	,,
	20-27	slight.		7-55	slight.		22-40	feeble.		20-29	,,
	22-15	smart.		19-47	smart.	2	0-52	slight.	7	21-42	slight.
	22-16	feeble.	29	12-37	slight.		2-5	,,		22-20	,,
										24-0	smart.
18	23-35	smart.		16-15	,,		6-5	,,			
19	19-9	,,		21-4	,,		7-17	,,			

XI.

List of earthquakes observed at Mairang in the Khasi Hills by the Rev. C. S. Stephens, from 7th September 1897 to 31st December 1898.

A record of shocks felt at Mairang in the Khasi Hills by the Rev. C. S. Stephens. This carefully kept record serves to show the frequency of earthquake shocks within the epicentral area. They were much more frequent than this towards the centre of it, but no records are available.

Date.	Time.	Nature.	Date.	Time.	Nature.	Date.	Time.	Nature.	Date.	Time.	Nature.
Sept.			Sept.			Sept.			Sept.		
7	13-5	feeble.	8	2-30	feeble.	9	8-28	feeble.	9	16-27	feeble.
	16-40	,,		6-33	slight.		8-30	,,		16-32	,,
	22-30	,,		13-25	feeble.		8-43	,,		22-45	,,
	23-0	,,		22-3	,,		8-47	,,	10	7-37	,,
	23-7	slight.	9	5-35	,,		8-52	,,		8-46	,,
	23-35	,,		8-14	,,	*	12-35	,,		13-17	,,

* Engaged in turmoil of market.

Date.	Time.	Nature.	Date.	Time.	Nature.	Date.	Time.	Nature.	Date.	Time.	Nature.
Sept.			Sept.			Oct.			Oct.		
10	17-26	feeble.	21	10-15	slight.	11	8-48	feeble.	23	19-29	feeble.
	21-11	,,		14-1	,,		10-25	,,	24	9-58	,,
	23-5	,,		18-25	feeble.		10-26	slight.		20-55	slight.
	23-28	,,		20-1	,,		12-2	,,	25	2-20	feeble.
11	2-56	,,		21-35	,,		13-46	,,		6-47	,,
	6-42	,,	22	12-0	,,		18-48	feeble.		9-20	,,
	7-40	slight.		14-40	,,		19-2	,,		16-37	,,
	8-49	feeble.		22-30	,,		21-35	,,		17-46	,,
	9-49	,,		22-37	,,	12	3-53	,,		23-1	slight.
	17-42	,,	23	7-42	,,		6-45	slight.		23-20	feeble.
	20-30	slight.		12-4	,,		9-0	feeble.	26	8-32	,,
12	3-7	,,		19-2	,,		19-37	,,		9-59	v. feeble.
	4-42	smart.		19-52	,,		19-41	,,		20-34	,,
	8-55	feeble.		19-36	,,		20-53	,,		21-5	feeble.
	21-19	,,		19-44	,,		21-14	slight.	27	5-56	feeble.
	22-48	,,		23-38	,,		21-38	feeble.		10-22	v. feeble.
13	16-45	smart.		23-40	,,		22-20	,,		10-36	feeble.
	17-15	,,	24	22-2	,,	13	6-51	,,		13-27	slight.
	19-45	,,		5-10	slight.		12-14	,,		16-6	feeble.
	23-45	,,		16-26	feeble.		12-43	,,		20-59	,,
14	5-10	slight.	25	6-5	,,		15-35	smart.		23-53	,,
	5-45	feeble.		7-22	,,		16-7	feeble.	28	0-25	,,
	8-54	,,		8-16	,,		21-14	v.feeble.		1-20	,,
	13-0	,,		9-29	,,	14	3-15	slight.		9-1	slight.
	14-20	,,		15-45	,,		15-5	feeble.		16-47	feeble.
15	11-13	,,		18-40	slight.		20-56	slight.		22-47	v. feeble
	12-38	,,		21-44	feeble.	15	9-36	feeble.		23-22	slight.
	13-8	,,	26	5-13	,,		12-49	slight.	29	2-57	feeble.
	17-35	,,		6-55	,,	16	21-21	,,	30	2-45	slight.
	19-28	,,		8-49	,,	17	19-45	,,		21-27	feeble.
	21-22	,,	27	3-40	,,	18	Twice during night.		31	1-23	smart.
16	6-20	,,		14-32	,,					8-10	feeble.
	14-54	,,		22-16	,,		4-15	slight.		9-18	,,
	18-22	slight.		22-40	,,		11-5	feeble.	Nov.		
	18-37	feeble.	28	8-40	,,		11-35	slight.	1	13-46	,,
	19-7	,,		12-41	,,		12-9	feeble.		13-56	,,
	19-57	,,		14-25	,,		13-30	,,	2	17-28	,,
	20-40	,,					19-15	,,		5-22	slight.
17	21-25	,,	*	*	*		22-35	,,		7-23	feeble.
	2-40	,,				19	7-13	slight.		10-21	,,
*	7-4	,,	Oct.				10-17	feeble.		10-33	,,
*	18-11	,,	7	7-19	feeble.		14-3	,,	2	11-45	slight.
	22-3	,,		11-21	slight.		20-52	,,		12-37	feeble.
18	6-0	,,		12-32	,,	20	12-35	,,		20-31	,,
	9-26	,,		13-40	feeble.	21	12-6	,,		21-12	feeble.
	14-0	,,		20-13	v. feeble.		14-46	,,		22-16	,,
	21-50	smart.	8	7-57	feeble.		15-40	,,		23-25	slight.
	22-8	feeble.		11-8	v. feeble.		17-28	,,	3	10-35	feeble.
19	6-21	v. feeble.		14-57	smart.	22	3-16	,,		22-24	,,
	9-51	,,		18-51	feeble.		4-17	,,	4	7-11	,,
	17-17	,,	9	2-5	,,		10-0	,,		8-35	,,
	19-3	slight.	10	5-7	,,		10-36	smart.		10-59	,,
20	13-18	,,		8-40	slight.		15-48	feeble.	5	18-55	,,
	15-15	feeble.		11-33	feeble.		16-31	slight.		21-38	,,
	19-13	,,		18-40	,,		18-23	,,	6	1-59	slight.
21	6-10	,,		19-3	,,		21-10	feeble.		another later.	
	6-24	,,		22-51	,,	23	11-27	,,		9-34	feeble.

* Engaged in turmoil of market.

Date.	Time.	Nature.	Date.	Time.	Nature.	Date.	Time.	Nature.	Date.	Time.	Nature.
Nov.			Nov.			Nov.	*	*	Dec.		
6	17-4	slight.	17	21-7	smart.	Dec.			26	17-20	slight
	22-25	feeble.	18	0-28	feeble.	4	1-6	feeble.	27	8-40	feeble.
7	7-29	,,		0-38	,,		13-3	slight.	28	11-32	,,
	17-40	v. feeble.		20-9	,,		21-26	,,		9-58	,,
	20-7	feeble.		20-58	,,		22-0	feeble.		10-35	,,
8	8-54	,,	19	15-28	slight.	5	19-52	,,	29	8-40	,,
	10-42	slight.		16-52	feeble.	*	20-31	,,	30	9-21	,,
	10-44	feeble.		18-40	slight.	6	5-53	slight.			
9	16-1	,,		19-55	feeble.		9-7	smart.	Jan.		
	18-32	slight.		19-57	,,	7	1-40	feeble.	1	19-30	feeble.
	23-5	smart.		23-13	,,		20-57	,,	2	20-48	slight.
10	10-37	slight.	20	8-26	,,		21-40	smart.	*	*	*
	21-51	,,		8-31	,,	8	11-4	,,			
11	7-32	feeble.		14-38	,,		22-32	feeble.	Feb.		
	9-13	,,		15-18	,,	9	8-44	,,	2	15-12	feeble.
	19-0	,,	21	0-12	,,		12-43	slight.		16-11	slight.
	21-35	,,		2-10	,,		17-3	,,		19-46	,,
12	13-58	,,		12-38	,,		22-23	feeble.	4	8-47	feeble.
	18-19	,,		15-58	,,	10	1-54	,,		12-40	,,
	21-30	,,	22	4-10	slight.		2-10	,,		20-4	,,
	22-51	slight.		4-35	,,		9-45	,,		night	smart.
13	2-1	feeble.		6-9	feeble.		16-32	,,	5	7-40	,,
	3-4	,,		8-13	,,	11	13-9	v. feeble.		9-15	,,
	3-37	,,		8-53	,,	12	10-14	feeble.	6	13-22	slight.
	15-5	,,		9-10	,,		19-32	,,		14-0	feeble.
	15-10	slight.		13-57	slight.		20-8	,,		17-12	,,
	15-49	feeble.	23	2-57	feeble.	13	4-15	slight.		20-40	slight.
14	6-30	,,		13-35	,,	14	18-40	feeble.	7	9-25	feeble.
	12-27	slight.		16-37	,,		19-8	,,		13-0	,,
	14-32	feeble.		21-14	v. feeble.	15	5-37	slight.		21-5	slight.
	21-0	,,		23-0	feeble.		16-15	feeble.			
	21-35	,,	24	11-8	,,		21-8	,,			
15	2-58	,,		18-35	,,	17	21-12	slight.	*	*	*
	4-14	,,		21-26	,,	17	7-2	,,			
	5-40	smart.	25	16-56	,,		7-6	feeble.	20	9-50	feeble.
	15-23	feeble.		18-48	,,		8-3	,,		15-55	,,
	18-38	,,		23-14	,,		17-2	,,		18-40	,,
	21-42	,,	26	10-38	,,		19-45	,,		20-20	slight.
16	5-48	smart.		18-5	,,		20-24	,,	22	18-35	feeble.
	9-20	feeble.		19-36	slight.	18	9-51	,,	24	10-30	,,
	10-21	,,		21-27	,,	†	22-11	,,		13-40	,,
	11-21	slight.	27	10-52	feeble.	19	14-25	,,	25	13-35	,,
	11-37	feeble.		13-22	,,	20	18-31	,,	26	9-55	slight.
	15-15	,,		14-19	slight.	22	10-35	,,		14-55	feeble.
	17-27	,,		16-22	feeble.		10-42	,,		21-0	,,
	19-17	,,		18-24	,,		22-0	,,		21-18	v. feeble.
	20-1	,,		21-16	,,	23	20-50	,,	27	8-10	feeble.
	21-0	,,	28	4-15	,,		20-53	,,		17-10	v. feeble.
	22-26	slight.		6-30	,,	one in	night	smart.		18-5	slight.
	22-51	feeble.		17-5	,,		8-40	feeble.			
17	0-50	slight.		18-18	slight.		6-45	,,	*	*	*
	5-13	,,		18-40	,,		9·68	,,			
	7-30	feeble.		19-50	feeble.	25	one in	the night.	March		
	14-57	,,	29	6-16	v. feeble.	26	8-16	feeble.	22	17-37	slight.
	16-23	,,		11-44	feeble.		14-35	,,		17-55	,,
	19-36	,,		23-15	slight.		16-0	,,		21-58	smart.
	19-58	,,	30	6-20	feeble.				23	night	...

* Watch put on 15 min.

† Watch put on an hour.

Date.	Time.	Nature.	Date.	Time.	Nature.	Date.	Time.	Nature.	Date.	Time.	Nature.
Mar.			April			April			May		
24	6-20	slight.	5	22-43	feeble.	27	15-24	feeble.	21	9-20	feeble.
	11-0	feeble.	6	10-43	slight.		15-33	,,	22	22-22	slight.
	12-55	,,		12-32	feeble.	28	17-42	,,	23	6-15	smart.
25	8-18	,,		21-6	smart.	29	11-42	slight.		10-48	slight.
	8-58	,,	7	7-10	feeble.	30	14-15	feeble.		19-27	,,
	21-21	,,		20-4	,,		14-25	,,		20-10	,,
	night	slight.		20-13	,,	May				21-55	,,
26	early	,,	8	4-80	slight.	1	8-11	,,	24	19-23	,,
	7-14	feeble.		5-25	,,		19-40	,,		20-50	feeble.
	12-45	slight.		10-9	,,		21-23	smart.		20-56	,,
	14-1	feeble.		20-43	feeble.		21-25	slight.	25	6-19	slight.
	16-41	smart.	9	4-25	slight.		22-6	feeble.		21-50	feeble.
	19-19	feeble.		4-42	feeble.		night	1 smart,	26	13-5	smart.
	19-55	,,		22-0	slight.		six	5 feeble.		16-37	,,
	21-22	,,	10	12-58	feeble.		times		27	13-16	feeble.
27	17-1	slight.		13-20	,,	2	12-50	slight.		16-43	slight.
	19-43	feeble.		18-30	,,		21-12	feeble.		21-0	feeble.
	22-19	smart.		19-10	smart.		22-36	,,	28	16-36	,,
	night	feeble.		22-35	feeble.	3	6-55	,,		17-7	,,
	twice	slight.	11	0-10	smart.		19-23	,,		19-26	,,
28	8-55	,,		14-11	feeble.		20-3	slight.	29	17-35	smart.
	12-37	feeble.		16-10	smart.	5	15-30	feeble.		18-8	feeble.
	16-52	,,		19-5	slight.		20-32	slight.		18-21	,,
	19-26	,,		20-25	smart.		20-58	smart.		18-55	,,
	21-20	,,		20-37	feeble.	7	14-0	slight.		19-21	,,
	night	,,		20-48	,,		14-8	severe.		20-35	,,
29	12-0	,,	12	14-7	smart.		16-25	feeble.	30	9-8	,,
	19-16	,,		15-13	feeble.		22-50	slight.		22-4	,,
30	6-30	,,		16-30	,,	8	10 22	feeble.	31	21-20	,,
	11-13	,,		19-19	,,		11-48	slight.	June		
	21-6	smart.		20-25	,,		15-51	smart.	1	4-40	smart.
	21-17	,,	13	14-16	,,		21-23	slight.		13-50	feeble.
31	6-34	feeble.		20-58	,,	9	9-42	,,		22-8	slight.
	16-47	,,	14	5-55	slight.		11-45	feeble.	2	13-1	,,
	18-33	slight.		12-40	feeble.		12-36	,,	3	6-35	,,
	19-57	feeble.		19-30	,,		18-20	,,		7-30	,,
	22-23	slight.		19-47	,,	10	9-28	,,		15-36	feeble.
April				20-42	,,	11	9-5	,,		18-50	,,
1	10-0	feeble.		21-27	slight.	12	5-47	slight.		20-21	,,
	16-52	slight.		22-3	smart.	13	13-18	,,		21-7	slight.
	22-50	,,	15	4-40	,,		21-5	feeble.		21-27	,,
2	10-55	,,		13-52	feeble.		21-29	,,		21-31	,,
	12-12	feeble.		14-20	,,	14	11-13	,,	4	20-47	smart.
	13-17	,,		15-11	slight.		13-40	,,		21-41	slight.
	17-30	,,		20-46	smart.	16	12-5	slight.	5	9-24	feeble.
3	17-7	,,	16	21-28	feeble.		19-45	smart.		14-20	slight.
	18-17	smart.		23-5	slight.	17	5-58	feeble.		21-23	smart.
	19-30	feeble.	17	6-30	,,		19-8	smart.		Three feeble	
	21-20	,,		9-21	,,	18	17-45	feeble.		shakes during	
4	9-0	,,				19	19-42	slight.		the night.	
	9-30	,,	*	*	*		20-4	,,	6	6-37	feeble.
5	6-35	slight.					22-25	feeble.	7	8-0	,,
	19-20	,,	25	19-34	...	20	16-0	,,	8	9-20	,,
	20-3	smart.	26	6-33	severe.		18-30	slight.		16-34	,,
	20-59	feeble.		10-15	feeble.	21	6-15	smart.	9	15-20	slight.
	21-33	,,	27	1-30	severe.		11-30	feeble.		21-37	feeble.
	22-12	slight.		14-30	smart.		8-40	,,	11	18-25	,,

* Engaged in turmoil of market.

Date.	Time.	Nature.	Date.	Time.	Nature.	Date.	Time.	Nature.	Date.	Time.	Nature.
June			July			July			Aug.		
12	9-43	feeble.	2	17-45	smart.	25	21-43	feeble.	26	7-40	feeble.
	11-19	,,	3	9-45	feeble.	27	15-40	,,		12-57	,,
	13-5	,,	4	12-35	slight.		21-24	,,		16-24	,,
13	5-30	slight.		14-13	smart.		21-27	,,	27	6-30	smart
	16-37	,,		16-2	slight.	28	7-55	,,		10-50	slight.
	20-7	smart.		16-25	feeble.		19-0	,,		night	,,
	21-12	,,	5	19-47	,,		21-50	,,	28	15-2	,,
	21-29	feeble.		22-51	,,		22-5	,,		19-58	,,
15	12-55	,,	6	5-55	,,	30	20-47	slight.	29	5-15	,,
	13-36	slight.		6-25	,,		22-39	,,		5-30	feeble.
	14-34	feeble.	7	6-30	slight.	31	17-0	,,		15-43	,,
16	5-52	slight.		12-5	feeble.		17-4	smart.		16-41	smart.
	12-5	,,		20-30	,,		20-16	feeble.		19-55	feeble.
	16-55	,,	8	19-32	,,		22-5	,,		20-12	,,
	19-11	,,		22-3	,,	Aug.			30	13-7	,,
17	5-30	feeble.	9	7-29	,,	1	8-3	,,	31	8-30	,,
	12-27	smart.		20-40	slight.		8-48	,,		9-32	,,
	2-36	slight.		21-35	feeble.		12-50	,,		11-20	,,
18	6-30	feeble.	10	6-47	slight.		Twice during night.			22-10	
	11-9	,,		12-50	,,					22-35	,,
	13-1	slight.		20-30	feeble.	2	10-34	smart.		22-39	,,
19	6-35	feeble.	11	5-0	slight.		16-0	,,	Sept.		
	7-25	,,		7-17	feeble.		19-23	,,	1	7-20	feeble.
	9-12	,,	12	7-48	slight.	3	19-0	,,	2	13-28	,,
	17-40	slight.		9-33	,,		20-20	,,		16-15	,,
	18-43	feeble.	13	4-10	smart.		17-30	slight.	3	21-55	,,
	20-10	,,	14	17-46	,,	4	7-20	feeble.	5	15-30	,,
20	13-59	,,	16	11-40	feeble.		12-0	slight.		22-5	,,
	21-10	slight.		20-36	slight.		20-27	feeble.		22-32	slight.
21	6-37	,,	17	2-3	smart.		20-47	slight.	6	22-45	feeble.
	16-34	feeble.		13-26	,,		21-9	feeble.	7	2-0	smart.
	18-44	slight.	18	17-26	,,	5	6-45	slight.		12-32	slight.
22	8-34	feeble.	19	18-45	feeble.		7-42	,,		16-5	smart.
23	6-43	,,		19-40	,,		9-27	,,	8	17-22	feeble.
	15-50	,,		22-2	,,	6	19-0	feeble.		20-30	slight.
	19-54	,,	20	15-55	slight.		22-25	,,		23-0	feeble.
	22-17	,,		16-53	,,	7	15-2	,,	9	21-15	,,
24	6-0	smart.	21	8-6	,,		21-35	,,		21-30	,,
	10-45	feeble.		14-26	smart.		22-28	,,		21-35	,,
	13-37	smart.		16-45	feeble.		22-57	slight.	10	8-43	,,
	17-35	feeble.		16-49	,,	8	14-15	,,		16-50	slight.
25	7-45	smart.	22	10-33	slight.		18-24	feeble.	11	18-30	feeble.
	11-16	feeble.		21-45	feeble.		20-58	,,		18-58	,,
	12-5	slight.	23	11-40	,,					21-3	,,
	12-30	smart.		12-5	,,	*	*	*		22-34	,,
26	14-40	slight.		14-5	,,					Twice during the night.	
	14-45	smart.		14-20	slight.						
	19-58	feeble.		14-43	,,	22	13-22	slight.	12	6-30	feeble.
27	14-38	,,		15-37	feeble.		20-39	smart.		23-32	smart.
28	7-48	slight.	24	13-27	slight.		22-38	feeble.	13	9-20	feeble.
	16-3	feeble.		19-40	feeble.	23	12-43	smart.		19-25	,,
	16-36	,,		20-5	slight.		21-17	feeble.	14	9-48	,,
29	6-55	slight.	25	13-30	,,		21-28	slight.	15	22-0	,,
	9-42	,,		20-0	,,	24	16-34	feeble.	16	6-30	,,
	17-11	,,		20-45	feeble.		22-34	,,		18-5	,,
30	19-32	feeble.		21-40	slight.	25	21-44	,,		20-55	,,
				21-42	smart.		night	slight.		21-25	,,
									17	6 30	smart.

* Engaged in turmoil of market.

Date.	Time.	Nature.	Date.	Time.	Nature.	Date.	Time.	Nature.	Date.	Time.	Nature.
Sept.			Sept.			Oct.			Nov.		
17	19-20	smart.	30	16-45	slight.	13	17-30	slight.	24	20-25	feeble.
	21-20	feeble.		17-45	feeble.	14	none o	bserved.		21-48	,,
18	5-55	,,		17-57	,,					23-30	,,
	13-25	slight.		19-46	,,	*	*	*	26	16-25	,,
	20-35	,,		20-15	,,				27	10-5	,,
	22-24	,,		20-30	,,	Nov.				10-25	,,
19	19-15	feeble.		21-59	,,	3	10-15	slight.		10-45	,,
20	13-30	,,	Oct.				15-30	,,	28	18-25	smart.
	18-15	slight.	1	7-30	smart.		21-15	smart.			
21	8-20	,,		12-55	feeble.		22-19	feeble.	*	*	*
	22-48	feeble.		16-40	smart.	4	20-0	slight.			
22	10-4	,,		20-15	,,	5	12-3	feeble.	Dec.		
	10-13	,,		21-0	feeble.		13-3	,,	1	6-50	smart.
	15-25	smart.	2	8-30	slight.	6	16-0	slight.		13-0	feeble.
	21-30	feeble.		9-10	feeble.		17-55	,,		20-55	smart.
	21-40	,,	3	2-45	smart.		20-2	feeble.	5	22-30	feeble.
	23-55	smart.		12-5	feeble.	8	19-0	,,	8	12-15	,,
23	6-0	,,		21-15	,,	9	12-45	slight.		13-0	,,
	16-55	,,	4	6-15	,,	11	13-45	feeble.		19-30	,,
	Three or four during the night.			11-20	slight.		16-25	,,	9	11-0	smart.
				12-35	feeble.		16-30	,,		16-45	,,
				16-25	slight.		17-12	slight.	11	21-15	feeble.
24	17-36	feeble.		16-35	,,		22-0	feeble.	14	13-30	,,
25	6-15	slight.	5	19-10	,,	12	16-0	,,		21-30	smart.
26	22-55	smart.		21-20	smart.		17-25	,,		24-0	,,
27	2-15	,,	6	10-4	slight.		18-0	smart.	19	night	,,
	7-35	slight.		14-10	v. smart.		19-10	feeble.	22	21-50	,,
	8-21	,,		15-40	slight.	13	8-0	,,	23	8-20	feeble.
	15-40	,,		20-50	smart.		19-30	,,		12-0	,,
	19-30	smart.		22-20	slight.	14	7-54	,,	24	10-10	,,
29	9-40	feeble.	7	6-20	,,	17	18-0	,,		15-35	,,
	15-55	,,	8	19-0	,,		19-30	,,		18-50	v. smart.
	18-55	slight.	9	9-30	smart.	18	15-40	,,	25	7-50	slight.
	22-48	,,		21-50	,,		19-50	slight.	26	10-45	feeble.
30	10-5	v. smart.	10	19-15	,,		20-15	feeble.		19-25	,,
	10-10	slight.		20-40	,,		21-3	,,	27	9-15	,,
	10-14	feeble.	11	7-0	,,	19	7-30	slight.		11-35	slight.
	10-17	slight.		7-5	feeble.		18-25	feeble.		22-45	smart.
	10-22	,,		10-20	,,	20	18-35	,,	28	6-25	slight.
	10-31	feeble.		16-45	,,	21	21-35	,,		19-30	feeble.
	11-10	slight.		17-15	smart.	22	13-30	,,		19-50	,,
	13-17	feeble.	12	16-10	slight.		18-45	smart.			
	15-25	slight.		20-20	,,	23	10-15	feeble.			

* Engaged in turmoil of market.

XII.

List of earthquakes recorded at Tura, Garo Hills, from 21st July 1897 to 31st December 1898.

This list is composed of two records, one kept by the Civil Surgeon, the other by the Rev. W. Dring of the American Baptist Mission. The duration is given in seconds, except where otherwise stated.

Civil Surgeon.			W. Dring.			Civil Surgeon.			W. Dring.		
Date.	Time.	Nature.	Time.	Duration.	Nature.	Date.	Time.	Nature.	Time.	Duration.	Nature.
July						July					
21	...	...	7-40	4	feeble.	24	...	...	10-5	60	smart.
	...	...	9-55	10	,,		...	...	10-50	50	v. sm.
	...	...	9-58	9	,,		...	...	11-15	5	feeble.
	...	...	12-0	4	slight.		...	...	11-55	5	,,
	...	...	13-35	3	feeble.		...	...	12-12	30	slight.
	...	...	14-19	60	smart.		...	...	14-46	60	,,
	...	...	14-35	5	slight.		...		2 shakes between 14-46 and 20-45.		
	...	...	16-20	5	,,						
	...	...	16-49	3	feeble.		...	...	20-45	30	slight.
	...	...	18-0	2	,,		...	...	21-15	30	,,
	...	...	19-45	4	slight.				More during the night.		
	...	...	20-40	1	smart.						
	...	...	21-30	2	v. sm.	25	...	...	6-30	30	slight.
			Several hard shakes during the night.				...	...	9-25	30	,,
							11-57	smart.	12-10	60	smart.
22	...	...	6-30	5	feeble.		12-5	slight.	12-20	10	slight.
	...	...	11-22	60	slight.		12-35	,,	...	...	....
	...	...	11-35	10	,,		15-30	feeble.	16-0	10	slight.
	...	...	12-15	40	smart.		...	...	16-10	20	,,
	...	...	13-35	40	,,		...	...	17-50	60	smart.
	...	...	15-30	10	feeble.		17-45	feeble.	17-55	20	slight.
	...	...	16-0	10	,,		20-56	,,	21-8	20	,,
	...	...	16-40	15	,,		21-25	smart.	21-30	60	smart.
	...	...	17-30	10	,,		21-40	slight.	21-45	60	,,
	...	...	18-5	40	slight.		22-25	,,	Hard shakes in the night.		
	...	...	20-44	60	smart.						
			Count not taken during the night.			26	...	...	3-30	90	very sm.
23	...	...	5-0	10	slight.		4-50	slight.	...	...	...
	...	...	7-0	10	feeble.		...	...	6-35	20	slight.
	...	...	7-44	15	,,		...	...	6-43	20	,,
	...	...	8-45	60	slight.		...	...	7-0	20	,,
	...	...	9-20	80	,,		8-4	slight.	8-10	10	,,
	...	...	11-20	2m.	smart.		...	...	8-15	10	,,
	...	...	11-35	30	slight.		...	...	9-30	60	smart.
	...	...	15-30	30	,,		...	...	11-3	30	slight.
	...	...	16-30	90	smart.		...	...	11-50	30	,,
	...	...	16-53	20	slight.		15-35	slight.	15-45	30	,,
	...	...	20-25	60	smart.		19-50	,,	20-10	25	,,
	...	...	21-16	20	slight.		...	...	21-45	20	,,
			Several shakes during the night.				22-6	smart.	22-13	90	v. sm.
							...	...	22-20	10	slight.
24	...	...	5-30	2m.	v. sm.		23-10	slight.	...	...	...
	...	...	7-35	60	smart.		23-25	,,	...	...	...
	...	...	8-55	60	,,	27	...	...	6-12	10	slight.

Civil Surgeon.			W. Dring.			Civil Surgeon.			W. Dring.		
Date.	Time.	Nature	Time.	Duration.	Nature.	Date.	Time.	Nature.	Time.	Duration.	Nature.
July						July					
27	...	...	6-30	15	slight.	30	...	...	20-5	30	smart.
	7-46	slight.	...	...	...		21-29	slight.	21-35	20	,,
	8-0	smart.	...	...	...				Some more during the night.		
	9-10	slight.	8-40	20	slight.						
	9-25	,,	9-15	15	,,	31	4-3	smart.	4-0	90	v. sm.
	...	...	10-10	20	,,		8-19	slight.	8-0	30	,,
	10-53	slight.	11-5	30	,,		...	...	8-15	10	slight.
	...	...	11-26	20	,,		13-56	slight.	...	...	...
	...	...	14-8	10	,,		...	...	20-5	10	slight.
	13-55	slight.	14-10	60	smart.		...	...	20-41	15	,,
	...	...	14-14	20	slight.				Others during the night.		
	...	...	15-10	20	,,						
	...	...	16-0	20	,,	Aug.					
	17-5	slight.	...	...	...	1	...	...	8-43	8	slight.
	18-25	,,	18-0	30	smart.		...	...	10-0	5	,,
	19-54	,,	...	...	...		...	...	16-30	5	,,
	20-54	,,	21-5	20	slight.		...	...	17-0	15	,,
	21-26	,,	...	...	...		...	...	17-30	5	feeble.
	21-50	,,	...	...	...		...	...	17-50	5	,,
	22-0	,,	...	...	...		...	...	18-10	10	slight.
28	...	...	7-0	10	slight.		...	...	19-40	8	,,
	9-40	slight.	...	...	...		...	...	20-0	5	feeble.
	10-8	,,	...	...	...	2	...	...	7-0	5	,,
	10-30	,,	...	...	...		...	...	10-0	8	,,
	10-54	,,	...	...	...		...	...	11-10	20	,,
	12-6	,,	12-0	15	slight.		...	...	14-10	5	,,
	13-54	,,	13-0	20	,,		...	...	14-20	15	slight.
	...	...	14-40	10	,,		15-15	slight.	...	...	...
	...	...	14-55	15	feeble.		15-45	,,	...	...	...
	16-7	slight.	16-0	10	,,		20-35	severe.	20-40	90	severe.
	18-10	,,	18-0	10	slight		21-32	slight.	21-30	60	v. sm.
	...	...	18-15	20	,,		21-50	feeble.	21-40	10	slight.
			Several hard shakes during the night.				22-5	,,	...	...	...
						3	...	...	6-0	10	slight.
	19-4	slight.	...	...	...		9-0	feeble.	8-50	10	,,
29	5-23	smart.	5-10	30	smart.		...	...	10-50	5	,,
	...	...	5-45	10	slight.		11-22	slight.	11-25	20	smart.
	...	...	6-10	15	,,		14-6	,,	14-5	15	slight.
	...	...	7-15	10	,,		...	...	16-0	10	,,
	7-51	slight.	7-55	20	,,		...	...	20-50	20	smart.
	12-59	,,	...	...	...		...	...	21-5	20	,,
	...	...	14-0	20	slight.		...	...	21-20	5	slight.
	...	...	18-0	60	smart.				Some shocks during the night.		
	...	...	19-0	20	slight.						
	...	...	19-30	10	,,	4	...	...	6-45	5	slight.
			A smart shock or so during the night.				...	...	8-35	20	smart.
							...	...	10-0	5	slight.
30	3-25	smart.	...	...	...		...	...	11-0	10	smart.
	...	...	6-49	20	smart.		12-35	feeble.	12-10	5	slight.
	...	...	8-57	4	slight.		14-20	,,	...	...	...
	13-50	slight.	...	...	...		...	...	16-10	5	slight.
	...	...	16-0	20	slight.		...	...	20-13	10	,,
	...	...	17-10	10	,,		...	...	20-35	5	,,
	...	...	20-0	60	smart.		...	...	20-40	5	feeble.

Civil Surgeon.			W. Dring.			Civil Surgeon.			W. Dring.		
Date.	Time.	Nature.	Time.	Duration.	Nature.	Date.	Time.	Nature.	Time.	Duration.	Nature.
Aug.						Aug.					
5	...	...	5-20	4	slight.	10			One or two smart shakes during the night.		
	...	...	10-10	5	,,						
	12-0	slight.	13-30	1	,,						
	...	...	21-30	10	,,	11	2-23	slight.	...	...	...
	...	...	21-40	20	,,		...	...	6-0	5	slight
			A good hard shake or so in the night.				...	...	6-20	5	feeble.
							...	...	9-0	20	slight.
6	...	...	6-30	5	slight.		13-47	slight.	13-45	10	,,
	...	...	10-50	20	smart.		...	...	15-10	3	feeble.
	...	...	11-5	10	slight.		...	...	17-30	10	slight.
	...	...	14-40	10	,,		21-48	slight.	21-30	5	,,
	15-20	slight	...	...	...						
	15-56	,,	16-0	20	smart.	12	...	...	3-30	...	...
	16-30	,,	17-0	15	,,		4-45	slight.	...	...	...
	17-25	,,	17-30	10	slight.		...	...	5-50	10	slight.
	17-55	feeble.	...	...	...		10-0	slight.	...	...	...
	...	...	20-0	5	slight.		...	...	11-13	3	feeble
			Some shakes in night.				...	...	11-42	3	slight.
7	...	...	5-20	15	smart.	13	...	...	7-15	5	...
	...	...	6-0	20	,,		...	...	11-10	4	feeble.
	9-40	slight.	10-0	...	slight.		13-38	smart.	13-22	20	smart.
	13-0	,,	...	...	...		1-0	...	15-45	5	slight.
	14-10	,,	14-0	10	slight.		18-22	slight.	...	...	...
	18-38	,,	18-25	20	smart.		19-13	,,	19-2	5	slight.
	18-50	,,	...	...	...		19-44	,,	19-35	10	smart.
	...	...	19-45	10	slight.		...	...	20-23	5	slight.
	...	...	20-8	10	,,		...	...	20-45	30	,,
	...	...	20-55	5	,,				A few shakes in the night.		
	...	...	21-30	10	,,						
8	...	...	5-0	15	smart.	14	...	...	7-46	...	feeble.
	...	...	7-50	5	slight.		...	...	11-50	5	,,
	9-21	slight.	...	...	...		...	...	14-0	4	,,
	...	...	10-6	10	slight.		16-14	slight.	...	...	...
	...	...	12-5	5	,,		...	...	20-0	50	smart.
	13-55	,,	...	...	...		21-33	slight.	...	...	...
	...	...	16-0	10	,,				Smart shakes during the night.		
	16-55	,,	...	...	...		22-4	,,			
	18-50	,,	...	...	...	15	4-20	smart.	4-30	30	smart.
	19-27	,,	19-25	...	slight.		12-5	slight.	12-0	35	,,
9	0-57	,,	Several smart shakes in early morning.				14-58	smart.	14-50	20	slight.
							16-25	slight.	16-30	10	,,
			5-30	10	slight.		...	...	16-38	2	feeble.
	...	...					19-12	slight.	...	...	...
	13-20	,,	...	...	...		22-3	,,	...	...	...
	...	...	20-23	4	slight.	16	...	...	5-10	5	smart.
	...	...	21-35	15	smart.		...	...	12-0	5	slight.
			Shakes in the night.				...	...	18-30	4	feeble.
10	8-30	feeble.	...	...	...		20-5	slight.	...	...	...
	9-4	slight.	9-5	15	smart.		20-35	,,	20-40	6	slight.
	...	...	11-50	5	slight.		...	...	20-45	2	feeble.
	...	...	16-50	5	,,		21-45	slight.	...	...	...
	...	...	17-25	25	smart.		24-0	severe.	...	...	...
	...	...	20-0	5	,,				Two or three smart shakes in the night.		
	21-35	slight.	...	...	...						

Civil Surgeon.			W. Dring.		
Date.	Time.	Nature.	Time.	Duration.	Nature.
Aug.					
17	15-56	slight.	16-10	2	slight
	17-39	smart.	17-45	2	,,
			Three shakes in the night.		
18	6-0	slight.	5-27	...	slight.
	6-15	severe.	6-22	4	smart.
	8-0	slight.	...	...	...
	10-5	,,	...	...	...
	...	...	11-48	2	feeble.
	...	...	14-0	5	slight.
	16-17	smart.	16-20	10	smart.
			Two smart shakes in the night.		
19	4 slight shocks.		7-30	5	slight.
	...	...	10-15	5	,,
20	Two	shocks.	6-0	4	feeble.
	...	...	11-0	...	,,
21	...	...	3-0	...	smart.
	...	...	3-20	...	,,
	7-0	slight.	...	...	...
	8-0	,,	...	...	...
	...	...	10-0	8	slight.
	11-0	severe.	11-0	35	v. sm.
	...	...	14-5	2	feeble.
	15-0	slight.	15-2	10	slight
	22-0	smart.	...	...	...
22	...	...	3-10	20	smart.
	...	...	8-10	4	feeble.
	...	...	9-40	4	,,
	10-0	slight.	10-15	10	slight.
	...	...	12-0	5	,,
	14-0	slight.	14-20	8	,,
	...	...	16-59	20	slight.
	...	...	17-30	4	feeble.
	19-0	slight.	...	...	...
	21-0	,,	...	...	...
23	9-0	feeble.	...	...	...
	...	...	16-45	2	feeble.
	...	...	17-10	4	,,
	21-30	slight.	...	...	...
24	...	...	5-10	8	slight.
	...	...	9-55	4	feeble.
	...	..	10-5	3	,,
	14-0	feeble.	...	...	...
	15-0	,,	...	...	...
	19-10	slight.	19-45	...	feeble.
	22-10	feeble.	...	...	...
	...	...	One in the night.		
25	7-10	feeble.	...	...	...
	8-15	,,	...	...	...
	9-40	,,	9-5	4	feeble.
	...	...	11-15	8	slight.
	14-5	slight.	...	...	...
	19-0	,,	19-20	8	slight.

Civil Surgeon.			W. Dring.		
Date.	Time.	Nature.	Time.	Duration.	Nature.
Aug.					
25	21-0	slight.	...	...	...
26	8-45	feeble.	...	...	...
	15-15	,,	...	...	...
	...	...	16-30	8	slight.
	...	...	16-45	8	,,
27	7-5	slight.	...	...	...
	11-0	smart.	10-55	7	v. sm.
	14-30	,,	14-25	4	slight.
	...	...	15-30	10	,,
	16-10	feeble.	...	...	...
	21-0	slight.	...	...	...
28	2-0	smart.	3-50	40	v. sm.
	6-0	,,	6-20	15	smart.
	17-0	slight.	...	...	...
	21-0	,,	21-0	4	feeble.
	...	...	21-15	20	slight.
	...	...	A couple of shakes in the night.		
29	7-20	smart.	6-40	30	smart.
	...	...	6-45	8	slight.
	8-0	slight.	...	...	...
	8-30	,,	...	...	...
	9-0	smart.	...	...	...
	...	...	15-45	6	slight.
	...	...	16-5	3	feeble.
	17-10	slight.	...	...	...
	...	...	19-30	...	smart.
	21-0	slight.	...	...	...
	...	...	23-20	30	smart.
			A shake in the night.		
30	6-0	feeble.	...	...	...
	...	...	8-40	4	feeble.
	...	...	10-5	8	slight.
	...	...	15-0	4	,,
	...	...	16-35	8	,,
	...	...	20-0	15	,,
	22-0	slight.	21-15	10	,,
	22-30	,,	...	...	...
31	4-0	,,	...	...	...
	6-30	,,	...	...	...
	...	...	12-0	4	feeble.
	...	...	14-30	6	,,
	16-0	smart.	16-12	15	slight.
			20-0	...	feeble.
Sept.					
1	...	...	7-45	8	,,
	...	...	12-0	15	slight.
	...	...	14-30	10	feeble.
	15-25	smart.	15-18	60	v. sm.
			Two or three shakes in the night.		
2	...	...	7-20	8	slight.
	...	...	11-40	4	feeble.
	...	...	11-45	8	slight.

Civil Surgeon.			W. Dring.		
Date.	Time.	Nature.	Time.	Duration.	Nature.
Sept.					
2	...	...	16-30	4	feeble.
	...	...	19-28	...	,,
	...	...	20-0	8	,,
3	13-0	slight.	...	...	...
	...	...	20-30	8	feeble.
4	5-30	slight.	...	...	...
	...	...	10-30	4	feeble.
	19-0	feeble.	19-0	10	slight.
	...	...	19-15	6	feeble.
	...	...	20-35	4	,,
	...	...	21-10	15	slight.
5	...	...	7-25	8	,,
	10-0	slight.	...	...	...
	...	...	11-25	4	slight.
	14-0	feeble.	...	...	...
	21-0	slight.	...	...	...
6	...	...	7-5	4	feeble.
	10-0	feeble.	11-0	4	,,
	14-0	,,	...	...	...
	...	...	20-40	...	feeble.
7	...	...	7-45	...	,,
	7-30	slight.	7-56	4	slight.
	...	...	10-27	3	feeble.
	...	...	11-5	20	slight.
	20-0	slight.	20-0	6	,,
8	8-0	feeble.	9-0	...	feeble.
	14-0	,,	...	...	...
	...	...	20-0	4	feeble.
	20-30	slight.	20-25	8	slight.
9	...	...	2-0	4	feeble.
	...	...	2-18	8	slight.
	...	...	6-15	...	feeble.
	...	...	8-15	2	,,
10	...	...	10-0	4	slight.
	13-0	feeble.	...	...	...
	14-30	,,	...	...	...
11	...	...	2-30	10	smart.
	4-8	slight.	...	...	...
	5-50	,,	5-50	8	slight.
	...	...	8-50	2	,,
	9-8	slight.	9-8	10	,,
	9-30	,,	...	...	...
	13-0	feeble.	...	...	...
12	...	...	7-15	...	feeble.
	8-30	feeble.	8-50	10	slight.
	...	...	13-25	8	,,
	18-0	feeble.	18-0	10	,,
	...	...	19-20	...	feeble.
			One or two shakes in the night.		
13	9-8	feeble.	...	...	...
	13-0	,,	...	...	...
14	5-0	,,	...	...	...
	5-30	,,	...	...	...

Civil Surgeon.			W. Dring.		
Date.	Time.	Nature.	Time.	Duration.	Nature.
Sept.					
14	8-0	feeble.	...	...	...
	...	...	10-0	...	feeble.
	...	...	19-30	10	slight.
	...	...	19-40	8	,,
			One or two shakes in the night.		
15	...	...	5-0	8	slight.
	7-30	feeble.	...	...	...
	9-40	,,	...	...	...
	10-0	,,	...	...	...
	...	...	15-45	15	slight.
	16-30	feeble.	16-37	...	feeble.
	...	...	20-25	...	,,
	...	...	21-10	6	slight.
16	...	...	6-40	2	feeble.
	...	...	12-20	4	slight.
	...	...	14-0	2	feeble.
	...	...	14-25	10	slight.
	15-0	slight.	15-10	10	,,
	...	...	19-42	20	smart.
	20-0	slight.	20-30	4	slight.
17	...	...	10-20	4	,,
	...	...	11-0	2	feeble.
	...	...	20-45	10	slight.
	21-0	slight.	21-10	12	,,
			Several shakes during the night.		
18	9-30	,,	9-5	6	slight.
	13-0	,,	13-15	10	,,
	...	...	14-20	6	,,
	...	...	18-20	4	feeble.
	...	...	21-25	10	slight.
	...	...	21-35	3	feeble.
	...	...	21-45	20	slight.
19	...	...	9-11	15	,,
	16-30	smart.	16-38	20	smart.
	...	...	18-45	...	feeble.
	20-0	slight.	...	...	...
	20-40	,,	...	...	...
	...	...	21-30	10	slight.
			Several during the night.		
20	...	...	4-30	8	slight.
	8-30	feeble.	9-0	...	feeble.
	...	...	10-0	4	,,
	13-0	slight.	...	...	...
	13-20	feeble.	...	...	...
	...	...	18-0	2	feeble.
21	...	...	6-0	4	,,
	8-0	feeble.	9-0	2	slight.
	13-0	,,	...	...	...
	...	...	19-38	10	slight.
	...	...	21-0	1	feeble.
	...	...	21-20	2	,,

Civil Surgeon.			W. Dring.		
Date.	Time.	Nature.	Time.	Duration.	Nature.
Sept.					
22	...	...	4-45	...	slight.
	10-30	feeble.	10-0	4	feeble.
	...	...	14-10	8	,,
	...	...	18-5	...	,,
	...	...	18-22	10	slight.
23	1-15	feeble.	...	...	...
	8-0	,,	...	...	...
	...	...	13-0	8	slight,
	...	...	13-30	4	feeble.
	...	...	18-0	...	,,
	...	...	19-30	2	,,
	...	...	21-15	4	slight.
24	3-0	smart.			
	3-15	slight.			
25	...	...			
26	19-0	feeble.			
	20-30	,,			
27	2-45	slight.	Record lost.		
	9-35	,,			
	9-40	feeble.			
	13-30	,,			
	16-0	,,			
	21-45	smart.			
28	9-0	feeble.	9 23	2	feeble.
	...	...	11-5	2	,,
29	...	...	14-0	4	,,
	...	...	14-20	8	slight.
	...	...	20-35	6	,,
			Several in the night.		
30	6-0	feeble.	5-10	8	slight.
	13-0	slight.	...	...	...
	18-30	smart.	18-0	20	smart.
	19-0	,,	19-5	20	v. sm.
			One or two shakes in the night.		
Oct.					
1	...	..	...	...	...
	...	...	6-30	6	slight.
	10-10	slight.	10-7	15	,,
	...	...	11-0	...	feeble.
	13-0	feeble.	13-15	4	,,
	22-15	smart.	22-0	10	slight.
2	8-0	feeble.	...	...	...
	14-10	,,	15-0	...	feeble.
3	...	...	7-30	10	slight.
	...	...	13-0	6	feeble.
	14-30	slight.	14-0	6	slight.
	19-30	,,	...	...	...
4	...	...	6-45	15	feeble.
	...	...	10-0	...	,,
	...	...	15-0	4	,,
	19-0	slight.	19-0	10	slight.
	21-0	,,	...	...	...
	10-0	smart.	10-20	10	v. sm.

Civil Surgeon.			W. Dring.		
Date.	Time.	Nature.	Time.	Duration.	Nature.
Oct.					
5	...	...	14-0	...	slight.
	16-10	slight.	17-0	4	,,
	17-0	,,	...	...	...
	19-15	,,	20-0	6	feeble.
			One or two shakes in the night.		
6	...	...	4-35	8	smart.
	6-0	feeble.	6-15	...	feeble.
7	10-30	smart.	10-30	3	,,
	19-15	,,	19-22	4	,,
8	...	...	1-30	60	v. sm.
	23-0	feeble.	...	...	...
	23-5	,,	...	...	...
9	...	...	1-30	60	v. sm.
	...	...	10-0	...	feeble.
	...	...	18-20	6	slight.
10	7-30	feeble.	8-15	13	,,
	...	...	16-55	4	feeble.
	17-0	smart.	19-30	6	slight.
	...	...	20-35	8	,,
	21-30	feeble.	...	...	...
11	4-5	smart.	4-20	30	smart.
	...	...	4-30	8	slight.
	...	...	5-50	3	feeble.
	...	...	11-28	13	slight.
	...	...	13-12	4	feeble.
	16-0	feeble.	...	...	...
	...	...	17-10	...	feeble.
	...	...	18-15	4	,,
12	...	...	5-0	4	,,
	...	...	6-15	4	slight.
	20-5	smart.	20-43	6	,,
13	...	...	7-0	...	feeble.
	...	...	20-40	6	,,
14	7-15	feeble.	8-30	4	,,
	22-30	smart.	23-40	6	slight.
15	...	...	6-0	...	feeble.
	19-0	feeble.	...	...	...
	...	...	22-0	4	feeble.
16	5-0	feeble.	...	...	...
	5-15	slight.	...	...	...
	...	...	7-30	6	slight.
	...	...	12-30	8	,,
	...	...	19-0	...	feeble.
17	...	...	4-20	2	slight.
	...	...	6-0	6	,,
	16-30	smart.	...	...	...
	...	...	20-40	6	slight.
18	3-5	feeble.	...	...	...
	22-15	smart.	23-15	60	slight
19	...	...	14-45	6	feeble.
	19-30	smart.	19-54	10	slight.
	22-0	,,	...	...	...
20	4-0	feeble.	...	...	...

Civil Surgeon.			W. Dring.			Civil Surgeon.			W. Dring.		
Date.	Time.	Nature.	Time.	Duration.	Nature.	Date.	Time.	Nature.	Time.	Duration.	Nature.
Oct.						Nov.					
20	...	...	17-24	4	feeble.	6	7-15	feeble.	...	...	...
	20-15	smart.	...	...	...		15-0	smart.	15-40	8	feeble.
	21-30	,,	...	...	...		...	...	22-0	10	slight.
21	7-30	feeble.	...	...	...	7	15-15	smart.	...	...	...
	14-0	,,	14-20	...	feeble.	8	10-55	,,	11-0	2	feeble.
	...	...	20-0	...	,,		15-0	feeble.	...	...	...
	...	...	21-30	6	slight.		...	...	22-0	8	slight.
22	3-0	smart.	4-0	60	smart.	9	10-45	smart.	11-0	2	feeble.
	3-15	slight.	...	...	...		15-30	,,	...	...	...
	9-30	,,	...	...	...		17-0	slight.	...	...	...
	...	...	11-50	4	feeble.		21-30	smart.	22-0	...	feeble.
	...	...	13-45	8	,,	10	10-0	slight.	...	...	...
	16-0	smart.	15-40	10	slight.		17-30	,,	...	...	...
	18-0	,,	17-30	25	smart.		20-25	smart.	...	...	...
23	13-30	feeble.	...	...	...		21-0	feeble.	21-50	20	slight.
	...	...	15-0	...	feeble.	11	4-0	smart.	...	...	...
	20-15	slight.	...	...	...		7-30	feeble.	...	...	...
25	7-0	feeble.	...	...	...		18-0	smart.	...	...	...
	...	...	9-50	...	feeble.		18-30	slight.	...	...	...
	...	...	10-10	10	slight.		20-0	,,	...	...	...
	...	...	17-30	...	feeble.	12	8-25	feeble.	...	...	...
	...	...	18-0	4	,,		14-30	,,	...	...	...
	20-0	feeble.	...	...	...		...	...	16-20	...	slight.
26	10-15	,,	...	...	...		20-0	feeble.	...	...	...
	16-30	,,	...	...	...	13	15-0	,,	15-12	4	slight.
27	9-0	,,	...	...	...		19-0	slight.	...	...	...
	18-0	slight.	18-30	...	feeble.		21-30	,,	...	...	...
	...	...	21-20	6	slight.	14	7-30	feeble.	...	...	...
28	18-0	smart.	18-0	6	feeble.		18-25	slight.	...	...	...
29	15-0	feeble.	...	...	...	15	9-0	feeble.	...	...	...
	17-15	smart.	17-20	...	feeble.		13-30	,,	...	...	...
	...	...	18-30	8	slight.	16	7-0	slight.	...	...	...
30	...	...	6-0	...	feeble.		...	...	11-35	3	slight.
	9-30	smart.	8-30	20	slight.		17-0	slight.	...	...	...
	...	...	10-15	8	,,	17	7-15	,,	...	...	...
31	10-0	feeble.	10-15	...	feeble.		14-0	,,	...	...	...
	...	...	13-35	10	,,		21-15	smart.	...	...	...
	17-15	slight.	...	...	...	18	5-0	slight.	...	...	...
Nov.							14-30	feeble.	...	...	...
1	7-0	feeble.	...	...	...	19	19-15	slight.	...	...	...
	14-0	,,	...	...	...	21	2-30	smart.	A smart shake in the night.		
	17-10	,,	...	...	...		...	...	17-50	2	slight.
2	5-0	slight.	4-45	6	slight.	23	3-0	smart.	2-30	30	,,
	5-30	,,	5-0	60	,,		10-30	feeble.	10-30	6	,,
	...	...	10-15	20	,,		16-0	,,	...	...	...
	...	...	11-20	20	,,	25	3-30	smart.	2-10	20	smart.
	...	...	13-0	10	,,	26	10-25	,,	10-42	60	,,
	...	...	23-0	23	feeble.		17-0	feeble.	18-3	10	slight.
3	...	...	7-0	4	,,		...	...	19-44	10	feeble.
	10-0	feeble.	...	...	...	27	8-5	feeble.	7-45	10	slight.
4	...	...	20-30	35	slight.		...	...	14-35	20	,,
5	15-15	slight.	15-25	2	feeble.		...	...	15-5	10	feeble.
	15-25	,,	15-30	6	slight.		15-30	smart.	15-18	20	slight.
6	...	...	5-20	...	,,						

Civil Surgeon.			W. Dring.			Civil Surgeon.			W. Dring.		
Date.	Time.	Nature.	Time.	Duration.	Nature.	Date.	Time.	Nature.	Time.	Duration.	Nature.
Nov.						Dec.					
27	17-0	smart.	...	...	...	17	18-20	smart.	18-20	4	slight.
28	...	...	6-20	15	feeble.	18	8-15	feeble.	...	...	...
	...	...	6-30	10	,,	19	15-0	,,	...	...	...
	14-55	smart.	...	...	...		18-20	smart.	...	...	...
	19-0	,,	...	...	...	20	...	...	20-0	...	feeble.
29	15-0	,,	15-3	60	smart.		...	...	21-30	...	slight.
	19-45	slight.	...	...	...	21	...	...	8-18	...	feeble.
	...	...	21-0	20	slight.		...	...	18-0	...	,,
	...	...	21-25	10	,,		...	...	22-30	8	slight.
30	...	...	21-0	5	,,	22	15-30	smart.	...	...	...
Dec.						23	5-0	,,	...	...	...
1	...	...	6-0	6	slight.		...	...	20-0	...	feeble.
2	19-30	slight.	...	...	...		...	...	21-0	4	,,
	20-45	,,	20-40	8	feeble.		...	...	21-15	...	,,
	...	...	21-0	8	,,		...	...	21-30	...	,,
3	...	...	7-48	30	slight.	24	...	...	3-0	...	smart.
	8-35	slight.	...	..	...		9-0	slight.	...	...	...
	8-50	,,	9-7	20	slight.		...	...	19-52	4	slight.
	...	...	9-15	10	,,	25	...	..	21-30	4	,,
4	...	...	20-0	10	feeble.	26	...	...	11-0	3	feeble.
	...	...	20-20	8	,,		...	...	19-0	...	,,
	...	...	21-50	10	slight.		...	...	20-0	4	,,
5	16-30	smart.	16-20	35	smart.				One or two shakes in the night.		
	...	...	21-45	10	slight.						
6	9-25	slight.	...	...	...	27	14-25	smart.	...	...	...
7	13-30	smart.	13-45	70	smart.		15-0	,,	15-0	8	slight.
	18-15	,,	18-15	10	slight.		15-40	slight.	16-15	...	feeble.
	...	...	21-30	8	feeble.		...	...	18-0	2	slight.
8	9-15	slight.	...	...	...	28	...	...	20-33	40	,,
	15-0	,,	...	...	...		...	...	21-0	...	feeble.
	...	...	23-40	10	slight.		22-0	smart.	22-20	42	smart.
9	17-30	smart.	...	...	...	29	...	...	19-57	...	slight.
	20-0	,,	...	...	...		21-0	smart.	...	...	...
	21-15	feeble.	20-47	10	slight.	30	15-10	,,	...	...	...
10	5-0	slight.	...	...	...		...	...	20-15	6	slight.
	6-30	smart.	...	...	...		...	...	20-39	...	,,
	10-45	slight.	...	...	...	31	9-15	slight.	...	...	...
	...	...	14-0	4	feeble.		19-25	smart.	...	...	...
	...	...	20-35	...	,,	Jan.					
	...	...	21-0	6	slight.	1	9-30	,,	9-0	10	slight.
11	...	...	19-0	...	feeble.		16-0	,,	16-35	6	,,
12	...	...	7-30	2	slight.		...	...	21-0	10	,,
13	20.0	feeble.	19-45	4	,,	2	13-35	smart.	...	...	...
	21-30	,,	...	...	...		16-15	slight.	17-0	...	feeble.
14	10.0	,,	...	...	...		...	...	17-15	4	,,
	...	...	14-0	...	feeble.		20-0	slight.	...	...	...
15	...	...	6-0	4	slight.	3	11-0	smart.	...	...	...
	...	...	20-55	..	feeble.		14-15	,,	...	...	...
	...	...	21-0	8	slight.		19-0	,,	...	...	...
16	...	...	14-50	...	feeble.	4	4-0	,,	5-0	4	slight.
	18-30	smart.	19-30	8	slight.		13-0	,,	...	...	...
	19-0	,,	...	...	...		19-0	,,	...	...	...
			Two shakes in the night.				21-15	slight.	22-0	24	slight.
						5	3-30	smart.	...	...	...

Civil Surgeon.			W. Dring.		
Date.	Time.	Nature.	Time.	Duration.	Nature.
Jan.					
5	14-0	smart.	14-25	2	feeble.
	...	...	17-10	5	,,
	...	...	20-0	10	slight.
6	8-0	smart.	8-0	...	,,
	15-15	slight.	...	...	...
	20-10	,,	...	...	...
	...	..	23-0	25	slight.
7	...	...	6-0	20	,,
	...	...	7-30	4	feeble.
	20-0	smart.	20-0	10	slight.
	20-30	,,	20-20	4	,,
	21-20	,,	...	...	...
8	9-0	slight.	...	...	...
	14-0	,,	...	...	...
	19-15	,,	...	...	...
9	11-30	smart.	Several slight shakes: times not taken.		
	15-0	,,	...	...	...
10	10-15	,,	...	...	...
	...	...	19-0	...	feeble.
	...	...	19-30	2	,,
	...	...	20-0	3	,,
	21-35	slight.	21-0	8	,,
11	4-0	,,	Several shakes during the night.		
	...	...	20-0	...	feeble.
12	3-0	smart.	A hard shake in the night.		
	...	...	19-0	10	slight.
	...	...	19-30	...	feeble.
	20-15	slight.	20-30	8	,,
	...	...	21-0	2	feeble.
13	9-20	slight.	...	...	...
	14-10	,,	...	...	...
14	9-25	,,	10-10	20	slight.
	...	...	14-15	4	feeble.
	16-35	slight.	...	...	...
	18-0	,,	...	...	...
			Several during the night.		
15	...	...	6-8	2	feeble.
	...	...	6-20	2	,,
	...	...	6-24	4	slight.
	10-40	smart.	11-0	4	,,
	...	...	21-9	8	,,
16	1-30	smart.	A small shake during the night.		
	13-35	,,	13-45	10	slight.
17	13-30	,,	...	...	...
	...	...	23-0	12	slight.
18	13-45	smart.	13-30	12	,,
			A shake during the night.		

Civil Surgeon.			W. Dring.		
Date.	Time.	Nature.	Time.	Duration.	Nature.
Jan.					
19	6-0	slight.	6-0	15	slight.
	14-15	smart.	...	...	...
	...	...	21-43	4	slight.
20	...	...	5-30	10	,,
21	13-45	slight.	22-20	4	feeble.
22	15-0	,,	...	...	...
	...	...	19-30	...	feeble.
23	7-45	smart.	..	...	...
	...	...	20-30	...	feeble.
			22-0	4	,,
	...	...	A good shake during the night.		
24	...	...	11-0	...	feeble.
	...	...	15-0	4	,,
	...	...	19-15	6	slight.
	...	...	19-30	...	feeble.
	...	...	22-7	8	slight.
25	14-15	smart.			
	15-0	,,	A couple of slight shocks, time not taken.		
	21-0	,,	...	...	...
26	8-0	slight.	...	...	...
	11-30	smart.	...	...	...
	...	...	12-50	4	smart.
	14-15	smart.	...	...	...
	16-0	,,	16-0	4	slight.
	...	...	19-0	2	,,
27	...	...	20-30	...	feeble.
	...	...	22-0	4	,,
28	7-30	slight.	...	...	...
	...	...	20-30	10	slight.
	...	...	22-0	15	,,
29	...	...	21-0	...	feeble.
	...	...	22-20	8	slight.
	...	...	23-0	2	feeble.
31	20-0	slight.	...	...	...
	...	...	22-0	4	slight.
	23-30	slight.	...	...	...
Feb.					
1	11-30	smart.	12-0	8	smart.
	...	...	14-30	4	slight.
	16-0	slight.	...	...	...
4	...	...	19-30	4	slight.
6	...	...	22-0	10	,,
	...	...	22-30	12	,,
7	14-40	smart.	...	...	...
	...	...	18-15	6	slight.
8	15-0	severe.	15-18	40	smart.
10	...	...	10-40	8	slight.
	14 15	slight.	?	2	feeble.
11	...	...	6-0	2	,,
	...	...	6-10	20	slight.
	11-30	slight.	11-30	15	,,

Civil Surgeon.			W. Dring.			Civil Surgeon.			W. Dring.		
Date.	Time.	Nature.	Time.	Duration.	Nature.	Date.	Time.	Nature.	Time.	Duration.	Nature.
Feb.						March					
11	13-45	slight.	...	...	...	10	14-10	smart.	...	...	...
	20-0	,,	...	...	...	11	...	...	20-40	4	slight.
12	14-0	,,	A slight shake; time not taken.			12	13-10	slight.	...	...	...
						14	14-0	,,	...	...	...
13	...	...	10-0	...	feeble.	15	...	...	9-45	4	feeble.
	...	...	21-0	4	slight.		13-10	slight.	...	...	...
	21-0	smart.	21-15	8	,,	16	...	...	10-30	2	feeble.
14	...	...	15-15	...	feeble.		...	...	14-40	2	,,
	...	...	17-45	6	slight.	20	9-30	smart.	9-10	20	slight.
	...	...	22-0	4	,,		...	...	?	4	feeble.
15	...	...	6-22	4	feeble.	21	14-30	slight.	...	...	...
	9-30	slight.	...	...	...	22	8-12	feeble.	9-0	6	feeble.
18	...	...	11-52	2	feeble.	24	...	...	22-0	2	,,
	12-20	slight.	12-30	4	slight.	25	...	...	5-0	2	,,
19	...	...	?	2	feeble.		...	...	11-38	2	slight.
20	...	...	7-20	4	,,	26	5-55	smart.	5-30	6	smart.
21	5-30	smart.	5-14	4	slight.		16-50	slight.	...	...	...
	...	...	6-0	2	feeble.	28	...	...	?	2	feeble.
	12-50	slight.	...	...	...	29	9-0	slight.	...	...	...
	14-20	,,	...	...	...	30	...	...	8-0	2	feeble.
22	...	...	17-0	4	slight.		14-0	slight.	...	...	...
23	9-20	slight.	...	...	...	31	9-30	,,	...	...	...
	...	...	11-30	6	slight.	April					
	...	...	14-0	...	feeble.	1	...	...	3-10	4	feeble.
	16-0	slight.	...	...	...		11-25	slight.	...	...	...
	16-15	,,	...	...	...	2	...	...	?	2	slight.
24	...	...	6-30	2	feeble.	5	15-0	slight.	14-15	4	feeble.
26	5-30	smart.	?	?	,,		...	...	21-0	6	slight.
	7-35	slight.	...	...	...	6	...	...	19-45	8	,,
27	...	...	6-40	4	slight.		21-45	smart.	22-15	4	feeble.
	...	...	19-0	...	feeble.	8	...	...	15-30	4	,,
28	...	...	6-0	...	,,	9	...	...	?	2	,,
	...	...	12-0	8	slight.	10	...	...	19-35	4	slight.
	16-0	slight.	...	...	...	11	...	...	11-0	4	feeble.
	...	...	21-25	16	slight.		...	...	12-0	...	,,
March						13	21-0	slight.	...	...	...
1	7-40	slight.	...	...	...	14	9-40	,,	...	...	...
	...	...	10-30	4	slight.		...	...	12-10	4	slight.
	...	...	22-0	2	,,		...	...	20-33	2	,,
2	20-30	smart.	21-30	20	,,		...	...	20-35	10	,,
3	8-15	slight.	...	...	...	18	13-0	smart.	12-12	6	,,
	...	...	18-0	4	slight.	19	5-55	slight.	5-10	8	,,
4	13-30	smart.	...	...	...		6-0	smart.	...	...	...
	...	...	22-0	4	slight.	22	8-10	,,	...	...	...
5	7-30	smart.	7-0	6	,,	25	16-15	slight.	...	...	...
	8-0	,,	...	...	...	26	...	...	6-0	10	smart.
	...	...	19-40	25	slight.		...	...	16-5	4	slight.
6	7-10	smart.	...	,,	...	28	6-0	slight.	...	...	...
	9-0	slight.	8-40	10	feeble.	29	16-30	,,	?	4	feeble.
	...	...	18-0	4	,,	30	...	...	...	...	...
7	8-0	slight.	...	...	...	May					
8	...	...	9-0	4	feeble.	2	6-15	slight.	No record.		
	...	...	11-0	2	,,	6	7-25	smart.			
	17-10	slight.	...	...	...		14-5	slight.			

Civil Surgeon.			W. Dring.			Civil Surgeon.			W. Dring.		
Date.	Time.	Nature.	Time.	Duration.	Nature.	Date.	Time.	Nature.	Time.	Duration.	Nature.
May						July					
7	9-55	smart.				9	17-0	smart.	17-40	2-10	smart.
	13-45	slight.				11	...	...	?	4	feeble.
10	8-15	,,				12	...	...	19-20	10	,,
16	9-40	,,				13	...	...	16-0	2	,,
17	17-55	smart.				14	10-0	smart.	...	...	...
	18-0	slight.				15	8-0	feeble.	...	...	...
19	1-0	,,				16	...	...	11-12	2	feeble.
20	20-45	smart.	No record.			18	...	...	11-40	8	slight.
21	7-25	,,					...	...	13-50	4	feeble.
24	9-38	,,					...	...	19-0	...	,,
25	16-40	,,				20	...	...	4-50	20	slight.
26	14-45	slight.				21	14-0	smart.	13-40	10	,,
27	16-20	,,				22	...	...	18-0	12	,,
30	14-0	,,				23	9-55	smart.	...	...	...
31	20-10	,,				25	11-0	slight.	11-0	6	feeble.
							...	...	14-50	2	,,
June						29	21-0	slight.	?	6	slight.
1	...	...	5-0	30	slight.	30	...	...	1-0	...	smart.
	16-15	slight.	...	...	...		...	...	6-45	8	slight.
2	...	...	?	4	slight.	31	16-24	smart.	16-8	5	smart.
3	6-55	slight.	5-30	2	,,		16-26	,,	16-10	4	,,
	...	...	10-0	8	,,	Aug.					
	13-0	smart.	...	...	...	3	21-0	slight.	...	...	...
	14-15	slight.	...	...	...	4	...	...	11-0	28	smart.
5	7-40	smart.	7-20	4	slight.	5	15-25	slight.	...	...	...
	14-20	slight.	...	...	...	6	...	...	8-45	2	feeble.
	23-30	,,	...	...	...	7	...	...	21-0	4	,,
6	...	...	19-55	2	feeble.	8	...	...	18-0	2	,,
7	...	...	6-20	60	smart.	10	10-0	slight.	...	...	...
8	...	...	7-30	2	feeble.	11	...	...	?	4	feeble.
	14-0	slight.	...	...	...	12	16-35	slight.	...	...	...
10	...	...	?	2	feeble.	13	...	...	?	4	slight.
12	11-30	slight.	17-45	4	slight.	14	...	...	22-0	20	smart.
13	8-45	,,	8-30	6	,,	15	5-0	smart.	5-0	15	,,
	...	...	12-40	6	,,		7-10	slight.	6-0	4	slight.
16	...	...	5-30	10	feeble.		...	...	10-30	4	,,
17	2-0	slight.	...	...	...	16	14-30	slight.	14-10	6	,,
	...	...	14-50	...	feeble.		19-0	,,	20-0	30	smart.
	...	...	17-20	10	...	19	...	...	?	4	feeble.
19	1-0	smart.	0-0	2m.	smart.	20	...	...	20-0	6	slight.
	...	...	10-0	4	feeble.	21	10-15	slight.	10-40	10	,,
	17-0	slight.	...	...	...	23	0-40	,,	...	...	..
21	13-30	smart.	...	...	...		11-50	,,	10-40	10	slight.
24	8-30	slight.	...	...	...	24	2-30	smart.	...	...	...
25	...	...	21-15	2	feeble.	26	9-50	slight.	9-50	4	feeble.
27	8-10	slight.	?	2	,,		...	...	11-0	6	smart.
28	16-5	,,	...	...	...		...	...	11-10	4	feeble.
29	...	...	9-15	4	feeble.	27	6-15	slight.	...	...	...
	9-40	feeble.	9-30	10	slight.	28	...	...	?	4	feeble.
	20-0	smart.	20-15	15	,,	30	2-0	slight.	...	...	...
July						31	...	...	8-45	2	slight.
5	...	...	11-5	4	feeble.		...	...	13-40	4	,,
	20-20	slight.	20-45	6	slight.	Sept.					
6	8-40	feeble.	?	2	feeble.	3	2-0	slight.	?	6	slight.
						4	17-45	,,	...	...	...

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Date.	Time.	Nature.	Time.	Duration.	Nature.	Date.	Time.	Nature.	Time.	Duration.	Nature.
Sept.						Sept.					
5	...	...	11-0	8	slight.	22	...	...	16-0	2	feeble.
6	21-0	slight.	...	...	...	23	18-18	slight.	17-0	8	slight.
7	...	...	11-22	4	slight.	24	20-34	smart.	...	...	...
	15-15	feeble.	...	...	...	25	13-33	slight.	...	...	...
10	...	...	?	6	slight.	27	7-12	,,	7-30	10	slight.
12	13-12	smart.	13-30	20	,,		9-53	,,	...	...	...
	...	..	20-10	4	feeble.		10-12	smart.	10-20	4	slight.
13	13-0	slight.	...	...	..		14-55	slight.	...	...	...
15	...	...	?	4	feeble.	29	2-30	smart.	2-50	40	smart.
17	15-23	smart.	15-0	22	slight.	Nov.					
	...	...	18-30	10	,,	2	7-37	slight.	...	...	...
18	21-0	slight.	1-10	6	slight.	3	14-55	,,	...	...	...
	22-0	,,	...	...	...	4	19-27	,,	19-50	10	slight.
	23-45	,,	...	...	...	7	4-27	smart.	5-40	10	smart.
19	12-10	smart.	11-40	10	slight.		16-27	slight.	...	...	...
	...	...	14-0	2	feeble.	8	21-2	,,	...	...	...
	19-4	smart.	18-50	10	slight.	10	18-42	,,	...	...	...
21	11-10	,,	?	8	,,		...	...	21-0	20	slight.
22	...	...	14-30	10	,,		...	...	21-20	25	,,
23	...	...	11-15	4	feeble.	12	3-20	smart.	...	...	...
	19-55	slight.	...	...	...		23-10	slight.	...	...	...
26	5-0	smart.	...	...	...	17	...	...	7-0	10	slight.
	...	...	15-30	4	feeble.		...	...	21-0	6	,,
	23-5	slight.	...	...	...	20	...	...	20-50	8	,,
27	...	...	4-0	10	smart.	23	18-30	slight.	...	...	...
	19-5	smart.	...	...	...	24	23-45	smart.	...	...	...
29	15-30	slight.	...	...	...	29	19-0	,,	19-10	20	smart.
	...	...	17-15	4	feeble.	30	15-39	feeble.	...	...	...
30	9-35	severe	9-30	10	smart.		...	...	22-0	8	slight.
Oct.						Dec.					
2	7-10	smart.	...	...	...	1	13-47	smart.	...	...	...
	15-5	slight.	...	...	...	3	...	...	20-30	4	slight.
4	...	...	7-10	4	slight.	4	9-55	smart.	...	...	...
6	...	...	13-40	16	,,	6	7-3	,,	...	...	...
7	1-30	smart.	} No record.				9-48	slight.		...	...
9	7-40	slight.				8	1-12	smart.	...	...	...
	9-10	smart.					7-13	slight.	...	...	...
	18-20	slight.					8-12	feeble.	...	...	...
11	0-35	,,					8-27	slight.	...	...	...
18	...	...	10-55	10	,,		12-15	,,	...	...	...
	15-10	slight.	...	...	...		...	...	16-30	2	slight.
20	...	...	?	2	feeble.	9	13-5	slight.	...	...	...
22	...	...	11-50	4	slight.						

XIII.

Record kept by the Rev. G. Griffiths at Cherrapunji and afterwards at Laitlynkote (Lailangkot) in the Khasi Hills, from 8th August 1897 to 31st December 1898.

Date.	Time.	Duration.	Severity.	Remarks.
				Cherrapunji.
Aug. 8 .	9-48	5 s.	Feeble.	
	10-0	,,	,,	
	10-3	2 or 3 ,,	,,	
	19-35	30 ,,	Severe .	Brought down a stone pillar 12 feet high, which had been slightly moved on June 12th.
,, 9 .	2-50	30 ,,	Smart.	
	10-10	20 ,,	Feeble.	
	10-20	,, ,,	,,	
,, 10 .	16-40	30 ,,	Smart .	Distinct rumbling from W. at beginning and for first few seconds.
,, 11 .	1-20	5 ,,	Feeble.	
	15-10	5 ,,	,, .	Rumbling before shock, very plain from W.
,, 12 .	7-55	5 ,,	,,	
	11-5	3 ,,	,,	
	14-45	5 ,,	,, .	Distinct rumbling before shock.
	16-45	10 ,,	,,	
,, 13 .	7-45	3 ,,	,,	
	14-10	5 ,,	Slight.	
	18-28	5 ,,	,,	
	19-30	30 ,,	,,	
	20-0	10 ,,	Feeble.	
	21-30	15 ,,	Slight.	
	23-30	5 ,,	Feeble.	
,, 14 .	1-0	10 ,,	,,	
	18-35	5 ,,	,,	Distinct N. and S. vibrations.
	20-30	15 ,,	Slight .	A series of jerks, then, after a lull the jerks were as if they came from a different direction, but for a shorter duration than the first.
	21-50	10 ,,	Feeble .	Distinct rumbling before the shock.
	22-35	50 ,,	Sharp .	Distinct rumbling before and during first part of shock. The final vibrations being stronger than the others.
,, 15 .	1-0	15 ,,	Slight .	Time and duration guessed in the morning.
	4-0	0 ,,	,, .	
	...	...	.....	(Two feeble shocks of short duration. Time not known).
	18-25	5 ,,	Feeble.	
	19-30	2 ,,	,,	
,, 16 .	0-30	10 ,,	,,	
	7-45	5 ,,	,,	
	18-50	5 ,,	Slight.	
	19-50	20 ,,	Feeble.	
	21-40	3 ,,	,,	
	21-45	2 ,,	,, .	Only one jerk from N.-W. or N.-N.-W.
	22-0	10 ,,	,, .	Direction distinctly felt to be from N.-W.
	22-7	10 ,,	,,	
	22-50	25 ,,	Sharp .	Slight premonitory rumbling.

Date.	Time.	Duration.	Severity.	Remarks.
Aug. 16 .	23-5	5 s.	Feeble	
,, 17 .	10-35	5 ,,	,, .	Rumbling distinct.
	18-0	5 ,,	,, .	Time guessed.
	23-30	1 m.	,, .	Very feeble tremors for about 5 m. before and after the shock.
, 18 .	6-15	5 s.	,,	
	6-40	5 ,,	,,	
	8-0	0 ,,	,,	
	12-55	30 ,,	Slight .	Premonitory rumbling distinct. After about 5 s. there was a lull in the shocks and after this lull they came on more severely.
	13-0	5 ,,	Feeble .	From N.-N.-W.
	18-15	10 ,,	Slight .	Rumbling sound very plain.
	22-55	30 ,,	Feeble .	Slight premonitory rumbling.
	23-5	5 ,,	Slight .	No rumbling jerks from N.-N.-W.
	23-25	5 ,,	Feeble .	Faint premonitory rumbling sound from W.
	23-40	1½ m.	Severe .	Faint premonitory rumbling. Some of the woodwork of the house began to creak and I got out of bed ready to run out. Heard of no damage done, but heavy landslips occurred above the khud.
	11-45	30 s.	Sharp .	Faint premonitory rumbling.
,, 19 .	10-2	5 ,,	Feeble.	
	18-10	5 ,,	,, .	Rumbling sound from W.
	18-15	2 or 3 ,,	,, .	Jerks from N.-N.-W. or N., but no rumbling.
	20-40	5 ,,	,, .	
	21-10	5 ,,	,, .	
	23-10	10 ,,	Slight .	Rumbling sound plainly heard. Two other shocks between this and 3 A.M. Time and duration not ascertained.
,, 20 .	6-15	5 ,,	Feeble.	
	8-25	5 ,,	,,	
	10-40	5 ,,	,,	
	13-30	5 ,,	Slight.	
,, 21 .	3-15	1½ m.	Severe .	Rumbling sound, plain.
	...	...	.....	(There was another shock about equally severe a short time before or after this, but it did not rouse me sufficiently to take note of time or duration.)
	10-50	5 s.	Slight.	
	18-10	5 ,,	,,	
,, 22 .	9-10	1 m.	Feeble.	
	12-45	5 s.	,,	
	14-45	15 ,,	Sharp .	Premonitory sound very plain.
,, 23 .	19-0	10 ,,	,,	Do. do.
	22-55	5 ,,	,, .	Sound for about 10 s. before the shock.
,, 24 .	18-0	5 ,,	Slight.	
	21-55	5 ,,	,,	
,, 25 .	12-5	5 ,,	,, .	Premonitory sounds plain.
	12-25	5 ,,	,, .	
	13-5	2 or 3 ,,	Feeble .	Slight sounds.
	20-40	2 or 3 ,,	Slight.	
,, 26 .	12-50	2 or 3 ,,	Feeble.	
	20-20	2 or 3 ,,	Slight .	Rumbling sound heard before the shock and seemed to come from N.
	22-25	5 ,,	,, .	

Date.	Time.	Duration.	Severity.	Remarks.
Aug. 27 .	9-45	3 s.	Feeble.	
	17-0	3 ,,	,,	
,, 28 .	4-40	10 ,,	Slight.	
	6-45	5 ,,	Feeble.	
	20-30	2 ,,	,,	
,, 29 .	5-30	3 ,,	,,	
	6-30	3 ,,	,,	
	7-15	30 ,,	Slight.	
	11-10	2 ,,	Feeble.	
	11-45	3 ,,	,,	
	13-0	5 ,,	,,	
	15-35	10 ,,	,,	
	15-45	3 ,,	,,	
	15-50	10 ,,	,,	
	16-15	20 ,,	Slight .	Rumbling plain.
	17-50	5 ,,	,,	
	20-0	1 m.	Sharp .	Rumbling sound plain.
,, 30 .	20-50	5 s.	Slight.	
,, 31 .	7-0	15 ,,	Sharp .	Do. do.
	16-15	1½ m.	Severe .	Rumbling before, and a landslip immediately after 2 or 3 jerks in about 2 or 3 s. after the severe shock.
	18-25	1 ,,	Sharp .	From W., then N.-W.
Sept. 1 .	3-30	1 ,,	Slight.	
	15-50	2½ ,,	Sharp.	
	18-50	10 s.	Feeble.	
	22-55	3 ,,	,,	
,, 2 .	2-15	3 ,,	,,	(There happened 3 or 4 feeble shocks after this, but time was not taken.)
	17-15	3 ,,	Slight.	
,, 3 .	13-10	10 ,,	Sharp.	
,, 4 .	18-35	3 ,,	Feeble.	
	18-40	3 ,,	,,	
,, 5 .	1-25	15 ,,	Sharp.	
	2-0	5 ,,	Slight .	Slight rumbling.
	2-15	1 m.	Sharp .	Rumbling.
	11-55	5 s.	Slight.	
	15-20	20 ,,	Slight .	Rumbling.
	16-40	5 ,,	,,	
	23-35	1 m.	Sharp .	From W., rumbling for about 5 s. before shock.
	23-40	3 s.	Slight.	
,, 6 .	5-15	½ m.	,,	
	8-30	5 s.	Feeble.	
,, 9 .	6-45	3 ,,	,,	
	15-30	3 ,,	,,	
	21-55	5 ,,	Sharp .	From W.
,, 11 .	6-55	30 ,,	,,	
	7-50	15 ,,	Slight.	
	10-0	1 m.	Sharp.	
	12-25	3 s.	Feeble.	
,, 12 .	5-0	30 ,,	Sharp.	
	5-5	3 ,,	Slight.	
	5-25	3 ,,	,,	
	12-15	40 ,,	Sharp .	(Another sharp shock in the night; time not noticed.)
	...	...	.....	
,, 13 .	15-20	½ m.	Slight.	

Date.	Time.	Duration.	Severity.	Remarks.
Sept. 13 .	19-55	15 s.	Slight.	
„ 14 .	9-15	40 „	Sharp.	
	17-40	5 „	Slight.	
„ 16 .	17-0	3 „	„	No sound. Not so severe at first, but finished with a strong jerk from W.
	18-30	1 m.	Severe .	Distinct sound before shock.
	18-45	20 s.	Sharp.	
	20-10	10 „	„	
	21-10	3 „	Slight.	
„ 17 .	9-40	10 „	Sharp .	Sound very plain.
	11-0	3 „	Feeble.	
	2-10	1 m.	Sharp.	
„ 18 .	22-20	20 s.	Slight .	Rumbling sound, very plain, before and towards the end of the shock.
„ 19 .	7-15	40 „	Sharp .	No noise.
	23-40	5 „	„	
„ 20 .	2-10	5 „	Slight.	
	9-40	3 „	Feeble.	
„ 21 .	18-15	5 „	Slight.	
	18-35	10 „	„	
	20-10	5 „	„	
„ 22 .	13-35	5 „	Feeble.	
„ 23 .	14-40	5 „	Sharp.	
	22-50	10 „	Slight.	
	...	...	.....	(Within ½ hour after this, four feeble shocks were felt, each lasting 3 to 5 s.)
„ 24 .	16-35	30 „	Sharp.	
„ 25 .	11-0	5 „	Slight.	
	18-50	30 „	„	Sound was very plain and finished 2 or 3 s. before the shock began.
	21-55	30 „	Sharp.	
	22-35	15 „	Slight.	
„ 26 .	16-25	10 „	„	
	21-0	10 „	„	
„ 27 .	13-10	10 „	Feeble.	
	16-40	3 „	„	
	22-30	10 „	Slight.	
	22-55	1 m.	Sharp.	
„ 28 .	0-55	30 s.	Slight.	
	8-50	10 „	Feeble.	

From September 28th to the afternoon of October 8th, I was in Maophlang, and as I saw that the records were kept there, I did not keep any myself. But I noticed these differences between the shocks there and at Cherrapunji—(1) They came from a point which was generally more to the W. than in Cherrapunji. (2) The accompanying sound was much more pronounced. The majority of shocks at Cherrapunji are not accompanied by any appreciable sound, and when it is, it is generally before the shock, and invariably passes off before the end of the shock. I have not yet satisfied myself that we have any sound in Cherrapunji without a shock, though it is quite possible that we have had such sounds here which were put down by me to thunder, which has been common the last few weeks. In Maophlang, on the other hand, the sound was much more prolonged. Lying on a mattress on a plank flooring I could hear the sound sometimes for nearly a minute before any shock would be felt, and I could often hear the sound, when standing and when lying down after I could not feel any vibration. I often heard the same sound without feeling any vibration whatever. (3) Within about 200 yards of the D. B., which had fallen down, and nearer other masonry buildings which had also fallen down, there is one chimney standing and not a crack in it, as far as I could see from outside, and not a crack in the plastered reed wall of the same house.

Date.	Time.	Duration.	Severity.	Remarks.
Oct. 9				In the early morning a severe shock for 1½ or 2 m.
	22 0	2 s.	Feeble.	
	23 30	5 ,,	,,	
	23 40	20 ,,	Sharp.	
	23 50	10 ,,	Slight.	
,, 10 .	20 15	3 ,,	Sharp .	N. N. W.
	23 0	10 ,,	,, .	N. W. Distinct sound for a few seconds before shock. There were some feeble tremors for some 30 s. afterwards.
	23 5	5 ,,	,,	
,, 11 .	0 15	3 ,,	Slight.	
	6 15	3 ,,	,,	
	10 15	3 ,,	Sharp.	
	12 15	5 ,,	,,	
	13 55	2 ,,	,,	
	21 45	2 ,,	Feeble.	
,, 12 .	6 55	1 m.	Sharp .	Premonitory sound plainly heard from W or W. S. W.
	8 35	30 s.	Slight .	Premonitory sound very plain for some 5 s. before the shock.
	9 10	20 ,,	Slight.	
	19 45	3 ,,	,,	
	23 10	3 ,,	,,	
,, 13 .	9 0	3 ,,	,,	
	13 5	3 ,,	,,	
	15 35	1 m.	Sharp.	
,, 14 .	3 10	30 s.	,,	
	8 30	15 ,,	Slight.	
,, 15 .	...	...	...	(No shocks felt.)
				Surarim.
,, 16 .	21 10	5 ,,	Slight .	Sound very plain before, during and after the shock appeared to have ceased. I was in Surarim (eight miles from Cherrapunji on the Cherra-Shillong cart road) when I felt this shock. The character of the sound reminded me strongly of the sound as heard in Maophlang.
,, 17 .	19 30	10 ,,	Slight .	Sound very plain.
	23 30	5 ,,	Slight .	Sound heard 10 or 15 s. before the shock was felt.
	23 45	3 ,,	Feeble .	No sound.
				Cherrapunji.
,, 18 .	11 25	1 m.	Sharp .	Sound plain for 10 or 20 s. before the shock. The sound accompanying this last shock was loud, but it differed in character from the sound heard in Maophlang and Surarim. At those places it is more awe-inspiring, and partakes more of the character of the sounds I heard at Shillong, June 12th. The best way I can describe the difference is by saying (using a term common in medicine) that at those places it is more amphoric).
,, 19 .	7 0	2 ,,	Sharp .	No sound. This was made up of two long shocks with a lull for about (?) 2 s. between them.
	20 25	30 s.	Slight.	
,, 20 .	0 45	20 ,,	Slight.	
	11 25	10 ,,	,, .	Slight sound.

Date.	Time.	Duration.	Severity.	Remarks.
Oct. 20 .	12 35	10 s.	Slight .	Sound heard, but I was not quite sure whether it was distant thunder.
	22 15	3 ,,	,,	
,, 21 .	10 15	3 ,,	,,	
	14 40	3 ,,	Sharp.	
	23 40	2 ,,	Feeble.	
	23 55	2 ,,	,, .	Thought I felt very feeble tremors for some minutes after this shock.
,, 22 .	...	...	...	About 6 A.M. a sharp shock for 1½ or 2 m.
,, 28 .	23 15	30 ,,	Sharp.	
,, 29 .	2 0	5 ,,	,,	
	10 55	5 ,,	,,	
	11 5	5 ,,	,, .	Sound very plain for some seconds previous to the shock.
	13 0	...	...	(Fine guessed.)
	23 20	5 ,,	,,	
,, 30 .	9 30	5 ,,	Slight .	
,, 31 .	1 20	30 ,,	Severe.	
	8 5	20 ,,	Sharp .	Premonitory sound plain.
	9 45	5 ,,	Slight.	
	21 35	5 ,,	,,	
Nov. 1 .	13 50	10 ,,	,,	Premonitory sound, plain for about 10 s. before shock.
,, 2 .	5 15	1 m.	Severe.	
	10 15	20 s.	Slight.	
	12 0	20 ,,	,,	
	20 30	5 ,,	Severe .	Very sudden.
	21 10	5 ,,	Slight .	Sound heard for some 5 s. before shock.
	22 15	10 ,,	,,	
	23 20	30 s.	Sharp .	There was sound very plain for nearly a minute before a short feeble shock; the sound continued for about 20 seconds more when the sharp shock came.
,, 3 .	13 25	3 ,,	Slight .	Sound plain but not loud, with very feeble tremor for nearly a minute before the jerk.
*	*	*	*	* * * * *
,, 14 .	12 25	1 m.	Sharp .	From W. Sound heard plainly from W for about ½ minute before the shock.
,, 15 .	5 40	40 s.	,,	**Laitlynkot.**
,, 16 .	...	...	...	I was told that a sharp shock occurred about daybreak.
	19 15	20 ,,	Sharp .	About 10 seconds before the shock I heard a loud noise like the report of a cannon, louder than anything I have heard since June 12. Sound and shock seemed to come from S. E.
,, 17 .	...	...	...	Two sharp shocks awoke me during the night and they were accompanied by a good deal of noise.
				Shillong.
	21 10	1 m.	Severe .	Very feeble premonitory sound.
	22 50	15 s.	Slight.	
,, 18 .	...	...	...	No shocks noticed.
,, 19 .	15 30	1 m.	Slight .	Sound plain.

(Being away from home I was unable to give a fuller account of the fortnight ending October 30th.)

Date.	Time.	Duration.	Severity.	Remarks.
				Laitlynkot.
Nov. 19 .	20 0	½ m.	Slight.	
,, 20 .	...	...	...	Several times during the day heard the sound of distant rumbling, but no shock was felt.
,, 21 .	...	...	...	Ditto ditto.
				Cherrapunji.
,, 22 .	21 0	1 ,,	Severe .	No sound heard.
,, 23 .	9 0	½ ,,	Slight .	Ditto.
	11 20	20 s	Feeble .	Ditto.
Severe illness prevented my keeping any records of the shocks, which I felt *very* often from 24th to 29th.				
,, 29 .	15 30	1 m.	Severe.	Several shocks were felt, but none recorded till this.
,, 30 .	...	...	...	No shocks noticed.
Dec. 1 .	...	...	...	Ditto.
,, 2 .	8 40	30 s.	Slight .	Sound plain.
	11 30	20 ,,	Sharp .	Ditto.
	21 0	20 ,,	Slight.	
	21 10	15 s.	Sharp .	Sound plain.
,, 3 .	8 0	20 ,,	Slight.	
	9 0	15 ,,	Feeble.	
,, 4 .	14 0	15 ,,	Slight.	
	21 0	15 ,,	,,	
	22 0	20 ,,	Sharp.	
	22 30	20 ,,	Slight.	
,, 5 .	...	...	...	(A shock about 3 A.M.)
	16 30	13 ,,	Slight.	
,, 6 .	...	...	...	(A slight shock after day-light).
	9 30	1½ m.	Sharp.	
				Laitlynkot.
,, 7 .	14 0	40 s.	Slight .	Sound very plain.
	20 0	15 ,,	Feeble .	Ditto.
	21 30	5 ,,	Slight .	Sound very plain before and after the shock.
	22 15	10 ,,	Sharp .	Sound very plain before the shock.
,, 8 .	20 45	5 ,,	Feeble .	Sound very loud before the shock and approaching the sound of thunder more than usual in Laitlynkot.
	23 5	5 ,,	Slight .	Sound very loud before and after shock, partaking of the character of sound with shock of 8 45 P.M.
,, 9 .	11 30	30 ,,	,, .	Sound plain.
				Cherrapunji.
	6 30	30 ,,	,, .	Sound plain.
,, 10 .	0 10	5 ,,	,,	
	...	...	...	(A sharp shock during the night).
				Laitlynkot.
				Rumbling sound heard several times during the evening, but no shock felt.
,, 11 .	...	...	...	No shocks felt.
,, 12 .	7 0	10 ,,	Slight.	
	9 15	5 ,,	,,	
,, 13 .	...	...	...	No shocks felt, but several loud rumblings heard.
,, 14 .	...	...	...	

Date.	Time.	Duration.	Severity.	Remarks.
Dec. 15 .	7 0	5 s.	Slight .	Loud rumbling heard for several seconds before and after the shock.
	7 45	...	...	Loud rumbling but no shock felt.
,, 16 .	7 0	...	...	Ditto ditto.
				Some few more rumblings heard during the day.
,, 17 .	...	...	...	Two slight shocks between 7 and 10 A.M. and slight rumbling.
	14 30	15 s	Slight .	Slight rumbling heard.
	18 40	1 m.	,, .	Sound plain.
,, 18 .	15 0	...	..	A rumbling sound for 5 s., but no shock felt.
	16 10	...	...	Ditto for 10 s.
	21 20	...	...	Ditto for 5 s.
	22 0	5 s.	...	Two booms within 3 s. of each other, the last being the stronger. The shock hardly felt with the first, and feeble with the last.
	22 30	10 ,,	...	A dull rumbling sound, but the shock very feeble.
,, 19 .	21 15	...	...	Loud rumbling noise, but no shock felt.
,, 20 .	...	...	...	Failed to keep an account of several feeble shocks felt.
,, 21 .	...	...	...	Ditto ditto.
,, 22 .	...	...	...	Few feeble shocks felt in the early part of the day, but failed to keep any account of them.
	18 50	5 ,,	Slight .	No noise.
	22 20	30 ,,	Sharp .	Sound plain, shock came on suddenly and sharp and passed off gradually.
,, 23 .	8 0	10 ,,	Slight .	Noise present.
	14 0	5 ,,	..	Very feeble, slight rumbling sound heard in the distance.
	16 0	10 ,,	...	Very feeble tremor, slight rumbling sound heard in the distance.
	19 0	...	...	A rumbling noise for a few seconds, but no shock or tremor felt.
	20 55	...	...	A loud rumbling for half a minute, accompanied by a very indistinct tremor.
	21 5	...	...	Ditto for 1½ minute, but no tremor felt.
,, 24 .	8 55	5 ,,	Slight .	Sound plainly heard for about 1 minute.
				Maophlang.
,, 25 .	9 45	20 ,,	,, .	Sound very plain.
	19 25	5 ,,	...	Very feeble, slight sound.
	22 0	3 ,,	...	Ditto ditto.
	23 50	3 ,,	Slight .	Slight sound heard for 10 or 15 s. before the shock.
,, 26 .	8 40	5 ,,	,, .	Very feeble sound.
	9 15	...	...	Sound heard for 5 or 10 s., but no shock felt.
	10 35	3 ,,	Feeble .	Slight sound heard.
	11 15	3 ,,	,, .	Ditto.
	14 50	3 ,,	,, .	Ditto.
	16 40	...	,, .	Slight sound heard, but no shock felt.
	17 40	50 ,,	Sharp .	Sound heard, but not loud.
,, 27 .	...	...	...	No shocks felt.
				Laitlynkot.
,, 28 .	...	...	...	Several feeble shocks during the night.
	7 0	10 ,,	Slight .	Sound heard, but not loud.
	22 15	1 m.	,,	Ditto.
	22 55	10 s.	Sharp .	Slight sound heard.
	23 25	...	... .	A rumbling noise for about 10 seconds.

Date.	Time.	Duration.	Severity.	Remarks.
Dec. 29 .	9 0	30 s.	Slight .	The noise slight.
,, 30 .	11 0	30 ,,	Sharp.	
	14 10	...	...	A slight sound for about 5 s., but no shock felt.
	18 50	...	...	Ditto ditto.
	22 20	...	...	Ditto ditto.
,, 31 .	0 35	40 ,,	Sharp .	Sound before and during the shock.
	7 15	...	...	Sound without shock.
	15 25	...	...	A sound heard for a few seconds, but no shock felt.
	18 45	30 ,,	Slight .	Sound plain.
	20 45	...	...	A sound heard for a few seconds, but no shock felt.
	22 15	...	...	Ditto ditto.
Jan. 1 .	7 35	2 ,,	Feeble .	Sound plain, but not loud, before, during and after the shock.
	...	...	...	One short feeble shock about 1 P.M.
	20 5	10 ,,	Slight .	Two jerks from S. E. Sound plain but not loud before, during and after the shocks.
,, 2 .	21 5	40 ,,	Sharp .	Loud sound before, during, and after the shock, but louder before it.
,, 3 .	6 45	1 m.	Feeble .	Sound loud at first, then it died off for 2 or 3 s. and came on again. The shock was felt during the first sound.
	16 0	10 s.	Sharp .	Sound heard, but not very loud.
	18 5	5 ,,	Slight .	Ditto ditto.
,, 4 .	18 35	...	...	A sound heard for about 10 s.
,, 5 .	...	...	...	Heard two or three rumblings during the night, and one sharp, but short, shock about 5 or 6 in the morning.
	21 10	...	...	A sudden boom followed by a sound of the usual character for about 20 m. but no shock felt.
,, 6 .	12 55	1 m.	Slight .	Very feeble sound before shock. The heaviest part of the shock lasted for only about 3 s. in the beginning, the rest was only a very feeble tremor.
	22 45	...	...	A slight sound heard for about 30 s., but no shock felt.
	23 15	1½ ,,	Slight .	Slight sound before the shock. The first part of the shock stronger than the remainder.
,, 7 .	0 30	...	...	A sound heard for about 10 s.
	20 20	...	...	A slight rumbling heard for about 10 s.
,, 8 .	20 0	...	...	Ditto ditto.
	20 30	5 s.	Slight .	Accompanied by a feeble sound.
,, 9 .	7 30	...	...	A sound heard for about 10 s.
	8 30	40 ,,	Smart .	From W. sound plainly heard.
	21 0	1½ m.	,, .	Sound plainly heard before and during the shock, but more of a distant rumble and less of the loud report generally heard. The shock began feebly and reached its severest point in about 10 or 15 s., then died off very gradually.
	21 50	...	...	A distant rumbling sound heard for about 5 s.
,, 10 .	23 25	20 s.	Feeble .	A feeble distant rumble heard.
,, 11 .	...	...	...	Two feeble shocks felt between midnight and 1-30 A.M.
,, 11 .	8 45	10 ,,	Slight .	Came on very suddenly and was accompanied only by very feeble sound.
	11 55	10 ,,	Slight .	Similar to the one of 8-45 A.M. in character as regards sound, but the shock was weaker.

Date.	Time.	Duration.	Severity.	Remarks.
Jan. 11 .	16 30	10 s.	Slight .	No sound heard.
	21 5	...	Feeble .	Sound heard for about 15 s.
	22 20	40 ,,	,, .	Feeble sound heard.
,, 12 .	9 35	10 ,,	Slight .	Hardly any sound.
	20 45	40 ,,	,, .	Sound for 10 or 15 s. before the shock was felt.
	23 5	...	...	A distant rumbling heard for about 10 s.;
	13 0	20 ,,	Slight.	Time about 1 P.M.
,, 13 .	21 50	3 ,,	Very feeble	Slight sound heard.
,, 14 .	0 2	...	...	A slight sound heard for 3 or 5 s., but no shock felt.
	0 45	5 ,,	Feeble .	Slight sound heard.
	22 0	3 ,,	,, .	Ditto. Time about 10 P.M.
,, 15 .	...	...	...	There were some feeble shocks felt and rumbling noises heard during the day, but I was not in a position to record them.
	21 45	3 ,,	Feeble .	Sound very plain and resembled the report of a cannon.
	22 20	3 ,,	,, .	Sound loud, but not bursting forth so violently as the last one.
,, 16 .	11 30	10 ,,	Slight .	Sound not prominent; Time about 11-30 A.M.
	13 30	40 ,,	,,	Time about 1·30 P.M.
	19 30	15 ,,	,,	
	20 15	3 ,,	Feeble .	Sound heard, but was not loud.
	20 30	...	....	A slight sound heard for about 15 s.
	21 42	5 ,,	Feeble .	Feeble sound heard.
	21 45	40 ,,	Slight .	Feeble distant sound.
,, 17 .	7 55	...	...	Sound heard lasting about 10 s. and beginning like the boom of a cannon.
	14 30	30 ,,	Slight .	Slight sound before shock.
	23 15	5 ,,	Feeble .	Slight sound for about 30 s. before the shock was felt.
,, 18 .	18 35	40 ,,	Slight .	Sound plainly heard, but was not loud.
	22 30	...	...	A sound heard for about 30 s.
,, 19 .	9 0	30 ,,	Slight.	
	23 15	3 ,,	Feeble .	Sound rather loud.
,, 20 .	0 30	15 ,,	Slight.	
	16 50	...	...	A sound heard lasting about 30 s.
	21 50	1 m.	Feeble .	Sound very loud.
,, 23 .	22 0	...	...	A slight sound for about 1 m.
,, 24 .	9 30	3 s.	Very feeble	Sound lasted about 1 m.
	22 5	3 ,,	,, .	Ditto.
	23 0	30 ,,	Feeble .	Accompanied by a slight sound.
,, 25 .	9 10	...	...	A sound heard plainly for about 30 s. It gave me the impression of coming from the E.
	23 10	1½ m.	Severe .	The heaviest we have had for a long time, seemed to come from S. W. or W. S. W. Began suddenly and passed off gradually. The sound was not very loud.
,, 26 .	9 45	...	...	A loud sound for about 1 m; during the afternoon a distant rumbling sound was heard several times, but as there was a thunderstorm passing over us this afternoon, it was impossible to know to which disturbance it was due.
,, 27 .	15 40	5 s.	Slight .	No sound.
,, 28 .	23 0	5 ,,	Feeble .	Slight sound lasting for about 1½ m.
,, 29 .	0 5	10 ,,	Slight .	Ditto ditto 1 m.
	17 5	15 ,,	,, .	Slight sound present.
	22 55	...	...	Very feeble tremor for about 10 s.

Date.	Time.	Duration.	Severity.	Remarks.
Jan. 30 .	2 30	40 s.	Smart .	Seemed to come from W.
,, 30 .	11 40	40 ,,	,, .	Ditto ditto.
	17 0	30 ,,	Slight. .	Time about 5 P.M.
,, 31 .	21 25	30 ,,	Smart .	Good deal of noise, which sounded nearer than usual. Shock from S. W.
Feb. 2 .	21 0	30 ,,	Slight .	Hardly any sound.
,, 3 .	16 35	30 ,,	,, .	Ditto.
,, 4 .	20 30	...	...	Feeble rumbling sound heard like distant thunder.
	20 50	...	...	Ditto, but stronger and longer, lasting about 40 s.
	21 25	10 ,,	V. feeble .	Rumbling sound very plain and lasted about 40 s.
	23 15	5 ,,	Feeble .	Sound plain and lasting about 30 s.
	23 30	5 ,,	,, .	Ditto ditto.
,, 5 .	...	...	...	(From the state of the weather to-day I am inclined to believe that some of the sound I heard yesterday was due to distant thunder.)
	9 0	...	Feeble .	Loud noise lasting for about 40 s. The shock felt by others, but not by me.
,, 8 .	15 45	40 ,,	Sharp .	Sound very plain.
(Away from home for some days.)				
,, 12 .	21 0	5 ,,	Feeble .	Sound very plain for about one minute.
,, 13 .	11 40	5 ,,	Slight .	Sound very plain for 40 s.
	14 30	...	...	Rumbling sound for about 40 s., but a shock not felt; time about 2-30 P.M.
	16 15	10 ,,	Slight .	Slight sound heard.
,, 16 .	12 20	...	...	A sound heard lasting about 10 s.
	14 20	5 ,,	Feeble .	A loud noise heard for about 30 s.
,, 17 .	2 0	5 ,,	,, .	Sound very plain for about 30 s., and after 5 or 10 s. another shock feebler than the first, with the sound lasting about the same.
	2 20	5 ,,	,, .	Sound very loud for about 20 s.
[Owing to absence from home I was unable to give an account of the shocks that took place after this.]				
,, 26 .	16 10	10 s.	Slight .	Sound slight.
,, 27 .	13 15	20 ,,	,, .	Composed of two shocks following one another with an interval of about 3 s., but the sound (which was not loud) lasted from the beginning of the first to the end of the second without any break.
	14 0	15 ,,	,, .	Sound slightly louder than with the last shock.
	20 55	3 ,,	Feeble .	Loud rumbling sound lasting for about 1 m. and the shock occurred about the middle of it.
	22 10	...	...	A slight rumbling sound like distant thunder for about 10 s. but no shock.
	23 0	...	...	Ditto ditto.
,, 28 .	17 30	5 ,,	Slight .	Loud rumbling sound lasting about 1 m.
	18 20	...	...	Loud rumbling sound for about 30 s., but no shock.
	22 0	3 s.	Feeble .	Accompanied by a feeble sound.
	22 15	...	...	A loud rumbling sound for about 40 s., but no shock.
Mar. 1 .	15 40	3 ,,	Feeble .	Slight sound heard.
	22 30	1 ,,	Severe .	Accompanied by a sound.
,, 2 .	20 55	5 ,,	Slight .	Rumbling sound, plain for about 40 s.
	21 10	...	...	Rumbling sound slightly heard for about 40 s., but no shock felt.
,, 5 .	1 0	...	Slight .	(Time guessed), a shock felt.

Date.	Time.	Duration.	Severity.	Remarks.
Mar. 5 .	20 20	20 s.	Slight .	Sound plain.
	22 30	10 ,,	,, .	Ditto.
,, 6 .	10 30	10 ,,	,, .	Sound plainly heard.
	10 55	5 ,,	Feeble.	
	22 0	5 ,,	,, .	Rumbling sound very plain (time only guessed).
	23 0	...	...	Rumbling sound heard for about 25 s., loud and distant (time guessed).
,, 7 .	1 0	...	...	A loud rumbling sound heard for about 30 or 40 s. This gave me the impression of being much nearer than the sound has generally been. It was more of a crash (time guessed).
	11 35	1 ,,	Severe	Loud rumbliug sound heard, having the characters of the last.
,, 8 .	0 5	5 ,,	Slight .	Sound plain for about 20 s.
,, 11 .	20 50	3 ,,	Feeble .	No appreciable sound.
	20 53	5 ,,	Slight .	Ditto.
	21 35	10 ,,	,, .	Slight sound heard.
	22 40	5 ,,	,, .	Rumbling heard before and during the shock.
,, 12 .	23 0	3 ,,	Feeble.	
,, 13 .	12 3	50 ,,	Sharp .	No sound.
,, 13 .	22 0	3 ,,	Feeble .	Slight sound heard, which seemed to come after the shock was felt (the time may be wrong, 20 or 30 minutes.)
,, 14 .	7 0	30 ,,	Sharp .	Very feeble sound.
	7 50	3 ,,	Feeble .	Feeble sound, like that of distant thunder heard for about 25 s. before, and about 15 s. after, the shock.
	20 5	10 ,,	Slight .	Slight premonitory sound, like distant thunder.
	20 40	10 ,,	,, .	Premonitory sound a little louder, and the shock more pronounced than the last, but the sound did not last so long.
	22 0	3 ,,	Feeble .	Very feeble sound heard.
,, 15 .	7 10	30 ,,	Slight .	No sound.
	21 45	30 ,,	Feeble .	Slight sound.
,, 16 .	5 0	40 ,,	Sharp .	Sound heard (time guessed).
	17 10	5 ,,	Feeble .	No sound.
,, 17 .	21 55	30 ,,	Sharp .	Began without any warning in a sudden sharp upward jerk. This subsiding, was followed by a feeble tremor, then by stronger oscillations, I think, from the west or north-west. Hardly any sound heard.
	22 30	30 ,,	Slight .	Very slight sound.
,, 18 .	22 35	40 ,,	,, .	Hardly any sound.
	23 20	10 ,,	Feeble .	Sound heard, but it was not very loud.
	23 45	15 ,,	,, .	Slight rumbling sound heard.
,, 19 .	10 20	20 s.	Slight .	No sound.
	19 0	5 ,,	,, .	Ditto.
,, 21 .	22 0	10 ,,	,, .	Accompanied by a loud sound.
,, 22 .	4 0	15 ,,	,, .	Ditto. ditto.
	17 15	...	...	Very feeble sound heard for about 20 s. I cannot be sure about feeling any tremor.
	21 20	40 ,,	Sharp .	Accompanied by a slight sound. Began with feeble tremors, which lasted about 25 s., then the sharp shock lasted about 10 s., passing off gradually in another 5 s. or so.
	22 10	25 ,,	Feeble .	Feeble sound heard.
,, 23 .	15 15	5 ,,	Slight.	

Date.	Time.	Duration.	Severity.	Remarks.
Mar. 23 .	24 0	...	.....	Feeble sound heard for about 5 s.
„ 24 .	0 10	3 s.	Feeble .	A slight sound heard.
	0 40	5 „	„ .	Very feeble sound heard.
„ 25 .	16 30	1 m.	Sharp .	No sound. Began with a sudden jerk which lasted about 5 s. and died off gradually, and towards the end again the tremors became more distinct.
„ 26 .	13 10	10 s.	Feeble .	Slight rumbling sound.
	22 25	...	.....	Slight rumbling sound for about 5 s.
„ 27 .	0 50	20 „	Sharp .	Accompanied by slight noise.
	4 0	50 „	„ .	Do. (Time and duration guessed.)
	23 0	30 „	„ .	No sound.
„ 28 .	...	...	.....	Between midnight and 4 A.M. I felt two shocks, one of them must have lasted about 1 minute and was sharp.
	6 25	5 „	Sharp .	A loud rumbling sound for about 15 or 20 s. before the shock.
	21 30	...	.....	A distant rumbling sound for about 10 s. (as it thundered in half an hour afterwards, this sound may have been due to that).
„ 29 .	...	...	.....	I was told that a shock occurred during the night, but I did not feel it.
	12 25	20 „	Slight .	
„ 30 .	18 10	10 „	„ .	
	21 45	1 m.	Severe .	Feeble noise accompanied it.
„ 31 .	22 50	1 „	Sharp	
April 1 .	2 15	40 s.	„ .	
	...	...	.....	I have an impression that there was another sharp one a short time after this.
	17 25	5 „	Feeble .	No sound.
„ 3 .	...	...	.....	Not long after 3 P.M. (exact time forgotten) a slight shock was felt for 15 s., but the sound was not a prominent feature of it.
„ 4 .	12 25	10 „	Slight .	No sound.
„ 5 .	...	...	.....	Soon after midnight there was a slight shock.
	...	...	.....	Some time between that and 5 A.M., there were 2 sharp shocks within a few seconds of each other, accompanied by a good deal of sound. Each shock may have lasted 20 or 30 s.
	7 0	15 „	Slight .	Accompained by a slight sound.
	11 30	10 „	„ .	Rumbling sound very plain.
	12 5	10 „	Feeble .	Rumbling sound very loud.
	13 10	5 „	„ .	Slight sound.
	16 25	10 „	Sharp .	Came on with a sudden jerk and passed off almost as suddenly. The sound was not loud, but seemed nearer than usual.
„ 6 .	11 15	40 „	Slight .	Sound plain, but not loud, several seconds before shock.
	15 0	10 „	Sharp .	Preceded by a loud rumbling noise.
„ 9 .	17 0	40 „	Slight .	Sound present during the shock.
„ 10 .	19 55	30 „	„ .	Very little sound.
„ 11 .	23 50	30 „	„ .	Ditto
„ 12 .	14 50	15 „	„ .	Ditto
„ „ .	17 0	20 „	„ .	Ditto
„ 13 .	21 35	30 „	„ .	Began, without any sound, as a feeble tremor, which lasted some 20 s. before the stronger jerk came. This jerk seemed to be double, each part of it lasting a very short time.

Date.	Time.	Duration.	Severity.	Remarks.
April 14 .	1 15	1 m.	Slight .	Accompanied by a slight sound.
	9 20	20 s.	,, .	No sound, but a feeble tremor for about 30 s. before, and 15 s. after, the shock, beginning and passing off very gradually.
	*	*	*	* *
,, 17 .	6 55	10 ,,	Slight .	No sound.
,, 18 .	...	15 ,,	,, .	No sound. Between 8 and 11 A.M.
	12 45	20 ,,	,, .	No sound.
,, 19 .	...	1 m.	Sharp .	No sound. Between 5 and 6 A.M.
	7 15	10 s.	Slight .	No sound.
	8 0	...	.....	A feeble rumbling for a few seconds (distant thunder ?).
	...	...	.....	A shock was felt by some people about mid-day who said it lasted a pretty long time.
,, 20 .	13 45	5 ,,	Feeble .	No sound.
	15 30	15 ,,	Slight .	Ditto
,, 22 .	23 15	10 ,,	Feeble .	Ditto
,, 24 .	...	...	.....	Between 1 and 3 A.M. felt 3 slight shocks accompanied by slight rumbling sound. It is quite possible that *some* of them were due to thunder.
	8 30	10 ,,	Slight .	Very feeble sound.
	11 0	15 ,,	Sharp .	Ditto
	21 45	20 ,,	Feeble .	No sound.
,, 25 .	1 45	40 ,,	Sharp .	Ditto
	22 50	40 ,,	,, .	Ditto
	23 30	10 ,,	Feeble .	Preceded by a very feeble rumbling sound for about 25 s.
,, 26 .	6 20	1½ m.	Sharp .	No sound.
	6 55	20 s.	Slight .	Ditto
	8 5	15 ,,	,, .	Ditto
	11 20	5 ,,	Feeble .	Ditto
	16 35	50 ,,	Slight .	Ditto
,, 27 .	1 0	10 ,,	Feeble .	Ditto
	1 5	1 m.	Slight .	Ditto
	14 15	1 ,,	,, .	Very feeble rumbling sound heard.
	15 20	10 s.	Feeble .	Preceded by a feeble rumbling sound, which lasted about 25 or 30 s. before the shock was felt.
	23 5	10 ,,	,, .	No sound.
,, 28 .	18 30	40 ,,	Sharp .	Very feeble sound.
,, 29 .	11 30	40 ,,	Slight .	No sound.
,, 30 .	7 0	30 s.	Slight .	No sound.
	7 15	20 ,,	Feeble .	Ditto
	14 20	3 ,,	,, .	Preceded by a very faint rumbling.
	17 0	3 ,,	,, .	Preceded by a loud rumbling sound which lasted about 20 s.
May 1 .	7 10	5 ,,	Slight .	For about 40 s.
	21 0	...	.....	Two rumbling sounds within a few seconds of each other, the latter sound accompanied by a very feeble shock, which lasted some 2 or 3 s.
,, 2 .		...	.....	About 12-30 or 1 P.M. A slight shock came on suddenly and lasted about 3 s., but a very feeble tremor lasted some 10 or 15 s. after. No sound.

Date.	Time.	Duration.	Severity.	Remarks.
May 2 .	22 20	1 s.	Slight .	Attended by a slight rumbling sound.
,, 3 .	7 45	5 ,,	,, .	Sound plain, but not loud, for about 20 s. before the shock.
	21 25	5 ,,	,, .	Very feeble sound heard.
,, 5 .	10 35	10 ,,	,, .	Do. do.
	20 50	40 ,,	Sharp .	Hardly any sound heard.
	21 30	10 ,,	Feeble .	Very feeble rumbling sound before the shock was felt.
	21 50	10 ,,	,, .	No sound.
,, 6 .	...	...	...	Between 6A.M. and 10 A.M. there was a slight shock.
	11 15	10 ,,	Slight .	Very feeble sound.
	18 0	15 ,,	,, .	No sound.
,, 7 .	13 50	1 ,,	Sharp .	Slight sound.
	14 30	10 ,,	Feeble .	No sound.
,, 8 .	10 10	5 ,,	,, .	Slight rumbling sound heard.
	15 35	10 ,,	,, .	Rumbling sound, very plain.
,, 9 .	10 15	30 ,,	Slight .	
	12 15	10 ,,	,, .	
,, 11 .	7 55	5 ,,	Feeble .	No sound.
	19 45	10 ,,	,, .	Slight sound heard.
,, 13 .	9 40	5 ,,	Slight .	do. do.
	18 30	3 ,,	Feeble .	
	21 15	15 ,,	,, .	
,, 14 .	0 5	20 ,,	Slight .	
,, 16 .	7 45	10 ,,	,, .	Sound like that of a rushing wind accompanied it.
	9 30	10 ,,	,, .	Accompanied by a similar sound of wind.
,, 17 .	19 10	5 ,,	,, .	No noise.
,, 21 .	6 15	10 ,,	Sharp .	
,, 23 .	10 55	20 ,,	Slight .	No sound.
	21 45	30 ,,	Feeble .	do.
,, 25 .	12 45	30 ,,	Severe .	I was in one of the valleys near here at the time and the noise of large loose stones falling down, where there had been landships, was very apparent. No rumbling sound.
	16 40	15 ,,	Slight .	No sound.
	18 50	5 ,,	Feeble .	Slight sound heard.
,, 26 .	0 5	10 ,,	Slight .	No sound.
,, 27 .		...	...	A slight shock lasting about 10 s. felt in the afternoon. No sound.
,, 28 .	7 30	5 ,,	Slight .	Accompanied by a feeble sound.
	15 55	5 ,,	,, .	No sound.
,, 29 .	6 0	5 ,,	,, .	Slight noise.
	6 30	5 ,,	,, .	Very feeble sound.
	14 30	10 ,,	,, .	The rumbling sound very plainly heard.
	20 40	5 ,,	Feeble .	The sound very plain.
				Nongkrem.
30 .		...	...	Between 10-30 P.M. and midnight felt three or four shocks, all slight, some accompanied by noise, others not.
,, 31 .	0 30	...	...	A sharp shock.
	...	...	...	Between 7 and 7-20 A.M. Felt two shocks accompanied by sound.
	21 30	10 ,,	Slight .	No sound.
	21 35	5 ,,	,, .	Accompanied by sound.
June 1 .	1 80	10 ,,	,, .	Loud noise. (Heard in Mylliem).

Date.	Time.	Duration.	Severity.	Remarks.
				Maophlang.
June 1 .	22 35	20 s.	Sharp .	No noise.
	23 45	5 ,,	Slight .	Slight noise.
,, 2 .		...	...	Between day-break and 6 A.M. felt two slight shocks.
	13 20	10 ,,	Feeble .	Loud noise. (Heard in Sayong).
	23 0	3 ,,	Slight .	Preceded by a loud noise (in Mairang).
,, 3 .	15 30	10 ,,	,, .	Slight sound (between Mairang and Maophlang).
	16 35	15 ,,	Sharp .	Accompanied by a rumbling sound (do.)
	18 10	5 ,,	Slight .	Slight rumbling.
	21 25	10 ,,	Sharp .	No sound.
	22 40	5 ,,	Feeble .	Do.
	22 45	40 ,,	Severe .	Do.
	22 48	5 ,,	Slight .	Do.
	22 50	5 ,,	,, .	Do.
				Laitlynkot.
,, 5 .	9 45	10 ,,	Feeble .	Very feeble sound heard.
	13 5	5 ,,	Slight .	Do. do.
	14 40	10 ,,	,, .	Preceded by a slight sound.
	15 1	3 ,,	Feeble.	
	17 0	10 ,,	Slight .	No sound.
	21 45	20 ,,	Sharp .	Accompanied by a slight sound.
	22 0	10 ,,	Slight .	Do. do.
,, 9 .	0 30	40 ,,	,, .	No sound.
	1 40	1 m.	Severe .	Do.
	7 45	20 s.	Slight .	Do.
,, 10 .	8 10	10 ,,	,, .	Preceded by a loud noise.
				Thought I felt several very feeble shocks between mid-day and sunset, but as it was thundering at the time I was not sure of them.
	21 30	10 ,,	Feeble .	No sound.
	23 0	5 ,,	,, .	Do.
,, 12 .	11 58	30 ,,	Sharp .	Accompanied by a rushing sound like wind in a forest.
	13 45	10 ,,	Feeble .	Rumbling sound very plain.
,, 13 .	0 5	15 ,,	Sharp .	Do. do.
	17 20	10 ,,	Slight .	Do. do.
	21 50	5 ,,	,, .	Feeble rumbling sound.
	22 10	1 m.	Sharp .	Do. do.
*	*	*	*	* * * * *
,, 17 .	13 5	10 s.	Slight.	
	15 15	5 ,,	,, .	Preceded by a long rumble.
	22 0	...	...	(About) a slight shock.
,, 18 .	7 0	5 ,,	Slight .	A slight rumble heard.
	7 30	3 ,,	,, .	Do. do.
	...	...	...	Between 1 and 5 P.M. felt 2 slight shocks.
,, 19 .	8 5	3 ,,	Feeble .	Proceeded by a rumbling sound for about 10 s.
	9 40	5 ,,	,, .	Very feeble sound heard.
,, 20 .	21 30	...	...	A loud rumble for about 30 seconds, but I felt no shock, but a person sitting in the house at the time declared he felt.
,, 21 .	12 30	30 ,,	Slight .	Slight sound.

Date.	Time.	Duration.	Severity.	Remarks.
June 22 .	13 25	20 s.	Slight.	
,, 23 .	16 15	30 ,,	,,	
	22 40	15 ,,	,,	
	23 10	2 m	Sharp .	Preceded by a sound for about 1 m. It appeared like two shocks with an interval of about 1 m.
,, 24 .	6 20	10 s.	Slight.	
,, 26 .	7 30	5 ,,	,, .	Preceded by a loud noise for about 1 m.
,, 27 .	...	...	...	About 12-30 P.M. a feeble shock accompanied by a slight noise.
	22 30	5 ,,	Slight .	Preceded by a sound.
,, 28 .	8 0	3 ,,	Feeble .	The sound of heavy rain prevented me to hear any rumbling sound if there was any.
	16 15	1 m.	Slight .	No sound.
,, 29 .	9 50	10 s.	,, .	Do.
*	*	*	*	* * * * * *
July 2 .	18 15	40 ,,	,, .	Preceded by a loud noise.
	23 5	20 ,,	,, .	Do. do.
,, 3 .	1 0	...	...	(About) a slight shock felt.
	10 15	10 ,,	Feeble .	Accompanied by a feeble rumbling sound lasting for about 1 m.
,, 4 .	14 40	40 ,,	Sharp .	Preceded and accompanied by a loud rumble.
	15 45	5 ,,	Feeble .	No sound.
	16 30	15 ,,	Slight .	Preceded and accompanied by a sound.
	16 50	3 ,,	Very feeble	Do. do.
,, 6 .	19 0	5 ,,	Slight .	Do. do.
,, 7 .	7 6	10 s.	,, .	Do. do.
,, 9 .	18 30	1 m.	Sharp .	No sound.
	20 45	20 s.	Slight .	Do.
,, 10 .	12 50	5 ,,	,, .	Slight sound.
,, 11 .	...	...	...	Sometime between midnight and 4 A.M. there was a slight shock.
	8 45	5 ,,	Slight .	Came on suddenly without warning. No sound.
	14 45	5 ,,	,, .	Preceded by a loud sound like that of a rustling wind.
,, 12 .	6 45	40 ,,	Sharp .	No sound.
	9 30	5 ,,	Slight .	Preceded by a loud rumbling sound for about 40 s.
	18 55	10 ,,	,, .	No sound.
,, 13 .	4 25	40 ,,	Severe .	Do.
	19 20	5 ,,	Slight .	Very loud rumbling sound.
,, 14 .	17 50	40 ,,	Severe .	Accompanied by a slight rumbling sound.
,, 15 .	20 50	10 ,,	Slight .	Feeble sound accompanied it.
,, 16 .	21 20	30 ,,	Sharp .	Accompanied by a slight sound.
,, 20 .	...	...	...	Between 3 and 4 A.M. felt two feeble shocks.
	20 15	5 ,,	Slight .	No noise.
,, 21 .	14 15	18 ,,	,, .	A noise preceded it for about 15 s.
	16 30	5 ,,	Feeble .	No sound.
,, 24 .	8 45	10 ,,	Slight .	Do.
	18 10	10 ,,	,, .	Do.
,, 25 .	14 0	10 ,,	,, .	Do.
	19 55	5 ,,	,, .	Preceded by a feeble rumbling sound for about 10 s.
,, 27 .	21 30	15 ,,	Sharp .	Began suddenly with a thump underneath one and afterwards died away gradually. No noise.

Date.	Time.	Duration.	Severity.	Remarks.
July 28 .	...	...	...	Between 7-30 and 9 A.M. a slight shock was felt for about 10 seconds. No sound.
,, 30 .	20 40	10 s.	Feeble .	No sound.
,, 31 .	16 50	10 ,,	Slight .	No sound. Was told that a feeble short shock occurred a few seconds before this one, but did not feel it myself.
	20 40	3 ,,	Feeble .	No sound.
Aug. 1 .	12 30	1 m.	Sharp .	Do.
	13 10	10 s.	Slight .	Do.
	...	...	...	Rumbling noises were heard several times during the day, but I thought at the time that they were due to distant thunder.
	22 50	5 ,,	,, .	Accompanied by a long rumbling sound similar to those heard several times during the day.
,, 2 .	...	...	...	About 5 A.M. a slight shock was felt.
	21 30	5 ,,	Feeble .	No sound.
,, 3 .	7 0	10 ,,	Very feeble	Do.
,, 4 .	...	...	Slight .	A shock about mid-day.
	...	...	,, .	Do. ,, 7 P.M.
,, 5 .	9 0	20 ,,	Sharp .	Feeble sound.
,, 7 .	13 10	5 ,,	Slight .	No sound.
,, 9 .	18 40	10 ,,	Do. .	Accompanied by a rumbling sound, which came on suddenly.
*	*	*	*	* * * * * *
,, 18 .	17 50	20 ,,	Slight .	Preceded by a sound for about 40 s.
,, 19 .	9 10	10 ,,	Feeble .	Preceded by a feeble sound.
,, 21 .	8 30	20 ,,	Slight .	Accompanied by a feeble rumbling sound.
,, 23 .	0 35	40 ,,	,, .	Do. do.
	7 45	25 ,,	,, .	Hardly any sound.
,, 24 .	2 45	30 ,,	,, .	
,, 26 .	7 30	40 ,,	,, .	
	10 35	20 ,,	Feeble .	
	12 45	15 ,,	Slight .	
	16 45	10 ,,	,, .	No sound.
,, 27 .	6 30	1 m.	Smart .	Slight scund.
	11 45	10 s.	Slight .	Preceded by a sound.
,, 28 .	...	...	...	Thought I felt a shock about 3 or 4 A.M.
	6 0	15 ,,	Slight .	No sound.
,, 29 .	13 35	5 ,,	Feeble	Do.
	22 30	5 ,,	,, .	Accompanied by a sound.
,, 31 .	6 30	5 ,,	Smart .	Do. do.
Sept. 2 .	20 50	10 ,,	Slight .	Do. do.
	20 55	5 ,,	Feeble .	
	3 between 7 and 8	10 ,,	Slight .	
,, 5 .	14 40	10 ,,	,, .	No. sound.
	15 20	5 ,,	Feeble .	Do.
	22 0	5 ,,	Slight .	Preceded by a slight sound.
	22 30	10 ,,	Smart .	Do. do.
,, 6 .	6 30	15 ,,	,, .	No sound.
,, 7 .	2 0	20 ,,	,, .	Slight sound.

Date.	Time.	Duration.	Severity.	Remarks.
Sept. 7 .	12 30	30 s.	Severe .	Slight sound.
	...	...	...	3 or 4 doubtful shocks.
	13 30	10 ,,	Smart .	Slight sound.
	16 5	5 ,,	Feeble .	
	19 0	10 ,,	Smart .	Accompanied by a rumbling sound.
	21 30	10 ,,	,, .	Do. do.
,, 8 .	14 50	5 ,,	Feeble .	No sound.
	23 25	5 ,,	,, .	Feeble sound.
,, 9 .	10 10	15 ,,	Slight .	Slight sound.
	10 25	10 ,,	,, .	Do.
,, 11 .	11 45	10 ,,	Smart .	No sound.
,, 12 .	19 0	5 ,,	Slight .	Preceeded by a loud rumbling noise, lasting about 15 s.
	22 30	1 m.	,, .	No sound.
,, 13 .	9 0	4 s.	,, .	Do.
,, 15 .	...	...	,, .	A smart shock about 1 A.M.
	22 0	...	Feeble .	A slight rumbling noise preceded it.
,, 16 .	...	...	...	A slight shock about mid-day.
	21 20	15 ,,	Feeble .	No sound.
,, 17 .	19 10	5 ,,	Smart .	A loud noise preceded and followed the shock for several seconds.
,, 18 .	...	...	...	Two smart shocks during the night, one about mid night and the other a little before day-break.
	13 20	1 m.	,, .	No distinct sound. Began in feeble oscillations which culminated in smart ones lasting some 3 s., then passed off graduall y.
	22 20	1½ ,,	,, .	Came on rather suddenly and passed off slowly with intervals, towards the end, lasting a few seconds, when the vibrations seemed to stop.
				No sound.
,, 19 .	4 30	50 s.	,, .	No sound.
,, 20 .	18 30	40 ,,	Slight .	Do.
,, 22 .	23 45	1 m.	Severe .	Do.
,, 23 .	16 45	40 s.	Smart .	Preceded by a rumbling sound.
	17 20	30 ,,	Slight .	Do do.
	18 15	20 ,,	,, .	No sound.
,, 25 .	18 10	10 ,,	Smart .	Preceded and followed by a slight sound.
,, 26 .	21 50	1 m.	,, .	No sound.
,, 27 .	19 20	1½ ,,	,, .	Do.
,, 29 .	...	...	...	Somewhere between 11 A.M. and 2 P.M. there was a slight shock preceded by a slight sound.
	22 45	5 s.	Slight .	Preceded by a prolonged sound.
,, 30 .	9 55	2 m.	Severe .	No sound. A new wall built with stone and mud was cracked.
	10 5	3 s.	Feeble .	Do.
	10 10	5 ,,	Slight .	Do.
	11 0	10 ,,	Smart .	Slight sound preceding.
	15 15	5 ,,	Feeble .	No sound.
	20 15	3 s.	,, .	Do.
Oct. 1 .	7 20	1 m.	Severe .	Do.
	8 0	20 ,,	Slight .	Slight noise.
	23 0	23 10 s.	,, .	Do.
,, 2 .	8 20	10 ,,	,, .	Feeble sound.
,, 3 .	2 30	1 m.	Smart .	
	21 35	20 s.	Slight .	No sound.
	22 0	10 ,,	,, .	Preceded by a loud sound.

Date.	Time.	Duration.	Severity.	Remarks.
Oct. 5 .	21 5	10 s.	Slight .	Preceded by a loud noise.
,, 6 .	...	...	.....	A slight shock between 8 and 10 A.M.
	14 0	15 ,,	Slight .	
	15 30	10 ,,	,, .	
*	*	*	*	* * * * *
,, 20 .	22 30	5 ,,	Feeble .	Preceded by a loud rumbling sound.
,, 24 .	8 15	10 ,,	Smart .	Sudden. No sound.
,, 27 .	14 15	30 ,,	,, .	Sound before shock.
,, 29 .	12 45	1 m.	,, .	Do. do.
	14 30	40 s.	Slight .	No sound.
	17 30	40 ,,	Smart .	Do.
30 .	7 0	1 m.	,, .	Shock preceded sound. The latter (which was considerable) increased as the shock increased.
	17 35	10 s.	Feeble .	Feeble sound.
,, 31 .	8 15	40 ,,	Slight .	Do.
Nov. 1 .	20 30	10 ,,	Feeble .	Sound very plain.
,, 2 .	21 55	30 ,,	Smart .	A series of upwards jerks coming on suddenly without sound.
	22 10	3 ,,	Feeble .	Distinct sound.
,, 3 .	21 20	15 ,,	Smart .	No sound.
	22 15	5 ,,	Feeble .	Preceded by sound.
	22 40	5 ,,	,, .	Do. do.
,, 4 .	9 55	10 ,,	...	A loud rumbling like distant thunder, but no appreciable shock.
	21 0	10 ,,	Slight .	A loud rumbling sound accompanied it.
,, 5 .	20 20	...	...	A rumbling noise without a shock.
	21 0	10 ,,	Feeble .	Loud noise.
,, 7 .	11 55	10 ,,	Slight .	Slight sound.
,, 9 .	12 35	15 ,,	,, .	No sound.
,, 10 .	...	...	...	Between 7 and 11 P.M. 2 slight shocks.
,, 11 .	21 45	50 ,,	Sharp .	Slight sound.
,, 12 .	6 16	10 ,,	Slight .	Feeble sound.
	17 50	40 ,,	,, .	Sound present.
	19 0	30 ,,	,, .	Do. (feeble).
	19 20	30 ,,	,, .	Do. (louder).
	22 20	...	...	A loud rumbling for about 40 s. No shock.
,, 13 .	19 20	30 ,,	Slight .	Accompained by a loud rumbling sound.
,, 17 .	0 5	50 ,,	Sharp .	No sound. Two shocks, first weaker and shorter, the other following quickly.
	25 25	40 ,,	Slight .	Slight sound.
,, 24 .	18 30	1 m.	Sharp .	Do.
	22 0	40 s.	Feeble .	
	22 30	30 ,,	,, .	
,, 25 .	0 10	50 ,,	Slight .	
	8 30	20 ,,	Feeble .	
	22 30	10 ,,	,, .	Preceded by a sound.
,, 26 .	20 25	5 ,,	,, .	Preceded by a loud noise.
,, 27 .	8 30	20 ,,	Slight .	No sound.
	12 45	15 ,,	,, .	Sound proceded it.
	22 0	40 ,,	,, .	
,, 28 .	5 45	15 ,,	,, .	
	16 20	10 ,,	Feeble .	Preceded by a distinct sound.
	17 40	40 ,,	Slight .	No sound.
,, 29 .	22 35	5 ,,	Feeble .	Loud rumbling sound.
,, 31 .	20 40	20 ,,	,, .	

XIV.

List of aftershocks felt outside the epicentral tract, from 12th June 1897 to 31st May 1898.

This list is intended to include only those earthquakes which were felt outside the epicentral area of the great earthquake of 12th June. The records from the epicentral area, owing to the number of shocks, would swell the list to an inordinate bulk. Besides this, their frequency was so great for some months that in view of unavoidably imperfect time-keeping, it is frequently impossible to decide whether the records from two separate stations refer to a single shock, or to two distinct shocks, each felt at only one of the two stations.

The list is divided into three parts—(1) from 12th June to 15th July, for which period it is very incomplete; (2) from 15th July to 31st December 1897, when a large number of observers having been interested, it is probably as complete as possible, without the use of automatically recording instruments; and (3) from 1st January to 31st December 1898, when, owing to the decrease in the number of shocks, interest was falling off and the record becomes less complete once more, though still much more so than in the first period.

In the first period, besides the records from the epicentral tract, those from Rangpur, Kuch Bihar, and Kaunia are omitted. At these three places it so happened that regular records were being kept, two of which have been printed (*supra* Nos. II, III), and their incorporation would give this small tract of country a misleading prominence in the list, which would be far from representing a really greater predominance of earthquakes. Moreover, as was shown in chapter X, this tract probably lies within or close to the epicentral area, and slight shocks which did not extend far were probably common in it immediately after the great earthquake.

The fragmentary records from Dhubri during this period also have not been included, but are given, like those from Kuch Bihar, etc., in a separate list (No. VI).

From Gauhati a number of earthquakes have been reported that do not seem to have been felt elsewhere. This place does not seem to have been within the epicentre, though it possibly was, but owing to its proximity, a number of small earthquakes appear to have originated near it, especially as time wore on after the great earthquake. They have not been included in the list, except where there is evidence that the earthquake was felt elsewhere too.

This list has been prepared from various sources, comprising (1) returns from all telegraph masters; and (2) from all station masters, covering the few days immediately succeeding the 12th June; (3) newspaper reports; (4) private correspondence addressed to me in response to circulars asking for information regarding the earthquake of 12th June; and (5) postcards which have been sent by numerous correspondents throughout Assam and Northern and Eastern Bengal.

The list is necessarily incomplete, especially for the period between 20th June

and 15th July. By the former date in many cases records had ceased to be kept either on account of the great number or the fewness of the earthquakes, according to the nearness or distance of the station from the epicentre, and before the latter I had not been able to interest a sufficient number of correspondents to ensure an even approximately accurate record.

The authority on which the record is based naturally varies largely in value, but it has not been possible to indicate this in each case without making the list one of unwieldy bulk. It may be taken, however, that in general the authority is sufficiently trustworthy as to the fact of an earthquake having been felt, though the times given vary much in their degree of accuracy.

In the list I have given, first the approximate local time of the shock at its assumed origin in about long. 91° E. ; then follow the stations from which it was recorded, or, in the case of the more extended earthquakes, such selection from them as shows the extent of the shock. Immediately following the name of the place is the time as given in the original record ; local time is indicated by the letters A.M. and P.M., Madras time by the letter m., and in this case the twenty-four hours system is used, *i.e.*, 1 P.M. is 13 h., 11 P.M. is 23 h.

The duration and nature of the shock have not been inserted, as it was found, that, however useful this information was for comparison with other records of the same observer, the standards of different observers varied so much that it was impossible to compare the statements of duration or violence at different stations.

In nearly every case there can be little doubt that the observations grouped together do refer to the same earthquake. In a few cases where two or three widely separated stations are grouped together on the ground of an approximate accordance in time, it is possible that we have to do with two or three small earthquakes approximately coincident in time. In a large proportion of these cases the identity of the shock can be established by reference to the records from the central area.

PART I, 12 JUNE TO 15 JULY.

June 12 . .	17-20	Lalmai, A. B. Ry. (S. Sylhet), 7 min. after first shock.
	17-30	,, A.B. Ry. (S. Sylhet), 16-54 m ; Mirpur E. B. S. Ry. (Nadia), 16-45 m.
	18-40	Tung (Darjiling), about 18 m.
	19-30	Chirirbandar (Dinajpur), 18-54 m ; Rajbari (Faridpur), 18-50 m ; Nadia, 7-35 P. M.; Rangpur, 8-15 P.M.
	20-10	Chapra (Nadia), abt. 8-30 P.M., Rajbari (Faridpur), 8 P.M., Chirirbandar (Dinajpur), 19-30 m ; Maungdaw (Akyab), 19-5 m.
	21-40	Golaghat, 10 P.M.; Chirirbandar, 20-56 m ; Kasba (Tippera), 9 P.M.; Calcutta, 9-30 P. M., also felt at Bansberia (Hugli) and Kustia.
	22-0	Chirirbandar, 21-10 m.
	22-50	Jorhat, 11-10 P.M.; Chapra (Nadia), abt. 11 P.M. ; Kushtia, 10-45 P.M.; Mudpoint, 10-3 m. ; Saugor Island, 10-30 P.M.
		Chanderpura (Sonthal Pargannahs) reports earthquakes frequent through the night, and three times strong enough to wake the recorder.
		Mogok reports shocks through the night.
,, 13 . .	0-15	Rangpur, 12-25 P.M. ; Mirpur (Nadia), 23-30 m ; Rajbari (Faridpur), 23-30 m ; South Sylhet, midnight.

June 13 . . 1-20 Dibrugarh, 0-30 m. ; Sibsagar, 1 A.M., Kohima, 1-20 A.M ; Tezpur, 1-30 A.M. ; Kaunia, 0-30 m ; Darjiling ; Sutna, between 0-30 and 1-0 m ; Berhampur, 1 A.M. ; Suri, 1 A.M. ; Rajmahal, 0-30 m ; Naihati (Hughli), midnight ; Rajbari (Faridpur), 1-30 A.M. ; South Sylhet, 1-30 A.M. ; Kindat, 0-0 m ; Mandalay, 0-15 m.

2-10 Darjiling ; Chirirbandar (Dinajpur), 1-25 m ; Berhampur, 2 A.M.; Dacca, 2 A.M., two shocks ; South Sylhet, 2-30 A.M.; Manipur, 2 A.M.

3-0 Chirirbandar, 2-13 m. ; Berhampur, 3 A.M., decided.

3-55 Darjiling ; Kindat, 3-58 A.M ; Goalundo, 4 A.M. ; Chirirbandar, 3-10 m ; Phultalah (Khulna), 4 A.M. ; Maung daw (Akyab), 3-10 m.

5-0 Jorhat, 5-3 A.M.

5-50 Darjiling, 5-40 A.M.

6-45 Chirirbandar, 6-0 m.

8-40 Golaghat, 9 A.M. ; Kaunia, 8-0 m ; Darjiling, 8 A.M., distinct; Chirirbandar, 8-15 m ; Rajmahal, 8 A.M. ; Kushtia (Nadia), 8-35 A.M. ; Rajbari (Faridpur), 8 A.M. ; Calcutta, abt. 8-30 A.M. ; Dacca, 8-30 A.M. ; Comillah (Tippera), 8 m ; Manipur, 7-45 A.M.

9-20 Darjiling, 9 A.M. ; Kuch Bihar, 9 A.M. ; Kaunia, 8-40 m.

11-0 Golaghat, 11-30 A.M. ; Chanchal (Malda), 10-30 A.M.

At Chanchal there were eleven shocks before 10-30 A.M.; probably all the above were felt there.

12-25 Charali (Tezpur), 12-30 P.M.

12-50 Dibrugarh, 12-20 m ; Sibsagar, 1 P.M. ; Charali (Tezpur), 1-30 P.M. ; Kaunia, 12-12 m ; Kuch Bihar, 1 P.M. ; Darjiling, ; Purniah, midday ; Jamalpur, 12-5 m; Bihar, 12-0 m.; Giridih, 12-40 P.M.; Hazaribagh, 1-0 P.M.; Purulia, 12-15 P.M. ; Bardwan, about noon ; Berhampur, 1 P.M. ; Rajmahal, 1noon ; Hughli, 12-45 P.M. ; Barrackpur, 12-45 P.M. ; Panch Kuru (Midnapur), 1-20 P.M. ; Naldanga (Jessor), 12-35 P.M. ; Phultala (Khulna), 12-30 P.M. ; Rajbari (Faridpur), 1-30 P.M. ; Barisal, 12-52 P.M. ; Dacca, 1 P.M. ; Chittagong, 1 P.M. ; Maungdaw (Akyab), 12-15 m ; Akyab, no time ; Fort Aijal, 1-21 P.M. ; Manipur, 1-15 P.M.; Wuntho (Upper Burma), 13-20 ; Paletwa (Akyab), at midday.

A shock is reported from Mogok at 12-15 noon ; unless the time is very much out, this must have come from a different centre.

14-0 Dibrughar, 13-0 m ; Sibsagar, 2 P.M.

14-20 Sibsagar, 2-30 P.M. ; Jorhat, abt. 2-2 P.M. ; Rangpur, 2-10 P.M.

14-30 Jorhat, abt. 2-40 P.M.

15-40 Sutna, abt. 15-0 m. This must be from a different centre or the time very much in error.

17-10 Kaunia, 16-25 m ; Kuch Bihar, 4-45 P.M. ; Dakshinbagh, A. B. Ry. (S. Sylhet), 16-23 m ; Darjiling, 5 P.M.

19-30 Rangpur, 7-20 P.M.; Rajmahal, 8 P.M.

21-35 Rangpur, 9-20 P.M. ; Chittagong, 9-30 P.M.

22-45 Kaunia, 22-10 m ; Rajmahal, 10 P.M. ; Murshidabad, 10-30 P.M. ; Calcutta, 10-40 P.M. ; Kushtia (Nadia), 10-40 P.M.

June 14 . 0-45 Kaunia, 23-12 m ; Rangpur, 12-17 A.M.; Darjiling, 11 P.M. ; Giridih, 12-40 P.M. ; Gaya, between 11 and 12 P.M.; Chandarpura (Santal Parganas), abt. 1 A.M.; Berhampur, between 11-30 and 12-30 P.M. ; Calcutta, 0-47 A.M. ; Bongong (Jessore), 12-45 P.M. ; Kushtia (Nadia), 12 P.M. ; Goalundo, 12-30 P.M. ; Kasba (Tippera), midnight ; Maungdaw (Akyab), 23·0 m.

2-50 Rangpur, 2 A.M. ; Gham (Darjiling), 2-13 m ; Darjiling, 3 A.M. ; Rajmahal, 2 A.M.

5-45 Jorhat, daybreak ; Dakshinbagh, A. B. Ry. (South Sylhet), 5-0 m.

7-50 Golaghat, 8-15 A.M. ; Kohima, 7-5 m ; Kaunia, 7-12 m ; Kuch Bihar, 7-30 A.M. ; Rangpur, 8-13 A.M. ; Gaya, on Monday morning ; Kushtia (Nadia), 8-8 A.M. ; Hailakandi, 8 A.M.

12-35 Kaunia, 11-50 m ; Rangpur, 12-10 P.M. ; South Sylhet, 1 P.M.; three distinct shocks ; Pinlebu, noon ; (this last probably comes from a different centre).

14-30 Rangpur, 3-15 P.M. ; Darjiling, 2-40 P.M. ; South Sylhet, 4 P.M.

19-55 Kaunia, 18·10 m, ; Berhampur, abt. 7 P.M.

20-10 Darjiling, 8 P.M.

22-30 Kohima, 21-48 m ; Rangpur, 10-7 P.M. ; Saraghat, E. B. Ry., abt. 22-0 m ; Birbhoom, abt. 11 P.M.

Berhampur reports " almost constant tremulous motion " throughout this day. Jorhat reports slight shocks throughout the day.

,, 15 . 3-0 Kaunia, 2-15 m ; Kuch Bihar, 2-30 A.M. ; Rangpur, 3-7 A.M.; Darjiling 3 A.M.

10-0 South Sylhet, 10 A.M.

22-45 Kuch Bihar, 10-45 P.M. ; Ghoom (Darjiling), 22-15 m.

24-0 Kuch Bihar, 11-05 P.M. ; Darjiling, 11-45 P.M.; Narainganj, midnight.

,, 16 . 1-50 Kaunia, 1-2 m ; Darjiling, 1-45 A.M.

2-45 Dakshinbagh, A. B. Ry. (South Sylhet), 2-0 m.

4-40 Kaunia, 3-55 m'; Darjiling, 4-30 A.M.

9-0 ,, 8-13 m ; Jorhat, 9 A.M. ; smart.

12-10 ,, 13-30 m, ; Kuch Bihar, 11-52 A.M. ; Murshidabad, between 11-30 and 12 A.M.

23-50 Kaunia, 23-14 m ; Kuch Bihar, 11-40 P.M. ; Ghum (Darjiling), 22-15 m ; Berhampur, no time ; Dacca, 11-50 P.M.; Kasba (Tippera); abt. 10 P.M. ; South Sylhet, two shocks between 12 and 1 at night.

,, 17 . 2-40 Kaunia, 1-55 m ; Kuch Bihar, 3-10 A.M. ; Rangpur, 2-5 A.M. ; Berhampur, no time ; Dakshinbagh, A. B. Ry. (South Sylhet), 2-0 m.

. 5-10 Kaunia, 4-30 m ; Rampur (Nowgong), 5-30 A.M.

7-10 Murshidabad, 7 A.M.

15-0 South Sylhet, 3 P.M., smart.

22-15 Kaunia, 12-30 ml; South Sylhet, midnight, feeble.

,, 18 . 16-10 Dhubri, 4 P.M. ; Kaunia, 15-44 m ; Darjiling, 4-15 P.M.

18-20 Dhubri, 6-10 P.M. ; Kaunia, 17-46 m ; Kuch Bihar, 6 P.M. Darjiling, 6-15 P.M. ; South Sylhet, 6 P.M.

Murshidabad reports " tremors at intervals. "

June 19	4-50	Dakshinbagh, A. B. Ry. (South Sylhet), 4-0 m.
	6-15	Dhubri, 6-8 A.M.; Kaunia, 5-35 m; Kuch Bihar, 6-18 A.M.; Tung (Darjiling), 5-38 m; Purneah, 5-30 A.M.
	18-4	Kaunia, 8-0 m; Darjiling, 6-15 P.M.
	20-30	Kaunia, 19-30 m; Kuch Bihar, 8-30 P.M.; Ghum, 19-45 m; Noakhali, about 7 P.M.
	22-35	Jorhat, 10-30 P.M.; South Sylhet, 11 P.M.; Silchar, 10-30 P.M.
	15-30	Barrackpur, abt. 3-30 P.M.; slight.

This earthquake, reported by Major H. D. McIntyre, 8th Madras Infantry, does not seem to have been reported from any other station. At 5-15 P.M., a very severe shock was felt at Shillong and throughout the Garo Hills and Lower Assam.

June 20	4-25	Jorhat, 4-30 A.M.
,, 21	0-25	Kaunia, 23-40 m; Ghum (Darjiling), 23-40 m.
	2-0	Dhubri, 1-55 A.M.; Kuch Bihar, 1-20 A.M.; Ghum, about 1-0 m.
,, 22	13-30	Kaunia, 13-0 m; Berhampur, 1-25 P.M.
	19-10	Goalpara, 7-5 P.M; Kaunia, 18-52 m; Darjiling, 18-46 m; Purniah, 6-45 P.M.; Berhampur, 7 P.M., the most severe since 12th; Bardwan, 18-52 m; Calcutta, South Sylhet, 8 P.M.
	22-40	Bardwan, 21-50 m; Bansbaria (Hugli), 12 P.M.; South Sylhet, 11 P.M.
,, 23	2-0	Kaunia, 1-15 m; Sonamganj (Sylhet), 2 A.M.; South Sylhet, 2 A.M.
	5-0	Darjiling, 4-13 m, slight.
	19-30	Kaunia, 18-50 m; Kuch Bihar, 7-5 P.M.; Darjiling, 7-16 P.M.
,, 24	1-50	Jorhat, 2 A.M.
	2-50	,, 3 A.M.
	7-30	Calcutta, 7-20 A.M.(?)
	16-10	Kaunia, 15-33 m; Kuch Bihar, 4-10 P.M; Darjiling, 3-55 P.M.; Berhampur, 4 P.M.; Daragaon (Sylhet), 4 P.M.
,, 25	5-0	Ghum (Darjiling), 4-13 m.
	21-20	Dhubri, 9-11 P.M.; Kuch Bihar, 9-10 P.M.; Berhampur, 9-3 P.M.; Darjiling, 9-10 P.M.
,, 26	19-10	Kohima, 18-30 m, rather severe, dislodged some plaster.
,, 27	6-0	Jorhat, daybreak.
	22-30	Kohima, 21-50 m; Kaunia, 21-55 m; Kuch Bihar, 10-25 P.M.; Jaipur Hat (Bogra), 10-15 m; Berhampur, between 10-30 and 11 P.M.; Calcutta, 10-19 P.M.
,, 28	1-30	Lakhimpur, 1-30 A.M.
	3-20	Jorhat, 3-30 A.M; Kuch Bihar, 3-10 A.M.
	15-50	Jorhat, 4 P.M.; Kuch Bihar, 3-43 P.M.
July 2	11-20	Jorhat, 11-30 A.M.; Kaunia, 10-29 m; Naraingani, 11-30 A.M.
,, 4	19-50	Baxa, 19-6 m.
,, 7	21-10	Kuch Bihar.
,, 8	8-10	Kaunia, 7-15 m; Dewan Hat (Rangpur), 7-23 m, very distinct, waves of ground quite visible; Kuch Bihar, 7-45 A.M., smart; Berhampur, about 8 A.M.
,, 9	13-0	Kaunia, 12-15 m.; Kuch Bihar, 12-50 P.M.; Jaipur Hat (Bogra), 12-25 P.M.; Murshidabad, 12-45 P.M.
,, 10		Two shocks in the afternoon at Nilphamari.
,, 12	11-10	Kaunia, 10-32 m; Kuch Bihar, 11 A.M.; Jaypur Hat (Bogra),

		10-42 A.M.; Berhampur, 11 A.M., a strong suspicion of an earthquake.
July 15	21-0	Bindukuri (Darrang), 8-27 P.M.; Kaunia, 20-20 m; Rangpur, 8-41 P.M., with sound.

PART II.—16 JULY TO 31 DECEMBER 1897.

July 16	5-0	Rangpur, 5 A.M.; Kuch Bihar, 5-30 A.M.
	7-0	,,
	14-50	,, 2-45 P.M.
	17-0	,, 4-52 P.M.
,, 17	14-15	Darrang, 2-15 P.M., violent, but momentary, accompanied by local noise as of subterranean guns; Kuch Bihar, 2-16 P.M.; Rangpur, 2-20 P.M.
		South Sylhet, a long gentle tremor lasting a minute on night of 17th-18th July.
,, 18	16-50	Kaunia, 16-18 m; Rangpur, 4-50 P.M.; Maimansingh, 5 P.M.
	24-0	Kaunia, 23-20 m; Rangpur, 12-30 A.M.; Kuch Bihar, midnight; Munshibazar (Sylhet), 12 midnight.
,, 19	4-30	Jorhat, 4-30 A.M.
	5-30	Kuch Bihar, 5-30 A.M.
	7-0	Sibsagar, 7-5 A.M.; Jorhat, 7 A.M.; Salona (Nowgong), 7 A.M.; Tezpur, 6-45 A.M.; Kuch Bihar, 6-40 A.M.; Rangpur, 6-45 A.M.; Bogra, 6-48 A.M.; Maimansingh, 7 A.M.; Munshibazar (South Sylhet), 7-20 A.M.
	8-0	Maimansingh, 8 A.M.
	11-0	,, 11 A.M.
	11-30	Kuch Bihar, 11-30 A.M.; Rangpur, 11-30 A.M., with sound; Dinajpur, 11-30 A.M.
	11-40	Kaunia, 11 m.
	13-45	Rangpur, 1-45 P.M.; Munshibazar, 1-30 P.M., feeble.
	20-30	Kuch Bihar, 8-30 P.M., smart; Rangpur, 8-25 P.M.; Dinajpur, 8-30 P.M., 2 smart shocks; Bogra, 8-30 P.M.; Sajirganj, 8-40 P.M.; Maimansingh, 8-43 P.M.
	22-15	Kaunia, 21-30 m.
	23-0	Munshibazar, 11 P.M.
,, 20	5-45	Darjiling, 5-45 A.M.; Dinajpur, 6 A.M.; Bogra, 6 A.M.
	6-45	Salona (Nowgong), 7-5 A.M.; Tezpur, 6-45 A.M.; Kaunia, 6-15 m; Rangpur, 6-27 A.M.
	8-30	Sirajganj, 8-30 (?) A.M.
	10-0	Maimansingh, 10 A.M.
	12-45	,, 12-45 P.M.
	13-50	Rangpur, 1-44 P.M.
	20-15	Maimansingh, 8-15 P.M.
	21-30	Darjiling, 9-35 P.M. (?)
	22-30	Maimansingh, 10-30 P.M.
,, 21	7-0	Maimansingh, 7-10 A.M.
	9-30	Dinajpur, 9-30 A.M.
	12-0	Maimansingh, 12 (noon).

July 21	14-15	Maimansingh, 2-15 P.M.
	14-30	Haldibari (Kuch Bihar), 13-55 m; Kuch Bihar, 2-30 P.M. Rangpur, 2-35 P.M.; Dinajpur, 2-30 P.M.
	21-30	Kuch Bihar, 9-30 P.M.; Rangpur, 9-25 P.M.; Baxa Duars, 9-30 P.M; Darjiling, 9-45; P.M.; Haldibari, 20-55 m; Dinajpur, 9-30 P.M.; Sirajganj, 9-30 P.M.
,, 22	0-30	Rangpur, 0-23 A.M.
	6-30	Haldibari, 5-40 m.
	9-0	Maimansingh, 9 A.M.
	20-0	,, 8 P.M.
	22-30	Rangpur, 10-35 P.M.; Dinajpur, 11 P.M.
	23-55	,, 11-30 P.M.; Kuch Bihar.
,, 23	7-0	Maimansingh, 7 A.M.
	9-0	,, 9 A.M.
	11-30	Rangpur, 11-26 A.M.
	12-0	,, 12.
	16-0	Kuch Bihar, 4 P.M.; Sirajganj, 4 P.M.
	16-30	Rangpur, 4-33 P.M.; Maimansingh, 4-30 P.M.
	21-30	Kaunia, 20-53 m.; Rangpur, 9-29 P.M.
,, 24	6-0	Maimansingh, 6 A.M.
	9-15	Rangpur, 9-12 A.M.
	9-45	Maimansingh, 9-45 A.M.
	10-0	Kaunia, 10 m.
	11-0	Kuch Bihar, 10-50 A.M.; Rangpur, 11 A.M.; Comillah, 11 A.M
,, 25	9-30	Maimansingh, 9-30 A.M.;
	11-0	,, 11 A.M.
	12-15	Dhubri, 12-15 P.M.; Kuch Bihar, 12-10 P.M.; Rangpur, 12-14 P.M.; Mymensing, 12-15 P.M.
	12-20	Dhubri, 12-20 P.M.
	13-30	Comillah, 1-35 P.M.
	16-15	Maimansing, 4-15 P.M.
	21-40	Dhubri, 9-40 P.M.
	22-0	,, 9-55 P.M.; Bogribari (Goalpara), 10-30 P.M.
,, 26	3-0	Kuch Bihar, 3 A.M.
	3-5	Bijni (Goalpara), 3 A.M.; Dhubri, 3-45 A.M.; Rangpur, 3-43 A.M.; Baxa Duars, 3-42 A.M., severe, movement in long waves; Alipur Duars, 3 or 4 A.M.; Darjiling 3-40 A.M.; Jalpaiguri, 4 A.M.; Dinajpur, 3-45 A.M.; Berhampur, about 4 A.M.
	4-15	Comillah, 4-15 A.M.
	6-20	Bogribari (Goalpara), 5-40 A.M.; Maimansingh, 6-20 A.M.
	8-15	Nowgong, 8-15 A.M.
	10-0	Maimansingh, 10-15 A.M.
	12-0	Darjiling, noon.
	16-30	Rangpur, 4-25 P.M.; Maimansingh, 5 P.M.
	18-30	Maimansingh, 6-40 P.M.
	20-30	Kaunia, 19-50 m.
	21-30	Baxa Duars, 9-30 P.M.; Comillah, 9-35 P.M.
	22-30	Bijni, 10-45 P.M.; Dhubri, 10-25 P.M.; Rangpur, 10-25 P.M.; Haldibari, 22 m; Dinajpur, 10-30 P.M.; Maimansingh, 10-30 P.M.
	22-10	Haldibari, 22-0 1 A.M.
,, 27	1-0	Maimansingh, 1 A.M.

July 27	5-30	Kaunia, 5 m; Jaintiapur, 5-30 A.M. and 5-35 A.M.
	7-45	Rangpur, 7-45 A.M.
	9-0	Bijni, 9 A.M.; Bogribari (Goalpara), 9 A.M.
	10-0	Gauripur, 10-20 A.M.
	14-20	Rangpur, 2-11 P.M.
	9-30	Darjiling, 7-30 P.M.
	22-30	Singribari, 11 P.M.; Mangaldai, 10-48 P.M.; Bogribari, 10-25 P.M.
	24-0	Munshibazar (Sylhet), midnight, feeble, "Barisal guns" heard immediately before.
,, 28	12-0	Dhubri, 12-20 P.M.; Kuch Bihar, 12-10 P.M.; Rangpur, 12-9 P.M.; Darjiling, 12-10 P.M.; Dinajpur, 11-50 A.M.; Bogra, noon; Sirajganj, 12-20 P.M.; Comillah, noon; Jaintiapur, noon.
	12-30	Rangpur, 12-30 P.M.
	14-0	Bogribari, 2 P.M.
	18-0	Singribari, 6-10 P.M.; Bogribari, 5 P.M., slight; Bijni, 6 P.M.
,, 29	1-0	Rupsi (Goalpara), 1-5 A.M.
	3-30	Gauripur (Goalpara), 3-30 A.M.; Alipur Duars, 2 or 3 A.M.; Darjiling, 3 A.M.
	11-15	Dhubri, 11-15 A.M.
	14-0	Maimansingh, 2 P.M.
	15-30	Mangaldai, 3-40 P.M.
	22-30	Bogribari, 11 P.M.
,, 30	0-15	Bogribari, 0-15 A.M.
	2-15	Mangaldai, 2-25 A.M., Dacca, 2-15 A.M.
	2-45	Borjuli (Tezpur), 2-45 A.M.; Mangaldai, 3-20 A.M.; Singribari, 3 A.M.; Dhubri, 2-45 A.M.; Bijni, 2-30 A.M.; Kuch Bihar, 2-50 A.M.; Rangpur, 2-45 A.M.; Alipur Duars, 2 or 3 A.M.; Baxa Duars, 2-40 A.M.; movement in long waves.
	3-30	Kaunia, 3-10 m.; Rangpur, 4-5 A.M.; Darjiling, 4-20 A.M.; followed by 2 or 3 others during the night; Maimansingh, 4-10 A.M.
	5-15	Rangpur, 5-15 A.M.
	15-0	Rangpur about 3 P.M.; Comillah, 2-48 P.M.
	16-10	Rangpur, 4-10 P.M.
	20-20	Gauripur, 9 P.M.; Rupsi, 8-35 P.M.
	22-0	Rupsi, 10 P.M.; Dhubri, 10-3 P.M.; Kuch Bihar, 9-54 P.M.
	22-45	Haldibari, 22 m.
,, 31	0-15	Sirajganj, 0-15 A.M.
	1-0	Bogribari, 1 A.M.; Singribari, 1-20 A.M.
	2-0	Rangpur, 1-52 A.M.; Tung (Darjiling), 2-25 A.M.; Sirajgunj, 2-30 A.M.
	3-0	Bijni, 3 A.M.; Kuch Bihar, 3-10 A.M.; Tung (Darjiling), 3-15 A.M.
	4-15	Borjuli (Darrang), 4-15 A.M.; Dhubri, 4-15 A.M.; Rangpur, 4-5 A.M.; Baxa Duras, 3-45 A.M.; Darjiling, 4-5 A.M.; Jalpaiguri, 3-30 (m.?); Bogra, 4 A.M.; Dinajpur, 4 A.M.; Sirajganj, 4-50 A.M.; Faridpur about 4 A.M.; Maimansingh, 4-17 A.M.; Comillah, 4-1 A.M.
	11-0	Mangaldai, 10-40 A.M.
	13-0	Bogribari, 1 P.M.
	17-0	Singribari, 5-22 P.M.; Bijni, 5 P.M.

July 31	23-0	Singribari, 11-10 P.M.
August 1	1-0	Chunsali (Gauhati), 1 A.M.; Bijni, 1 A.M.; Dhubri, 1-25 A.M.
	3-0	Rangpur, 3 A.M.
	4-10	Lackateria (Sylhet), 4-15 A.M.
	4-40	Borjuli (Tezpur), 4-45 A.M., Sonapur (Gauhati), 5 A.M.
	9-0	Dhubri, 9 A.M.
	12-0	Lackateria (Sylhet), 12-5 P.M.
	16-50	Maimansingh, 4-45 P.M.
	18-0	Mangaldai, 6 P.M.; Singribari, 6 P.M.; Bijni, 6 P.M.; Dhubri, 5-30 P.M.
	18-30	Kuch Bihar, 6-31 P.M.
	20-50	Sonapur (Gauhati), 9-10 P.M.; Dhubri, 8-30 P.M.; Gaibhanda (Rangpur), 8-50 P.M.
	22-0	Bordwar, 10 P.M.; Gaibhanda, 9-55 P.M.
,, 2	3-0	Lackateria (Sylhet), 3 A.M.
	12-30	Bogribari, 12 A.M.
	14-0	Dhubri, 2 P.M.
	15-30	Rangpur, 3-25 P.M.
	21-0	Tinsukia (Dibrugarh), 9-30 P.M.; Dibrugarh, 9-25 P.M.; Lakhimpur, 9-15 P.M.; Sibsagar, 9-17 P.M.; Jorhat, 9 P.M.; Nowgong, 9 P.M.; Borjuli (Tezpur), 9 P.M.; Bijni (Gopalpara), 8-30 P.M.; Dhubri, 9 P.M.; Kuch Bihar, 9 P.M.; Jalpaiguri, 8-53 P.M.; Darjiling, 8-57; Guntok, 8-45 P.M.,; Dinajpur, 8-30 P.M.; Rampur Boalia, no time; Bhagalpur, 9-1 P.M.; Berhampur, 9-54 P.M.; Burdwan 8-55 P.M.; Calcutta 8-58 P.M.; Bogra, 9 P.M.; Manikganj, 9 P.M.; Sirajganj, 9-5 P.M.; Maimensingh, 9-15 P.M.; Narainganj, 9-10 P.M.; Comillah, 9-10 P.M.; Sylhet, 9-30 P.M.; Munshibazar (Sylhet), 9-6 P.M.; Silchar, 9 P.M.; Katlicherra (Cachar), 9 P.M.
	21-25	Sonapur (Gauhati), 10 P.M.; Singribari (Darrang), 10-7 P.M.; Dhubri, 10 P.M.; Kuch Bihar, 9-57 P.M.; Dam Dim, about 10 P.M.; Darjiling, 9-55 P.M.; Dinajpur, 9-30 P.M.; Bogra, 10 P.M.; Panibari (Sirajganj), about 10 P.M.; Sonamganj, 9-27 P.M.; with "Barisal Gun."
	22-30	Bijni, 10 P.M.; Dhubri, 10-28 P.M.; Hathikoda (Alipur Duars), 10-35 P.M.
	23-0	Bijni, 11 P.M.; Bogribari, 11 P.M.
	23-45	Kuch Bihar, midnight; Pankabari, between 12 and 1; Sonamganj, 11-41 P.M., Rampore (Cachar), 11-52 P.M.
,, 3	2-20	Rampore (Cachar), 2-18 A.M.; Silchar, 2-30 A.M.; Dhubri, 2 A.M.
	3-30	Silchar, 3-30 A.M.
	4-15	Sonamganj, 4-19 A.M., with "Barisal Gun."
	5-30	Udarband (Cachar), 5 A.M.
	9-0	Tamar Hat, 8-55 A.M.; Rangpur, 9 A.M.
	10-30	Bijni, 11 A.M.; Dhubri, 10-30 A.M.
	11-15	Bijni, 11-15 A.M.; Bogribari, 11-20 A.M.
	12-10	Lackateria (Sylhet), 12-10 P.M.
	14-40	Sonapur (Gauhati), 2-45 P.M.
	16-40	Mangaldai, 5 P.M.
	18-0	Mangaldai, 6-15 P.M., Lackateria (Sylhet), 6-30 P.M.
	21-0	Kalaigaon (Mangaldai), 9-5 P.M.; Singribari, 9-15 P.M.; Bijni,

August 3		9-15 P.M.; Dhubri, 9 P.M.; Kuch Bihar, 9-5 P.M.; Jalpaiguri, 8-30 P.M.; Alipur Duars, 8-30 P.M.; Bogra, 8-30 P.M.
	21-15	Kohima, 9-25 P.M.; Messa 9-15 P.M.; Kalaigoan, 9-20 P.M.; Singribari, 9-40 P.M.; Sonapur, 9-15 P.M.; Bijni, 9-20 P.M.; Dhubri, 9-23 P.M.; Kuch Bihar, 9-20 P.M.; Rangpur, 9-15 P.M.; Darjiling, 9-19 P.M.; Jalpaiguri, 9-30 P.M.; Dinajpur 9 P.M.; Sirajganj, 9-30 P.M.
	22-0	Borjuli, 10 P.M.; Kalaigaon (Mangaldai), 10 P.M.; Dhubri, 10 P.M.
	23-15	Borjuli, 10-30 P.M.; Bengbari, 11-10 P.M.; Dhubri, 11-25 P.M.; Kuch Bihar, 11-22 P.M.; Rangpur, 11-23 P.M.; Alipur Duars, 11-10 P.M.; Jalpaiguri, 10-30 P.M.
	23-30	Alipur Duars, 11-30 P.M.
,, 4	0-30	Bogribari, 0-30 A.M.
	2-30	Bengbari (Darrang), 2-20 A.M.; Bogribari, 2-35 A.M.; Sirajganj, 2-45 A.M.
	3-30	Bengbari, 3-45 A.M.; Rangpur, 3-25 A.M.
	5-0	Sonapur (Gauhati), 5-10 A.M.
	7-0	Sonapur (Gauhati), 6-45 A.M.; Rangpur, 7 A.M.
	9-0	Sonapur, 9-10 A.M.; Bijni, 8 A.M.; Dhubri, 9-10 A.M.; Rangpur, 9 A.M.
	9-15	Dhubri, 9-25 A.M.
	11-5	Dhubri, 11-5 A.M.
	14-0	Bengbari (Darrang), 2 P.M.
	17-30	Mangaldai, 5-30 P.M.
	20-15	Silcuri (Cachar), 8-15 P.M.
	20-50	Dhubri, 9-30 P.M.; Bijni, 9-15 P.M.
	23-0	Dhubri, 11-35 P.M.; Rupsi, 11-7 P.M., Kuch Bihar, 11 P.M.
,, 5	1-0	Bogribari, 1-40 A.M.; Darjiling, 0-30 m.; Lackateria, Sylhet, 1 A.M.
	3-0	Nagri spur (Darjiling), 3 A.M.
	3-15	Sonapur (Gauhati), 3-10 A.M.
	3-30	Rangpur, 3-32 A.M.
	6-10	Rangpur, 6-10 A.M.
	7-15	Bindukuri (Darrang), 7-18 A.M.
	8-15	Shaistaganj, 8-15 A.M.
	12-0	Gauhati, 12-30 P.M.; Bogribari, 1 P.M.
	14-0	Dhubri, 2 P.M.
	14-50	Sonapur (Gauhati), 2-50 P.M.
	16-0	Gauripur, 4-5 P.M.
	19	Gauripur, 7 P.M.
	21-5	Sirajganj, 9-5 P.M.
	22-0	Dhubri, 10-7 P.M., Kaunia, 21-3 M.
	22-30	Dhubri, 10-30 P.M.
,, 6	0-30	Sirajgunj, 0-35 A.M.
	2-0	Bogribari, 1 A.M.; Alipur Duars, 2 A.M.
	3-30	Dhubri, 3.30 A.M.; Kuch Bihar, 3-30 A.M.; Rangpur, 4 A.M.
	4-30	Alipur Duars, 4-25 A.M.
	6-30	Sonapur 6-30 A.M.
	11-0	Kaunia, 10-20 m.
	11-30	Mangaldai, 11-27 A.M.; Sonapur, 11-25 A.M.; Dhubri, 11-30 A.M. Kuch Bihar, 11-25 A.M.; Rangpur, 11-25 A.M.

August 6	12-0	Bijni, 12 A.M.; Dhubri, 11-56 A.M.
	13-0	Kurseong, 12-57 P.M.
	13-30	Gauhati, 1-30 P.M.; Bijni, 1-30 P.M.; Dhubri, 2 P.M.
	19-30	Maimansingh, 7-30 P.M.
	23-0	Bogribari, 11-10 P.M.
,, 7	0-30	Sonapur, 12-50 P.M.; Tung (Darjiling), 0-20 A.M.
	2-0	Gauhati, 2 A.M.; Bijni, 2 A.M.; Pankabari, 2-12 A.M.; Tung, 1-19 A.M.
	5-30	Mangaldai, 5 A.M.; Gauhati, 5-30 A.M.; Bijni, 6 A.M.; Dhubri, 5-30 A.M.; Sonamganj, 5-30 A.M.
	6-15	Salona (Nowgong), 6-20 A.M.; Balipara, 6-15 A.M.; Mangaldai, 6 A.M.; Kuch Bihar, 6 A.M.; Rangpur, 6 A.M.; Alipur Duars, 6-5 A.M.; Sonamganj, 6-30 A.M.; Sylhet, 6-12 A.M.
	8-30	Sonamgannj, 8-30 A.M.
	9-45	Gauhati, 9-40 A.M.; Mangaldai, 9-50 A.M.
	11-0	Mangaldai, 11-5 A.M.; Benghari (Darrang), 10-30 A.M.; Gauhati, 10-55 A.M.
	13-0	Bengbari (Darrang), 1 P.M.; Gauhati, 1-10 P.M.; Sonamganj, 1 P.M.
	20-0	Darjiling, 8 P.M.
	23-20	Maimansingh, 12 P.M.
,, 8	2-0	Sibsagar, 2-15 A.M.
	3-30	Tung (Darjiling) 3 A.M.
	5-30	Rangpur, 5-20 A.M.
	8-45	Gauhati, 8-30 A.M.; Dhubri, 8-45 A.M.
	9-0	Chittagong, 8-55 A.M.
	9-30	Mangaldai, 9-30 A.M.
	11-45	Nowgong, 12-5 (noon); Mangaldai, 11-45 A.M.; Singribar (Darrang), 11-30 A.M.; Sonapur (Gauhati), 11-30 A.M.
	12-50	Lackateria (Sylhet), 12-50 P.M. (?)
	17-0	Bengbari (Darrang), 5 P.M.; Choonsali (Gauhati), 5 P.M.
	18-0	Choonsali (Gauhati), 6 P.M.
	18-15	Gauhati, 7 P.M.; Sonamganj, 7-15 P.M.; Karimganj, 7 P.M.
	18-55	Borjuli (Tezpur), 7-35 P.M.; Mangaldai, 7-15 P.M.; Bengbari (Darrang), 7-30 P.M.; Gauhati, 7-30 P.M.; Bijni, 6-30 P.M.; Bogribari, 7 P.M.; Alipur Duars, 7-30 P.M.; Sylhet, 7-35 P.M.; Munshibazar, 7-40 P.M.
	19-50	Messa (Assam), 8-10 P.M.; Nowgong, 7-50 P.M.; Mangaldai, 7-55 P.M.; Gangkul (Sylhet), 8 P.M.
	22-0	Tung, 9-15 M.
,, 9	3-15	Messa, 3-15 A.M.
	8-0	Chittagong, 7-51, A.M.
	13-0	Alipur Duars, 1-5 P.M., Dhubri, 1-7 P.M.
	14-15	Jamalpur (Maimansingh), 2-15 P.M.
	19-40	Lackateria (Sylhet), 7-40 P.M.; Salona (Nowgong), 7-45 P.M.
	22-0	Dhubri, 10 P.M.
	23-0	Dhubri, 11 P.M.
,, 10	3-50	Berhampur, 4-24 A.M.
	10-30	Gangkul (Sylhet), 10-37 A.M.
	14-0	Rangpur, 1-58 P.M.
	9-20	Gaibanda, 9-20 A.M.
	21-50	Dhubri, 9-55 P.M.; Alipur Duars, 9-45 P.M.

August 12 .	1-30	Gaibanda (Rangpur), between 1 and 2 A.M.; Alipur Duars, 1-30 A.M.
	4-45	Gauhati, 5-2 A.M.; Rangpur, 4-46 A.M.
	10-10	Dhubri, 10-10 A.M.
	11-30	Balipara, 12 A.M.; Dhubri, 11-30 A.M.
	16-0	Dhubri, 4 P.M.
	16-40	Sonapur, 4-40 P.M.; Dhubri, 4-54 P.M.; Alipur Duars, 4-30 P.M.
	17-0	,, 5-5 P.M.; Dhubri, 5-1 P.M.
	22-30	Darjiling, 10-30 P.M.; Tung (Darjiling), 10-48 P.M.
,, 13 .	1-45	Tung, 1-41 A.M.
	2-45	Rangpur, 2-50 A.M.
	3-15	Tung, 3-14 A.M.
	4-30	Rangpur, 4-30 A.M.
	11-30	Dhubri, 11-30 A.M.
	13-30	,, 1-30 P.M.; Sherpur (Maimansingh), 1 P.M.
	14-15	,, 2 P.M.; Netrakona, 2-15 P.M.
	15-0	Choonsali (Gauhati), 3 P.M.; Jamalpur (Maimansingh), 3 P.M.
	17-0	Dhubri, 4-54 P.M.
	18-20	Balipara (Darrang), 6-20 P.M.; Mangaldai, 6-50 P.M.; Gauhati, 6-30 P.M.; Dhubri, 7 P.M.; Alipur Duars, 6-20 P.M.; Kumargram (Jalpaiguri), 7 P.M.; Jamalpur (Maimansingh), 7-17 P.M.; Sonamganj, 6-30 P.M.
	19-30	Gauhati, 7-35 P.M.; 15; Tamar Hat, 7-40 P.M.; Kuch Bihar, 7-35 P.M.
	20-0	Nowgong, 8 P.M.; Mangaldai, 7-35 P.M.; Gauhati, 8 P.M.; Bijni, 8-30 P.M.; Dhubri, 7-53 P.M.; Rangpur, 8-30 P.M.; Sherpur, 19-17 P.M.; Comilla, 8 P.M.
	21-0	Bogribari, 11 P.M.; Rangpur, 8-55 P.M.
,, 14 .	0-40	Gauhati, 1-2 A.M.; Sonamganj, 2-30 A.M.
	1-10	Sonapur (Gauhati), 1-30 A.M.; Bogribari, 1 A.M.; Sonamganj, 1-11 A.M.
	4-15	Balipara (Tezpur), 4-5 A.M.; Sonamganj, 4-15 A.M.
	6-30	Bogribari, 6 A.M.
	9-30	Nowgong, 10-5 A.M.; Rangpur, 9-35 A.M.
	16-30	Dhubri, 4-20 P.M.; Jamalpur (Maimansingh), 4-30 P.M.
	18-0	Alipur Duars, 6-5 P.M.
	20-0	Gauhati, 8 P.M.; Dhubri, 8-10 P.M; Rangpur, 8-10 P.M.; Kumargram (Jalpaiguri); 8 P.M.; Maimansingh, 8 P.M.; Netrakona, 8 P.M.
	20-20	Messa (Assam), 8-20 P.M.; Nowgong, 8-35 P.M.; Balipara, 8-30 P.M.; Gauhati, 8-25 P.M.; Dhubri, 8-30 P.M.; Rangpur, 8-23 P.M.; Alipur Duars, 8-20 P.M.; Tung, 8-17 P.M.; Maimansingh, 8-30 P.M.; Sonamganj, 8-40 P.M.
	22-0	Bengbari (Darrang), 10-15 P.M.; Gauhati, 10-10 P.M.; Sonamganj, 10-2 P.M.; Darjiling, 10 P.M.; Silchar, 9-40 P.M.
	22-30	Gauhati, 10-35 P.M.; Sonamganj, 10-56 P.M.; Sylhet, 10-30 P.M.
	23-45	Kalaigaon (Darrang), 11-45 P.M.; Sonapur, 11-55 P.M.
	24-0	Nowgong, 12-5 A.M. (15th); Gauhati, 0-15 A.M.
,, 15 .	1-0	Nowgong, 1-10 A.M.; Dhubri, 1-19 A.M.; Rangpur, 1-5 A.M.
	2-20	Nowgong, 3-15 A.M.; Gauhati, 2-40 A.M.; Rangpur, 3-30 A.M.; Maimansingh, 3-9 A.M.; Sonamganj, 2-56 A.M.
	4-15	Mangaldai, 4 A.M.; Gauhati, 4-23 A.M.; Kuch Bihar, 4-10, A.M.; Rangpur, 4-5 A.M.; Sherpur, 3-45 A.M.; Sonamganj, 4-29 A.M.

August 15 .	4-40	Gauhati, 4-30 A.M.; Dhubri, 4-40 A.M.; Maimansingh, 4-30 A.M. Sonamganj, 4-40 A.M.
	7-0	Kaunia, 6-30 M.
	9-15	Sonapur (Gauhati), 10 A.M.; Dhubri, 6-15 A.M.
	10-0	Dhubri, 10-45 A.M.
	13-20	Munshi Bazar (Sylhet), 1-20 P.M.
	14-0	Dhubri, 2 P.M.
	13-20	Bogribari, 2 P.M.
	19-0	Choonsali (Gauhati), 7 P.M.
	18-0	Kaunia, 17-30 M.
	21-0	Sonamganj, 10-56 P.M.
,, 16 .	0-20	Gauhati, 12-22 A.M.; Bengbari, 12-25 A.M.; Nowgong, 12-30 A.M.; Maimánsingh, 12-15 A.M.
	2-10	Tung, 1-17 A.M.; Bogra, 2-30 A.M.; Maimansingh, 1 A.M.; Kishorganj, 2 A.M.
	6-0	Gauhati, 6-0 A.M.; Dhubri, 6-0 A.M.; Dinajpur, 5 A.M.
	7-40	Gauhati, 8 A.M.; Dhubri, 8 A.M.; Kuch Bihar, 7-26 A.M.
	12-0	Sylhet, 12 noon.
	14-30	Kalaigaon (Darrang), 2-30 P.M.
	22-45	Gauhati, 10-55 P.M.; Bijni, 11 P.M.; Dhubri, 10-40 P.M.; Rangpur, 10-35 P.M.; Comilla, 10-20 P.M.; Sonamganj, 10-17 P.M.; Sylhet, 11-30 P.M.; Lala (Cachar), 11 P.M.
	1-40	Kalain (Cachar), 2-10 P.M.
,, 17 .	0-20	Lakhimpur, 12-35 P.M.; (of 16th); Kalaigaon (Darrang), 12-15 A.M.; Bengbari, 12-15 A.M.; Gauhati, 0-30 A.M.; Dhubri, 0-2 A.M.; Rangpur, 12-15 A.M; Darjiling, 12-20 A.M.; Sylhet, 0-30 A.M.; Maimansingh, 1 A.M.
	2-0	Kalaigaon, abt. 2 A.M.; Mangaldai, 2-10 A.M.; Bijni, 2 A.M.; Rangpur, 2-30 A.M.; Pankhabari (Darjiling), 1-25 A.M.; Bogra, A.M.; Maimansingh, 2 A M.; Kishorganj, 2 A.M,
	3-10	Tamar Hat (Goalpara), 3-10 A.M.; Bengbari, 4-40 A.M.
	7-0	Maimansingh, 7 A.M.
	12-30	Sirajganj, 12-30 P.M.
	14-30	Bogribari, 2-30 P.M.; Dhubri, 3 P.M.
	23-30	Kuch Bihar, 11-48 P.M.; Tung, 2-23 M.; Maimansing, 11-30 P.M.; Sylhet, 11-30 P.M.
	0-30	Salona (Nowgong), 12-15 A.M.; Gauhati, 0-30 A.M.; Kuch Bihar, 12-10 A.M.
,, 18 .	3-0	Borjuli (Tezpur), 3 A.M.; Gauhati, 3-5 A.M.; Tung, 2-37 A.M.
	6-30	Gauhati, 6-15 A.M.; Dhubri, 6-36 A.M.; Rangpur, 6-24 A.M.; Pankhabari, 6-19 P.M.; Bogra, 6-37 A.M; Nator, 6-30 A.M.; Maimansingh, 6-30 A.M.; Sherpur, 6 A.M.
	7-30	Gauhati, 7-35 A.M.; Bijni, 8 A.M.; Sherpur, 6-30 A.M.
	12-49	Gauhati, 12-50 P.M.; Sonapur, 12-49 P.M.; Sherpur, 11-30 P.M.
	15-0	Netrakona, 3 P.M.
	16-30	Gauhati, 4-40 P.M.; Comilla, 4-35 P.M.; Sylhet, 4-25 P.M.
	22-0	Rangagora, 10-15 P.M.
	23-40	Jorhat, 11-30 P.M.; N. Lakhimpur, 11-30 P.M.; Messa (Nowgong), 11-50 P.M.; Tezpur, 11-44 P.M.; Singribari, 11-30 P.M.; Gauhati, 11-40 P.M.; Dhubri, 11-30 P.M.; Kuch Bihar, 11-30 P.M.; Tung 23-30 m; Dinajpur, 11 P.M.; Kishorganj, abt. 11 P.M.; Sirajganj, 18-30 P.M.; Maimansingh, 11-45 P.M.; Sylhet,

August 18 . 11-45 P.M.; Maulvi Bazar, 11-30 P.M.; Silchar, 21-45 P.M.; Haflong (Cachar), 11 P.M.; Hailakandi, 11-50 P.M.

„ 19 . 1-0 Salona (Nawgong), 12-30 A.M.; Gauhati, 1-5 A.M.; Rangpur, 1 A.M.

2-0 Tung, 1-58 A.M.

4-0 Kuch Bihar, 4 A.M.; Tung, 3-47 A.M.; Gauhati, 5-15 P.M.

5-0 Maimansingh, 5 A.M.

6-30 Tung, 6-29 A.M.

18-30 Sonamganj, 6-30 P.M.; Munshi Bazar (Sylhet), 6-30 P.M.

21-30 Chandkira (Sylhet), 9-30 P.M.

22-30 Borjuli, 10-30 P.M.; Alipur Duars, 10-4 P.M.

23-30 Borjuli, midnight; Kalaigaon (Darrang), 1-15 P.M.; Maimansingh, 11-30 P.M.; Sylhet, 11-27 P.M.; Udarband (Cachar), 11-30 P.M.

An earthquake appears to be recorded on the barograph trace at St. Xavier's College, Calcutta, at about midnight.

„ 20 . 2-0 Kalaigaon (Darrang), 1-30 A.M.; Maimansingh, 2 A.M.; Munshi Bazar, 2 A.M.; Mangaldai, 3-15 A.M.

3-0 Bengbari, 3-15, Kalain (Cachar), 3-20 A.M.

3-40 Nowgong, 3-45 A.M.; Balipara, 4-5 A.M.; Sonapur (Gauhati), 4-10 P.M.; Rangpur, 4-15 A.M.; preceded by low sound; Maimansingh, 3-30 A.M.

16-0 Sonapur, 4-10 P.M.; Sylhet, 4 P.M.; Haflong, 5-10 P.M.

23-50 Comilla, 11-48 P.M.; Bengbari, 11-30 P.M.

St. Xavier's College, Calcutta, barograph trace shows an interruption at midnight.

„ 21 . 1-20 Singribari, 12-30 A.M.; Tezpur, 2 A.M.; Gauhati, 1-25 A.M.; Alipur Duars (Dhubri), 1-5 A.M.; Sonamganj, 1-50 A.M.

3-10 Borjuli, 3-20 A.M.; Gauhati, 3-25 A.M.; Dhubri, 3-10 A.M.

345 Messa (Nowgong), 4-5 A.M.; Tezpur, 3-45 A.M.; Borjuli (Tezpur), 3-15 A.M.; Singribari, 3-10 A.M., Dhubri, 3-36 A.M.; Rangpur, 4 A.M.; Maimansingh, 4 A.M.; Sylhet, 3-45 A.M.

7-0 Bogribari (Dhubri), 7-15 A.M.

9-30 Kalaigaon (Darrang), 9-30 A.M.

11-0 Bengbari, 11 A.M.; Gauhati, 11-10 A.M.; Bijni, 10.A.M.; Dhubri, 10-55 A.M.; Kuch Behar, 11 A.M.; Rangpur, 10-43 A.M.; Maimansingh, 11-30 A.M.; Sylhet, 10-55; Hailakandi, 11-35 A.M.

12-30 Balipara, 12-20 P.M.

14-0 Salona (Nowgong), 2 P.M; Borjuli (Tezpur), 1-45 P.M.; Sonapur, 2 P.M.; Sirajganj, 2 P.M.

15-30 Rangagora, 3-25 P.M.; Messa (Nowgong), 3-37 P.M.; Gauhati, 3-25 P.M.; Bindukuri (Darrang), 4 A.M.; Bijni, 2-30 P.M.; Dhubri, 2-30 P.M.; Alipur Duars, 3-20 P.M.; Maimansingh, 3 P.M.; Sylhet, 3-35 P.M.; Chandkira,(Sylhet); Haflong, 2-58 P.M.

17-50 Balipara, 6-10 P.M.; Sonapur, 5-50 P.M.; Gauhati, 5-55 P.M.

21-30 Kalaigaon, 9-30 P.M.; Bijni, 10 P.M.

22-0 Chandkira, 9-30 P.M.

22-30 Bengbari, 10-30 P.M.

23-0 Silchar, 11 P.M.

„ 22 . 2-30 Mangaldai, 2-35 A.M.; Singribari, 3-45 A.M.; Gauhati, 3-20 A.M.; Bogribari, 2-45 A.M.; Maimansingh, 2-31 A.M.; Munshi Bazar, 2-45 A.M.

7-40 Kaunia, 7-0 A.M.

August 22	9-0	Kurigram (Rangpur), 9 A.M.
	12-0	Jorhat, 11-45 A.M.; Gauhati, 12-14 P.M.; Rangpur, 12-15 P.M.
	12-45	Rangpur, 12-45 P.M.
	14-45	Jorhat, 2-50 P.M.; Nowgong, 2-50 P.M.; smart; Borjuli, 3-15 P.M.; Singribari, 3-45 P.M.; Gauhati, 3-35 P.M.; Dhubri, 2-35 P.M.; Tung (Darjeeling), 14-50, P.M.; Sirajganj, 2-30 P.M.; Kishorganj, 2 P.M.; Sylhet, 2-48 P.M.; Maulvi Bazar, 2 P.M.; Silchar, 3 P.M.; Hailakandi, 3 P.M.; Haflong, 2-16 P.M.
	17-0	Dhubri, 5-6 P.M.
	23-30	Nowgong, 11-20 P.M.; Gauhati, 11-30 P.M.
,, 23	1-10	Sirajgunj, 1-10 A.M.
	2-30	Gauhati, 2-45 A.M.; Bengbari, 5-15 A.M.; Rangpur, 2-25 A.M.
	6-0	Dhubri, 5-59 A.M.
	10-0	Sonapur, 10 A.M.
	14-0	Sonamganj, 2-5 P.M.; Silchar, 1-45 P.M.
	18-0	Kalaigaon (Darrang), 5-50 P.M.; Mangaldai, 6-2 P.M.; Gauhati, 6-10 P.M.; Bengbari, 5-40 A.M.
,, 24	3-0	Sherpur, 3-20 A.M.
	11-30	Mangaldai, noon; Bijni, 11 A.M.
	15-0	Chandkira, 3 P.M.
	19-0	Gauhati, 7 P.M.; Bogribari, 6-30 P.M.; Bijni, 6-30 P.M.
	21-30	Dhubri, 9-28 P.M.; Bogribari, 9-30 P.M.; Alipur Duars, 10-10 P.M.
	22-0	Haflong (Cachar), 9 P.M.; Kalain (Cachar), 10-40 P.M.
,, 25	3-0	Tung, 3-4 A.M.
	3-30	Tung, 3-25 A.M.
	7-0	Kalaigaon (Darrang), 7 A.M.
	12-0	Dhubri, 12-15 P.M.
	12-10	Dhubri, 12-20 P.M.
	15-0	Sonapur, 3-30 P.M.; Gauhati, 2-20 P.M.; Dhubri, 3 P.M.
	18-30	Gauhati, 6 P.M.; Dhubri, 6-50 P.M.
	18-40	Dhubri, 7-0 P.M.
	21-0	Gauhati, 9 P.M.; Dhubri 9-40 P.M.
	22-0	Gauhati, 10 P.M.; Dhubri, 9-55 P.M.
	23-30	Maimansingh, 12 P.M.; Munshi Bazar, 11-30 P.M.
,, 26	1-30	Rangagora (Dibrugarh), 1-30 A.M.; North Lakhimpur, 1-20 A.M.
	4-10	Gauhati, 4-10 A.M.; Dhubri, 3-45 A.M.
	5-30	Munshi Bazar (South Sylhet), 5-30 A.M.
	18-45	Kalain (Cachar), 6-45 P.M.
	20-0	Gauhati, 8 P.M.; Comilla, 8-18 P.M.
	22-30	Dhubri, 10-25 P.M.
	23-30	Sylhet, 11-40 P.M.
	23-45	Tung, 11-46 P.M.
,, 27	0-30	Gauhati, 12-10 A.M.
	9-0	Bijni, 9 A.M., Dhubri, 9-15 A.M.
	11-0	Sonapur, 11-10 A.M.; Gauhati, 11 A.M.; Dhubri, 11-13 A.M.; Kuch Bihar, 11-0 A.M.; Rangpur, 11-6 A.M.; Bogra, 11 A.M.; Sirajganj, 11-15 A.M.; Kishorganj, 11-30 A.M.; Munshi Bazar (Sylhet), 11 A.M.
	11-30	Gaibanda, 11-30 A.M.; Netrakona, 12.
	16-30	Salona (Nowgong), 4-40 P.M.; Nowgong, 4-40 P.M.; Singribari, 3-45 P.M.; Gauhati, 4-40 P.M.; Dhubri, 4-35 P.M.; Rangpur, 4 P.M.

August 27	18-0	Mangaldai, 6 P.M.
	19-0	Sonapur, 6-45 P.M. ; Gauhati, 7-20 P.M. ; Bijni, 7 P.M.
	22-30	Bijni, 11 P.M. ; Gaibanda, 10 P.M. ; Netrakona, 10-30 P.M.
,, 28	0-45	Badlipar (Sibsagar), 12-50 A.M.,
	2-30	Rangpur, 2-30 A.M. ; Tung, 1-55 m ; Sherpur (Maimansingh), 2-10 A.M. ; Bogra, 3 A.M.
	4-0	Dhubri, 4-11 A.M. ; Kuch Bihar, 4 A.M. ; Tung, 2-46 m ; Darjiling, 4-10 A.M. ; Sonamganj, 3-50 A.M.
	4-45	Rangpur, 4-50 A.M. ; Jamalpur (Maimansingh), 5 A.M.
	6-45	Singribari, 7 A.M. ; Gauhati, 6-30 A.M. ; Bijni, 7 A.M., Dhubri, 6-42 A.M. ; Kuch Bihar, 6-30 A.M. ; Rangpur, 6-50 A.M.
	8-0	Nowgong, 7-58 A.M.
	8-30	Bijni, 8 A.M. ; Rangpur, 8-30 A.M.
	11-0	Rangpur, 11-30 A.M. ; Nator, 11 A.M.
	14-50	Sonapur, 2-35 P.M. ; Bijni, 1-45 P.M. ; Dhubri, 1-55 P.M. ; Kuch Bihar, 2-50 P.M.
,, 29	5-30	Tamar Hat (Goalpara), 5-57 A.M. ; Dhubri, 5-20 A.M.
	7-0	Nowgong, 6-52 A.M. ; Bengbari (Darrang), 7-12 A.M. ; Gauhati, 7-30 A.M. ; Bijni, 8 A.M. ; Dhubri, 7-10 A.M. ; Kuch Bihar, 7 A.M. ; Rangpur, 7-15 A.M. ; Darjiling, 7-5 A.M. ; Bogra, 7-2 A.M. ; Nator, 7-0 A.M. ; Dinajpur, 7 A.M. ; Berhampur, 7-5 A.M. ; Goalundo, 7 A.M. ; Maimansingh, 7 A.M. ; Sonamganj, 6-30 A.M.
	8-30	Gauhati, 8-30 A.M, ; Dhubri, 8-30 A.M.
	10-0	Gauhati, 10 A.M. ; Bijni, 10 A.M. ; Dhubri, 10-8 A.M. ; Rangpur, 10-6 A.M. ; Dhubri, 11-15 A.M.
	15-30	Nowgong, 3-35 P.M, ; Singribari, 4-9 P.M. ; Gauhati, 3-55 P.M. ; Bijni, 2-10 P.M.
	17-0	Rangpur, 4-50 P.M.
	19-30	Kalaigaon (Darrang), 7-30 P.M. ; Singribari, 7-51 P.M. ; Gauhati, 7-15 P.M. ; Bijni, 7 P.M. ; Dhubri, 7-30 P.M. ; Rangpur, 7-30 P.M. ; Kuch Bihar, 7-30 P.M ; Bogra, 7 P.M. ; Dinajpur, 8 P.M. ; Goalundo, 7-30 P.M. ; Jamalpur, 7-48 P.M. ; Netrakona, 7-45 P.M.
	22-0	Rangagora (Dibrugarh), 10-15 P.M.
	23-30	Gauhati, 11-10 P.M. ; Dhubri, 11-29 P.M. ; slight ; Kuch Bihar, 11-30 P.M. ; Rangpur, 11-32 P.M. ; Sherpur 10-50 P.M. ; Sonamganj, 10-3 P.M.
,, 30	0-10	Haflong (Cachar), 12-10 A.M.
	0-20	,, 12-20 A.M.
	0-22	,, 12-22 A.M. ; Silchar, 12 A.M.
	1-0	Silchar, 1 A.M.
	3-0	Gauhati, 3-10 A.M. ; Dhubri, 2-45 A.M.
	7-0	Bengbari, 7-15 A.M. ; Sonapur, 7-30 A.M. ; Rangpur, 6-30 A.M.
	8-0	Messa, 8 A.M.
	16-15	Bengbari, 4-12 P.M. ; Bijni, 4 P.M. ; Rangpur, 4-45 P.M.
,, 31	0-30	Nator, 12-30 A.M.
	2-0	Gauhati, 2-5 A.M.
	4-30	Sherpur (Maimansingh), 3-50 m.
	6-0	Gauhati, 6-30 A.M. ; Rangpur, 5-30 A.M. ; Maimansingh, 6-30 A.M. ; Netrakona, 5-30 A.M.
	12-0	Kalaigaon (Darrang), 11-50 A.M.
	13-0	Darjiling, 12-45 P.M. ; Kalain (Cachar), 1-5 P.M.

August 31	16 30	Lakhimpur, 4-25 P.M. ; Jorhat, 4-30 P.M. ; Golaghat, 4-40 P.M. ; Nowgong, 4-15; Borjuli, 4-20 P.M. ; Singribari, 4-30 P.M. ; Gauhati, 4-40 P.M.; Dhubri, 4-16 P.M.; Kuch Bihar, 4-15 P.M.; Rangpur, 4-17 P.M. ; Tung, 4-5 P.M. ; Serajganj, 4-15 P.M. ; Habiganj (Faridpur), about 4-30 P.M. ; Maimansingh, 4-25 P.M. ; Sylhet, 4-30 P.M. ; Hailakandi, 4-50 P.M. ; Kalain (Cachar), 4-31 P.M.
	17-0	Nowgong, 5-5 P.M.
	18-15	Bengbari, 6-15 P.M.
	19-0	Sonamganj, 7-2 P.M.
	20-0	Nowgong, 7-55 P.M. ; Gauhati, 8 P.M.
	21-0	Mangaldai, 8-54 P.M. ; Singribari, 9 P.M.; Gauhati, 9-30 P.M.
	22-0	Sonapur, 9-30 P.M. ; Gauhati, 10 P.M.
September 1	2-30	Sonapur, 2-45 A.M. ; Gauhati, 2 A.M.
	4-0	Bengbari, 4 A.M. ; Bijni, 4 A.M. ; Dhubri, 4-1 A.M.
	6-30	Balipara, 6-15 A.M. ; Nowgong; 7-0 A.M.
	8-30	Sherpur (Maimansingh), 7-50 m.
	11-30	Dinajpur, 11-30 A.M.
	14-30	Lala (Cachar), 1 P.M. ; Hailakandi, 2-45 P.M.
	15-20	Balipara, 3-30 P.M.; Mangaldai, 3-20 P.M.; Singribari, 4-30 P.M.; Gauhati, 3-30 P.M.; Dhubri, 3-32 P.M.; Kuch Bihar, 3-20 P.M.; with sound ; Rangpur, 3-25 P.M. ; Kurseong, 4-15 P.M. ; Darjiling, 3-20 P.M. ; Jalpaiguri, 3-25 P.M. ; Rajshahi, 2-30 P.M. ; Bogra, 3-30 P.M. ; Dinajpur, 3-20 P.M. ; Serajganj, 3-15 P.M. ; Maimansingh, 3-15 P.M. ; Sylhet, 3-58 P.M.
	1-0	Tung, 0-55 A.M.
	7-15	Borjuli, 7 A.M.
	9-30	Bogribari, 9-30 A.M.
	9-15	Bogribari, 9-50 A.M.
	11-30	Netrakona, 11-40 A.M.
	14-30	Bindukuri (Darrang), 2-30 P.M. ; Sylhet, 2-30 P.M.
	16-30	Sonapur, 4-30 P.M. ; Sherpur, 15-15 m.
	17-30	Sonapur, 5-25 P.M.
	18-30	Nowgong, 6-30 P.M.
	19-30	Bogribari, 7-35 P.M.
,, 2	20-0	Rupsi, 8-25 P.M. ; Bogribari, 7-50 P.M. ; Rangpur, 7-23 P.M. ; with very loud sound.
	21-30	Rangpur, 9-20 P.M. ; with loud sound.
	20-15	Nowgong, 10-15 P.M.
	20-30	,, 10-30 P.M.
,, 3	1-0	Maimansingh, 1-15 A.M.
	2-0	Singribari, 2-10 A.M. ; Tamar Hat (Goalpara), 1 A.M. ; Rupsi, 2-45 A.M. ; Dhubri, 2 A.M.
	5-0	Rangpur, 5-20 A.M.
	11-30	Masumpur (Cachar), 11-40 A.M. ; Katlicherra (Cachar), about 10 A.M.
	12-0	Rupsi, 11-5 A.M. ; Bogribari, 12 A.M.
	13-0	Silghat, 12-40 P.M. ; Nowgong, 12-40 P.M. ; Tezpur, 1-5 P.M. ; Mangaldai, 12-15 P.M. ; Gauhati, 12-30 P.M. ; Dhubri, 12-30 P.M. ; Kurigram (Rangpur), 10-30 P.M.; Karimganj, 12-30 P.M. ; Chandkhira (Sylhet), 1-25 P.M. ; Silchar, 1 P.M ;

September 3 .		Hailakandi, 2 P.M.; Aijal, 12-48 P.M.; Manipur, 12-56 P.M.
	16-0	Maulvi Bazar (Sylhet), 4 P.M.
	17-0	Rangpur, 5-10 P.M.
	15-0	Serajganj, 3 P.M.
	20-45	Sherpur, 20-0 M.
	21-30	Bogribari, 9-30 P.M.
	22-0	Sylhet, 10-10 P.M.
,, 4 .	2-30	Gauhati, 2-30 A.M., feeble; Bogribari, 2 A.M.
	21-30	Messa, 9-55 P.M.; Kalaigaon (Darrang), 9-10 P.M.; Gauhati, 9-30 A.M.; Tamar Hat, 9-35 P.M.; Bijni, 9-5 P.M.; Dhubri 8-50 P.M. Nagri spur (Darjiling), 9-30 P.M.
,, 5 .	1-30	Mangaldai, 1-30 A.M.; Sonapur, 12-45 A.M.; Gauhati, 1-30 A.M.; Rupsi, 12-2 A M.
	3-30	Dhubri, 3-30 A.M.
	12-0	Gauhati, 12 A.M.; Dhubri, 12 noon; Kurigram 11-45 A.M.
	14-40	Gauhati, 2-0 P.M.; Bogribari, 2 P.M.; Sonamganj, 2-30 P.M.
	22-0	Mangaldai, 10 P.M.
	22-0	Katlicherra (Cachar), 10 P.M.
,, 6 .	0-30	Dhubri, 0-5 A.M.; Netrokona, 1 A.M.; Sonamganj, 0-30 A.M.; Hailakandi, midnight.
	5-30	Sonapur, 5-30 A.M.
	6-0	,, 6 A.M.; Gauhati, 6 A.M.
	8-30	Jorhat, 8-30 A.M.
	13-0	Sylhet, 1-5 P.M.
	21-15	Badlipar (Sibsagar), 9-10 P.M.; a loud rumbling, but no perceptible shock; Sonapur, 9 P.M.; Gauhati, 10 P.M.; Bijni, 10 P.M.; Dhubri, 9-19 P.M.
	22-0	Sonapur, 10 P.M.; Gauhati, 11 P.M.; Kalain (Cachar), 10 P.M.
	23-0	Kurseong, 11 P.M.
,, 7 .	4-30	Sonapar, 4 A.M.; Gauhati, 4-40 A.M.
	8-0	Sonapur, 8 A M.; Bogribari, 8-30 A.M.; Binji, 9 A.M.; Sonamganj, 9 A.M.
	11-15	Rupsi, 11-45 A.M.; Dhubri, 11-20 A.M.
	7-0	Singribari, 4-45 P.M.; Bijni, 5 P.M.
	23-0	Kalain (Cachar), 11 P.M.
	23-15	,, ,, 11-15 P.M.
,, 8 .	6-30	Sonapur, 5-50 A.M.; Gauhati, 6-30 A.M.
	11-30	Rangpur, 11-45 A.M.; Serajganj, 11-30 A.M.
	13-30	Rangpur, 1-30 P.M.
	21-0	Bengbari, 8-56 P.M.; Guahati, 9-5 P.M.; Bogribari, 9-30 P.M.
,, 9 .	6-0	Jaipur, 5-30 A.M., doubtful; Gauhati, 6 A.M.; Sonamganj 6-15 A.M.
	12-0	Bengbari, 12-5 P.M.
	19-0	Nowgong, 7-5 P.M.
	19-15	,, 7-20 P.M.
	20-30	Sonapur, 8-30 P.M.; Bogribari, 8 P.M.
	22-0	Karimganj, about 10 P.M.
	23-0	Kurseong, about 11 P.M.
	23-30	Sonapur, 11-30 P.M.
,, 10 .	2-0	Darjiling, 1-50 A.M.
	3-30	Karimganj, 3-20 A.M.

September 10 .	4-0	Karimganj, 4-10 A M.
	12-30	Benghari, 12-14 P.M. ; Sonapur, 12-45 P.M.
,, 11 .	1-0	Maimansingh, 1 A.M.
	4-30	Sonamganj, 4-30 A.M.
	8-0	Guahati, 8-5 A.M. ; Sonamganj, 8-30 A.M.
	9-15	Sonapur, 9-10 A.M. ; Sonamganj, 9-30 A M.
	10-0	Sonapur, 10-15 A.M.
	12-0	Sonapur, 12-5 P.M.
	13-15	,, 1-15 P.M.
	14-0	Singribari, 1-55 P.M.
	21-30	Sylhet, 10 P.M.; Dullabcherra (Sylhet), 930 P.M.
,, 12 .	0-30	Sonamganj. 12-30 A.M.
	4-0	Sonapur, 4-5 A.M. ; Sonamganj, 4-30 A.M. ; Sylhet, 4-30 A.M.
	6-0	Karimganj, 5-40 A.M.
	8-0	Gauhati, 8 A.M.
	8-30	Bogribari, 9 A.M.
	9-0	Mangaldai, 8-55 A.M. ; Sonapur, 9-30 A.M. ; Tamar Hat, 8-5 A.M. ; Rupsi, 9-4 A.M. ; Bogribari, 9-30 A.M.
	11-30	Sonapur, 11-30 A.M.; Bogribari, 12 noon ; Bijni, 12 noon.
	15-30	Singribari, 3-45 P.M.
	22-45	Darjiling, 10-40 P.M.
,, 13 .	6-0	Singribari, 6-5 A.M.; Gauhati, 6-30 A.M.
	10-30	Mangaldai, 10-30 A.M.; Bijni, 10 A.M.
	12-0	Rangpur, 12 A.M.
	12-0	Sonamganj, 12 A.M.
	15-0	Sonapur, 2-45 P.M. ; Sonamganj, 2 P.M.
	16-0	Sonapur, 4-10 P.M.
	16-30	,, 4-45 P.M. ; Gauhati, 4-30 P.M.
	20-30	Silchar, 8-30 P.M.
	23-30	Borjuli, 11-30 P.M., Bogribari, 12-10 A.M.
,, 14 .	0-30	Bogribari, 12-30 A.M.
	5-0	Gauhati, 5 A.M.; Sonamganj, 4-50 A.M.
	18-30	Dullabcherra, 6-30 P.M.
	14-0	Mangaldai, 7 P.M.
	23-30	Badlipar (Sibsagar). 11-10 P.M.; Silghat, 11-30 P.M.; Nowgong, 11-45 P.M., Borjuli, 11-20 P.M.
,, 15 .	3-0	Sonamganj, 3-30 A.M. ; Karimganj 3 A.M.
	3-5	Karimganj, 3-5 A.M.
	4-0	Singribari, 3-40 A.M.
	7-45	Kalain, 7-50 A.M.
	17-0	Sonapur, 5 P.M.; Gauhati, 5 P.M.; Kalain, 5-20 P.M.
	21	Bijni, 10 P.M. ; Dhubri, 9-10 P.M.
,, 16 .	4-45	Mangaldai, 4-45 A.M.
	10-0	Tung (Darjiling), 9-31 A.M.
	14-30	Kalain, 2-30 P.M.
	17-0	Badlipar (Sibsagar), 4-45 P.M., rumbling, no perceptible, shock.
	18-30	Dhubri, 6-30 P.M.
	19-30	Sonapur, 7-20 P.M. ; Gauhati, 7-20 P.M. ; Bijni, 7-30 P.M.; Dhubri, 7-45 P.M. ; Sonamganj, 6-30 P.M.
	21-0	Bogribari, 9 P.M.
,, 17 .	8-0	Singribari, 8-7 A.M.

September 17 .	21-0	Dhubri, 9 P.M.; Rangpur, 9-30 P.M.; Sherpur 20-4 M.; Jamalpur, 8-45 P.M.
	5-0	Bogribari, 5 A.M.
	8-0	,, 8 A.M.
,, 18 .	11-30	Rupsi, 11 A.M.
	13-45	Nowgong, 1-45 P.M.; Borjuli, 1-40 P.M.; Singribari, 12-30 P.M.; Sonapur, 1-20 P.M.; Gauhati, 1-45 P.M.; Bijni, 1 P.M.; Dhubri, 1-40 P.M.; Maimansingh, 1-15 P.M.; Sonamganj, 1-35 P.M.
	14-30	Kuch Bihar, 2-30 P.M.
	23-45	Badlipar (Sibsagar), 11-45 P.M.
,, 19 .	11-0	Nowgong, 11 A.M.; Mangaldai, 10-35 A.M.; Gauhati, 11-30 A.M.
	12-0	Diwanganj, 12-10 P.M.
	13-30	Gauhati, 1 P.M.; Rupsi, 12-35 P.M.; Dhubri, 1-45 P.M.
	14-45	Borjuli, 2-45 P.M.
	16-30	Bijni, 5 P.M.; Bogribari, 4 P.M.; Kuch Bihar, 4-30 P.M.; Rangpur, 4 P.M.; Sherpur, 15-15 m.
	18-30	Sonapur, 6-45 P.M.; Gauhati, 7 P.M.; Sonamganj, 6-30 P.M.
	23-0	Gauhati, 11 P.M.; Sonamganj, 11-30 P.M.
, 20 .	2-30	Gauhati, 2-30 A.M.; Rupsi, 2-10 A.M.
	7-0	Nalitabari (Maimansingh), 7 A.M.
	11-30	Nowgong, 11 A.M.; Kalaigaon (Darrang), 11 A.M.: Sonapur, 10-35 A.M.; Gauhati, 12 P.M.; Sonamganj, 12 A.M.
	13-30	Bijni, 2 P.M.; Dhubri, 1-40 P.M.; Kuch Bihar, 1-30 P.M.; Jamalpur (Maimansingh), 12-50 A.M.; Sonamganj, 1 P.M.
,, 21 .	20-30	Sherpur, 19-50 m.
	1-30	Narainganj, 1-30 P.M.
	13-0	Dhubri, 1 P.M.
	18-15	Sonapur, 6 P.M.; Gauhati, 6-11 P.M.; Netrakona, 6-15 P.M.; Sonamganj, 7 P.M.; Kalain (Cachar).
	21-15	Sonapur, 9-15 P.M.
	22-15	Sherpur, 21-30 M.
,, 22 .	1-30	Dhubri, 1-20 A.M.
	5-0	Karimganj, 5-10 A.M.
	14-0	Gauhati, 2 P.M.; Bijni, 2 P.M.
	17-0	Singribari, 4-55 P.M.
,, 23 .	0-30	Dhubri, 0-30 A.M.
	2-30	Mangaldai, 9-35 P.M.
	4-30	Borjuli, 4-30 A.M.
	10-30	Bogribari, 10-30 A.M.
	13-0	Bijni, 1 P.M.; Dhubri, 11-18 P.M.
	14-0	Tung, 1-6 P.M.
	14-0	Bijni, 2 P.M.; Bogribari, 2 P.M.
	15-30	Bogribari, 2-3 P.M.
	18-0	Sonapur, 6 P.M.
	21-0	Sonapur, 8-45 P.M.; Gauhati, 9-22 P.M.; Bogribari, 8-30 P.M.
	23-0	Kalain (Cachar), 1-1 P.M.
,, 24 .	1-0	Kalaigaon (Darrang), 2 A.M.; Gauhati, 0-30 A.M.; Dhubri, 0-30 A.M.; Kaunia, 23-40 m. (of 23rd).

September 24 .	4-30	Nowgong, 5 A.M.; Mangaldai, 5-15 A.M.; Gauhati, 4-15 A.M.; Bogribari, 4-20 A.M.; Sonamganj, 4-30 A.M.
	8-0	Bogribari, 8-20 A.M.
	16-0	Sonamganj, 4-15 P.M.
	23-0	Karimganj, 11-14 P.M.
	2-0	Dhubri, 2 A.M.
,, 25 .	3-0	Nowgong, 3 A.M.
	10-0	Bogribari, 10 A.M.; Bijni, 11 A.M.
	16-30	,, 4-30 P.M.
	19-30	Darjiling, 7-40 P.M.
,, 26 .	1-0	Katlicherra 1-10 A.M.
	3-0	Rupsi, 5-40 A.M.
	4-0	Mangaldai, 4 A.M.
	20-30	Bogribari, 8-30 P.M.; Bijni, 8 P.M.
	10-30	Bijni, 10-15 P.M.; Dhubri, 10-40 P.M.
	21-30	Sherpur, 20-40 m.
	2-0	Bogribari, 1-55 A.M.
,, 27 .	3-0	Rangajan, 3-40 A.M.; Gauhati, 2-45 A.M.; Bogribari, 2-30 A.M.; Rangpur, 3 A.M.
	9-45	Dhubri, 9-39 A.M.
	4-45	,, 9-41 A.M.
	16-0	Balipara, 4-20 P.M.; Sonapur, 4-5 P.M.; Rangpur, 3-57 P.M.; Netrokona, 4-11 P.M.; Sonamganj, 4-15 P.M.
	22-0	Nowgong, 10-10 P.M.; Borjuli, 10-30 P.M.; Gauhati, 21-40 m.; Bijni, 11 P.M.; Dhubri, 11-10 P.M.; Kaunia, 21-43 m.; Kuch Bihar, 10 P.M.; Rangpur, 10-8 P.M.; Jalpaiguri, 10-10 P.M.; Tung, 10-16 P.M.; 10-17 P.M.; Bogra, 9-30 P.M.; Nator, 10 P.M.; Dinajpur; Naogaon (Rajshahi), 10-10 P.M.; Berhampur, 10-17 P.M.; Sirajganj, 11 P.M.; Maimansingh, 10-22 P.M.; Sonamganj, 10-50 P.M.; Sylhet, 9-41 P.M.; Habiganj, 10-30 P.M.; Tangail, 10 P.M.
,, 28 .	2-30	Kurigram (Rangpur), 2-30 A.M.
	4-0	Karimganj, about 4 A.M.
	7-0	Balipara, 6-40 A.M.
	9-30	Dhubri, 9 A.M.; Gauripur, 10 A.M.
	22-0	Singribari, 10-45 P.M.; Gauhati, 10 P.M.; Rangpur, 9-40 P.M.; Jalpaiguri, 21-40 m.; Maimansingh, 10-15 P.M.
,, 29 .	10-0	Rangpur, 10 A.M.
	13-30	Dhubri, 1-40 P.M,
	14-0	Sonapur, 2-15 P.M.; Gauhati, 2-20 P.M.; Rupsi, 2 P.M.; Dhubri, 1-40 P.M.
	16-0	Sylhet, 3-15 P.M.; Karimganj, about 4 P.M.; Manipur, 2-55 m.
,, 30 .	11-0	Gauhati, 18-33 m.; Bijni, 8 A.M.; Dhubri, 7-12 P.M.; Rangpur, 7-5 P.M.; Sherpur, 18-30 m.; Netrakona, 9 P.M.
	13-0	Bogribari, 1 P.M.
	17-30	Bogribari, 5-20 P.M.; Bijni, 6 P.M.
	19-0	Dhubri, 7-20 P.M.; Bogribari, 7-10 P.M.; Rupsi, 7 P.M.
October 1 .	1-30	Kalain, 1-30 A.M.
	3-0	Bijni, 3 A.M.; Bogribari, 3-20 A.M.
	4-0	Kalaigaon, 4-10 A.M.; Sonapur, 4-0 A.M.; Gauhati, 3·35 m.
	5-0	Mangaldai, 5-55 A.M.; Gauhati. 4·20 m.; Bijni, 6-3[illegible] A.M.; Dhubri, 4-0 m.; Kuch Bihar, 5-0 A.M.; Sherpur, 4-10 m.

October 1 .	7-30	Gauhati, 6-30 m. ; Bijni, 8 A.M.
	10-15	Gauhati, 9-35 m. ; Bijni 10 A.M. ; Dhubri, 9-30 m.
	11-0	Bogribari, 11 A.M.
	17-0	Dhubri, 4-40 P.M.
	24-0	Munshi Bazar, midnight.
,, 2 .	1-0	Bijni, 1 A.M. ; Bogribari, 2 A.M.
	3-0	Sonapur, 3-0 A.M. ; Tamar Hat, 2-45 A.M. ; Bijni, 4 A.M.
	11-30	Kuch Bihar, 11-35 A.M. ; Rangpur, 11-25 A.M.
	12-0	,, 12-0 noon.
	21-0	Kalaigaon (Darrang), 9-10 P.M.
	18-0	Gauripur, 6 P.M.
,, 3 .	1-30	Gauhati, 1-30 A.M. ; Bijni, 1 A.M. ; Dhubri, 1-30 A.M.
	7-30	Tezpur, 7-57 A.M. ; Gauhati, 6-58 m. ; Dhubri, 6-59 m. ; Kaunia, 7-0 m. ; Kuch Bihar, 7-15 A.M. ; Rangpur, 7-25 A.M. ; Darjiling, 7-25 A.M.
	9-0	Bijni, 9 A.M. ; Gauripur, 10 A.M.
	10-30	Rangpur, 10-25 A.M.
	12-0	Chandkira (Sylhet), noon.
,, 4 .	2-0	Gauhati, 2 A.M. ; Bijni, 2 A.M.
	6-30	,, 6-30 A.M. ; Kurigram, 6-35 A.M.
	8-30	Bogribari, 8-30 A.M.
	10-0	,, 9-30 A.M.
	13-0	Gauripur, 1 P.M.
	16-10	Bijni, 4 P.M. ; Rangpur, 4 P.M.
	19-30	,, 7-30 P.M. ; Dhubri, 18-41 m. ; Sonamganj, 7 P.M.
	20-30	Gauhati, 8-20 P.M. ; Kuch Bihar, 8-30 P.M.
	23-30	,, 22-55 ; Bogribari, 9-30 P.M. ; Rangpur, 11-18 P.M.
,, 5 .	3-0	Dhubri, 3 A.M.
	9-0	Bogribari, 9-9 A.M.
	9-30	,, 9-30 A.M. ; Bijni, 9 A.M.
	9-30	Sirajganj, 9-0 A.M. ; Netrakona, 9-30 A.M.
	10-30	Mangaldai, 11-20 A.M. ; Gauhati, 9-54 m. ; Dhubri, 11 A.M. ; Kuch Bihar, 10-45 A.M. ; Rangpur, 10-17 A.M. ; Sirajganj, 11 A.M.
	12-30	Sherpur, 11-5 A.M.
	17-30	Bogribari, 5-30 P.M.
	20-0	Kurigram, 8 P.M.
	22-0	Gauhati, 10-15 P.M. ; Dhubri, 21-45 m. ; Kuch Bihar, 9-30 P.M. ; Netrakona, 10 P.M.
, 6 .	1-45	Gauhati, 1-5 m. ; Bijni, 2 A.M. ; Dhubri, 1-6 m.
	2-15	,, 1-35 m. ; Dhubri, 1-37 m. ; Sherpur, 2-30 A.M.
	5-0	,, 4-10 m. ; Dhubri, 4-17 m. ; Rangpur, 4 A.M.
	7-30	Rangpur, 7-30 A.M.
	10-0	Gauhati, 10-30 A.M. ; Sonamganj, 10 A.M.
	15-0	,, 3 P.M. ; Rangpur, 3-5 P.M.
	21-30	,, 9 P.M. ; Bijni, 9-30 P.M. ; Kuch Bihar, 10 P.M. ; Darjiling, 10-5 P.M.
,, 7 .	3-30	Dhubri, 3-30 A.M.
	5-30	Rangpur, 5-30 A.M.
	12-0	Gauhati, 12 noon ; Gauripur, 1 P.M.
	17-30	Bogribari, 5-30 P.M.
	1-30	Kaunia, 19-0 m.

October	7	23-0	Sylhet, 11-30 P.M. ; Silchar, 11 P.M.
,,	8	1-15	,, 1-17 A.M. ; Karimganj, about 2 A.M.
		2-30	Dhubri, 2-30 A.M.
		3-30	Sylhet, 3-30 A.M.
		13-30	Rupsi, 1-40 P.M.
		19-0	Bogribari, 7 P.M.
		22-0	Gauhati, 10 P.M. ; Dacca, between 9 and 10 P.M.
,,	9	1-40	Silghat, 2 A.M. ; Nowgong, 1-45 A.M. ; Tezpur, 2 A.M. ; Borjuli, 1-50 A.M. ; Mangaldai, 2 A.M. ; Gauhati, 1-7 m. ; Dhubri, 1-7 m. ; Kuch Bihar, 1-15 A.M. ; Rangpur, 1-35 A.M. ; Jalpaiguri, 1-45 A.M. ; Darjiling, 1-35 A.M. ; Dinajpur, 1-35 A.M. ; Rajshahi, 1-30 A.M. ; Calcutta, 1-40 A.M. ; Sirajganj, 1-45 A.M. ; Dacca, 1-45 A.M. ; Sonamganj, 1-30 A.M. ; Sylhet 2 A.M.
		18-0	Bogribari, 6 P.M.; Bijni, 6 P.M.
		23-30	,, 11-30 P.M.
		2-0	Rupsi, 2 A.M. ; Bijni, 3-30 A.M.
,,	10	3-0	Sylhet, 3-5 A.M.
		4-0	Gauripur, 4 A.M.
		8-0	Gauhati, 8 A.M. ; Bogribari, 7 A.M. ; Kurigram, 8 A.M.
		19-0	Netrakona, 6-30 P.M. ; Sonamganj, 7-26 P.M.
		20-30	Gauhati, 8-30 P.M. ; Dhubri, 8-15 P.M.
,,	11	1-30	Bogribari, 1-40 A.M.
		2-0	,, 2 A.M
		4-30	Tamar Hat, 4-30 A.M.; Bijni, 4 A.M.; Dhubri, 3-50 m.; Kaunia, 3-48 m. ; Kuch Bihar, 5 A.M. ; Rangpur, 4-35 A.M.
		5-30	Dhubri, 5-30 A.M. ; Gauhati, 6-30 A.M.
		10-0	Gauhati, 9-25 m. ; Bijni, 10 A.M.
		12-0	Gauhati, 11-3 m. ; Tamar Hat, 11-55 A.M. ; Bijni, 12 A.M.; Dhubri, 11 A.M. ; Karimganj, midday.
		16-0	Bijni, 5-30 P.M. ; Dhubri, 4 P.M. ; Rangpur, 4-15 P.M.
		24-0	Sirajganj, 11-50 P.M.
,,	12	3-0	Dhubri, 3 A.M.
		21-0	Gauhati, 20-15 m. ; Bogribari, 9-30 P.M. ; Rupsi, 8-58 P.M.; Rangpur, 9-5 P.M.
,,	13	9-30	Bogribari, 9-30 A.M. ; Bijni, 9 A.M.
		15-30	Salona, 3-53 P.M. ; Nowgong, 2-45 P.M. ; Tezpur, 3-30 P.M.; Mangaldai, 3-30 P.M.; Gauhati, 14-46 M.
		16-0	Sylhet, 4 P.M.; Karimganj, 3-45 P.M., Kalain, 4 P.M.
,,	14	2-30	Nowgong, 2-35 A.M. ; Bogribari, 2-10 A.M. ; Tung, 2-4 A.M.; Sirajganj, 2 A.M. ; Dacca, 2-15 A.M.; Brahmanbaria ; (Tippera), 2-45 A.M.; Sonamganj, 2-40 A.M. ; Sylhet, 3 A.M.; Maulvi Bazar, 2-45 A.M. ; Kalain (Cachar), 2 A.M.; Manipur, 1-28 m.
		4-0	Dhubri, 3-45 A.M.
		6-0	Rangpur, 6 A.M.
		9-0	Mangaldai, 9-15 A.M. ; Gauhati, 8-16 m. ; Bijni, 9 A.M.
,,	15	2-15	Kaunia, 1-40 m.
		13-0	Gauhati, 12-43 m.; Bijni, 2 P.M. ; Dhubri, 1 P.m.; Sonamganj, 12-35 P.M.
		24-0	Karimganj, 11-45 P.M.
,,	16	2-0	Bengbari, 2 A.M. ; Dhubri, 2 A.M.

October	16	4-30	Tamar Hat, 4-3 A.M.
		9-0	Bogribari, 9 A.M.
		12-0	Tamar Hat, 11-45 A.M. ; Dhubri, 12-10 P.M. ; Rupsi, 1 P.M.
„	17	6-30	Bijni, 6-30 A.M.; Dhubri, 6-30 A.M.; Kuch Bihar, 6 A.M.; Rangpur, 6 A.M.
		7-30	Dhubri, 7-30 A.M.
		22-0	Gauhati, 9-30 P.M.; Karimganj, 10 P.M.
„	18	1-45	Rangpur, 1-42 A.M.
		6-30	Dhubri, 6-30 A.M.
		11-0	Mangaldai, 10-50 A.M.; Gauhati, 11-20 A.M. ; Bijni, 11 A.M.; Dhubri, 10-31 m.; Rangpur, 11-10 A.M. ; Maimansing, 11-15 A.M. ; Sonamganj, 10-15 A.M. ; Sylhet, 10-30 A.M.
		23-0	Gauhati, 11-0 P.M.; Karimganj, 10 7 P.M.
„	19	20-0	Bijni, 9 P.M.; Dhubri, 8-30 P.M. ; Kaunia, 19-25 m.; Rangpur, 8-5 P.M.
		2-30	Dhubri, 2-30 A.M.
„	20	8-0	Rangpur, 7-45 A.M.
		9-15	Sherpur, 8-45 m.
		15-15	Bogribari, 3 P.M. ; Rangpur, 3-15 P.M.
		20-0	Lakhimpur, 8-5 P.M.
		2-15	Dhubri, 2-15 A.M.
„	21	4-0	Netrakona, 4 A.M.; Dhubri, 3-55 A.M.; Rupsi, 3-25 A.M.
		9-30	Dhubri, 9-30 A.M. ; Bijni, 10 A.M.
		12-30	„ 12-40 P.M.
		14-30	Nowgong, 2-30 P.M. ; Tezpur, 2-15 P.M. ; Borjuli, 2-30 P.M.; Mangaldai, 2-47 P.M.; Bengbari, 2-35 P.M.; Bijni, 2 P.M.; Dhubri, 2-15 P.M.
		15-30	Dhubri, 4 P.M. ; Rangpur, 3-40 P.M. ; Netrokona, 4 P.M.
		26-15	Golaghat, 15-30 m.
		19-0	Dhubri, 6-30 P.M.; Netrakona, 7 P.M.
	22	3-30	Nowgong, 3-30 A.M.; Borjuli, 3-55 A.M.; Bijni, 3 A.M.; Dhubri, 3-7 m; Kuch Bihar, 3-30 A.M.; Rangpur, 3-55 A.M.; Jalpaiguri, 3-45 A.M., Darjiling, 3-45 A.M.; Bogra, 3-50 A.M.; Sherpur, 3-10 m.
		4-0	Tamar Hat, 4-45 A.M.
		5-0	Sonamganj, 5 A.M.
		2-0	Mangaldai, 1-50 A.M.; Gauhati, 2-0 A.M.
		8-30	Dhubri, 8-35 A.M.; Kurigram, 9 A.M.; Rangpur, 8-35 A.M.
		10-30	Salona, 10-40 A.M.; Nowgong, 10-25 A.M.; Mangaldai, 10-30 A.M.; Gauhati, 10-5 A.M.; Dhubri, 10 A.M. ; Sonamganj, 10 A.M. ; Sylhet, 10-33 A.M.
		11-30	Sylhet, 11-30 A.M.
		12-0	Rupsi, 12-30 P.M.; Dhubri, 11-23 m. ; Kuch Bihar, 12 noon.
		16-0	Silghat, 4-30 P.M. ; Nowgong, 4-10 P.M. ; Tezpur, 4-12 P.M. ; Borjuli, 4-31 P.M. ; Mangaldai, 4-26 P.M. ; Bengbari, 4-15 P.M. ; Bijni, 4 P.M.; Dhubri, 15-22 m.; Kuch Bihar, 3-30 P.M. Gaibandha (Rangpur), 3-45 P.M. ; Sirajganj, 4-30 P.M. ; Maimansingh, 4-10 P.M. ; Sylhet, 15-29 m. ; Munshi Bazar, 4-20 P.M. ; Kalain, 4 P.M.
		18-0	Tamar Hat, 6-33 P.M. ; Rupsi, 6-30 P.M. ; Dhubri, 17-24 m.; Kuch Bihar, 6 P.M. ; Rangpur, 5-52 P.M. ; Maimansingh, 6-30 P.M. ; Sherpur, 17-33 m.; Sonamganj, 6-30 P.M.

October	22	22-0	Nowgong, 10-10 P.M.
,,	23	3-0	Tezpur, 2-50 A.M.
		6-0	Bogribari, 6 A.M.
		11-0	,, 11 A.M.
		12-0	Gauhati, 12 A.M. ; Sylhet, 12-30 P.M.
		14-0	Bogribari, 2 P.M.
		14-30	,, 2-30 P.M. ; Bijni, 2-30 P.M. ; Kuch Bihar, 2 P.M.
		23-0	Maimansingh, 11 P.M.; Sylhet, 10-40 P.M.
,,	24	1-40	Rangpur, 1-40 A.M.
		13-0	Sylhet, 1 P.M.
,,	25	1-30	Rangpur, 1-30 A.M.
		6-30	Tinsukhia (Dibrughar), 6-50 A.M. ; Dibrughar, 5-50 A.M.; Jaipur, 7-3 A.M. ; Lakhimpur, 6-25 A.M. ; Sibsagar, 6-45 A.M.; Mokokchoung (Naga Hills), 7 A.M. ; Kohima, 7 A.M.; Golaghat, 5-54 m. ; Nowgong, 6-20 A.M. ; Tezpur, 6 A.M.; Borjuli, 7-37 A.M.; Mangaldai, 6-40 A.M.
		7-0	Sylhet, 6-50 A.M. ; Karimganj, 7-0 A.M. ; Silchar, 7-0 A.M. ; Kalain, 6-35 A.M. ; Udarband, 6-50 A.M.
		9-30	Bogribari, 9-30 A.M.; Bijni, 10 A.M.
		13-30	Lakhimpur, 1-35 P.M.
		17-0	Sylhet, 5 P.M. ; Silchar, 4-10 P.M.
		22-30	Bijni, 11 P.M. ; Dhubri, 22-10 m. ; Kuch Bihar, 10-30 P.M. ; Rangpur, 10-30 P.M.; Tung, 10-31 P.M.; Darjiling, 10-40 P.M.
		24-0	Bengbari, 11-30 P.M.; Bogribari, 11-30 P.M.; Gauhati, 12-0 P.M.
,,	26	2-0	Tamar Hat, 2 A.M.
		10-30	Kurseong, 10-30 A.M.
		19-0	Sylhet, 6-50 P.M.
		21-0	Sonamganj, 9-30 P.M.; Sylhet, 8-50 P.M.
		23-0	Bogribari, 11 P.M.
,,	27	1-30	Karimganj, 1-25 A.M.
		13-0	Gauhati, 1-30 P.M.; Sonamganj, 1 P.M.
		18-0	Netrakona, 6 P.M.
		19-30	Sonamganj, 7-30 P.M.
		21-30	Bogribari, 9-30 P.M.
		22-30	Rangpur, 10-30 P.M. ; Maimansingh, 10-30 P.M.; Netrokona, 11 P.M.
,,	28	7-0	Siliguri, 7 A.M.
		7-30	Bogribari, 7-30 A.M.
		11-0	,, 11-0 A.M.
		13-0	Tung, 12-40 P.M.
		17-0	Sherpur (Maimansingh), 16-35 m.
,,	29	7-0	Sonamganj, 7 A.M.
		13-30	Sylhet, 1-30 P.M.
		17-0	Dhubri, 5 P.M.; Bogribari, 4-30 P.M.
		23-30	Bogribari, 11-30 P.M.
,,	30	1-0	Gauhati, 1 A.M.; Rangpur, 0-30 A.M.
		8-0	Dhubri, 8-10 A.M.; Bogribari, 8 A.M ; Kurigram, 8 A.M.; Kuch Bihar, 8-30 A.M.; Rangpur, 8-22 A.M.
,,	31	1-30	Nowgong, 1-15 A.M. ; Gauhati, 1-30 A.M. ; Sonamganj, 1-30 A.M.; Sylhet, 1-30 A.M.; Karimganj, 2-30 A.M., or before; Munshi Bazar, 1-30 A.M.
		3-0	Silghat, 3 A.M.

October 31 .	9-0	Gauhati, 9 A.M.; Bogribari, 9 A.M.; Rangpur, 9-2 A.M.
	11-0	Mangaldai, 10-50 A.M.
November 1 .	3-30	Bengbari, 3-30 A.M.
	14-30	Jalpaiguri, 2-30 P.M.
	19-0	Bogribari, 7 P.M. ; Chuttia (Darrang), 5 P.M.
	19-30	Kurseong, 7-30 P.M.
,, 2 .	0-30	Katlicherra, between 0-30 and 1 A.M.
	3-30	Kalain (Cachar), 3-30 A.M.
	5-15	Nowgong, 5-14 A.M.; Borjuli, 5-15 A.M.; Mangaldai, 5-0 A.M.; Gauhati, 5-35 A.M. ; Tamar Hat, 5-30 A.M. ; Dhubri, 5 A.M. ; Rangpur, 5-10 A.M.; Jalpaiguri, 5-0 A.M.; Tung (Darjiling), 5-4 A.M. ; Darjiling early morning; Sherpur, 4-27 m.; Kishoreganj, 5-30 A.M.; Sonamganj, 5 A.M.; Sylhet, 5-45 A.M. ; Kalain, 5-30 A.M.
	11-30	Tiphook (Sibsagar), 11-55 A.M.; Nowgong, 11-27 A.M.; Mangaldai, 11-7 A.M.; Bengbari, 11-45 A.M. ; Gauhati, 11-45 A.M. ; Dhubri, 10-52 m.; Rangpur, 11-20 A.M.; Nilphamari, 11-30 A.M.; Dinajpur, 11-30 A.M.; Sherpur, 10-56 m.; Sonamganj, 11-45 A.M.; Kalain, 11-30 A.M.
	12-30	Gauhati, 12-32 P.M.; Tamar Hat, 12-55 P.M.; Dhubri, 11-42 m. ; Rangpur, 12-20 P.M.; Sherpur, 11-50 m.
	13-0	Lakhimpur, 1-7 P.M.; Gauhati, 1-30 P.M.; Dhubri, 1-45 P.M.; Kaunia, 12-42 m.
	23-30	Nowgong, 11-17 P.M.; Mangaldai, 11-20 P.M.; Gauhati, 10 P.M.
,, 3 .	0-30	Sylhet, 0-30 A.M.
	1-0	Borjuli, 1-0 A.M.
	2-0	Rangpur, 2-10 A.M.
	4-0	Gaibandha, 3-45 A.M.
	11-30	,, 11-25 A.M.
	22-0	Dinajpur, 10 P.M.
,, 4 .	1-30	Dhubri, 1 A.M.; Dinajpur, 2 A.M.
	5-0	Rangpur, 4-45 A.M.
	9-30	Bengbari, 9-20 A.M.; Gauhati, 8 P.M.; Tamar Hat, 9 P.M.; Dhubri, 19-47 m., Rangpur, 8-11 P.M.; Jalpaiguri, 19-44 m.; Darjiling, 8-25 P.M.; continuous creakings through the night ; Sherpur, 9-45 m.
,, 5 .	2-0	Mangaldai, 2-10 A.M.
	4-0	Bogribari, 4 A.M.
	11-0	Sylhet, 11-0 A.M.
	22-0	Bogribari, 10 P.M.
	22-30	,, 10-30 P.M.
,, 6 .	4-30	Gauhati, 4 A.M.; Dhubri, 5 A.M.
	16-0	Bogribari, 4 P.M.
	19-30	Sylhet, about 7-30 P.M.
	22-30	Gauhati, 10 P.M.; Rangpur, 11-10 P.M.; Sherpur, 21-50 m. Sylhet, 10-45 P.M.
,, 7 .	0-30	Salona, 0-20 A.M.
	10-0	Tung (Darjiling), 9-57 P.M.
,, 8 .	0-30	Bogribari, 0-30 A.M.
	11-0	Rangpur, 10-40 A.M.
	17-30	Bengbari, 5-45 P.M.; Bogribari, 5-30 P.M.
	21-30	Mangaldai, 9-25 P.M.; Gauhati, 9-30 P.M.
	22-30	Bijni, 10 P.M.; Dhubri, 10-30 P.M.; Rangpur, 10-0 P.M.; Kur-

November 8		seong, 10-30 P.M.; Maimansingh, 10-30 P.M.; Sylhet, 10-45 P.M.; Kalain, 11-12 P.M.
,, 9	5-30	Rangpur, 5-34 A.M.
	8-0	,, 8-0 A.M.
	10-0	Bijni, 10 A.M.; Bogribari, 9-20 A.M.; Kurigram, 10 A.M.; Nator, 10 A.M.
	20-0	Kaunia, 20-0 m.
	23-0	Salona, 11-35 A.M.; Nowgong, 11-8 P.M.; Tezpur, 10 P.M.; Mangaldai, 10-25 P.M ; Gauhati, 11 P.M.; Rupsi, 10-30 P.M.; Dhubri, 10-30 P.M.; Rangpur, 11-10 P.M.; Tung (Darjiling), 10-55 P.M.; Sherpur, 22-40 m.; Maimansing, 10 P.M.; Sonamganj, 11-30 P.M.; Sylhet, 11 P.M.; Habiganj, 11 P.M.; Kalaura (Cachar), about midnight.
,, 10	3-0	Sylhet, 2-45 A.M.
	7-30	Bindukuri (Darrang), 7-30 A.M.
	7-45	Sherpur, 7-10 m.
	12-0	Mangaldai, 12-10 P.M.; Singribari, 11-25 A.M.; Tangail (Cachar), 8-30 P.M.
	21-0	Singribari, 8-30 P.M.; Gauhati, 9 P.M.
	22-0	Kalaigaon (Darrang), 11 P.M.; Tamar Hat, 10-30 P.M.; Dhubri, 9-30 P.M.; Rangpur, 9-30 P.M.; Dinajpur, 9-30 P.M.; Sirajganj, 9-30 P.M.; Maimansingh, 10 P.M.; Sonamganj, 9-30 P.M.
,, 11	12-30	Sherpur, 11 m.
	21-0	Sonamganj, 9 P.M.; Bindukuri, 8-30 P.M.
	23-0	Kaunia, 22-30 m.; Kuch Bihar.
,, 12	2-30	Dhubri, 2-30 A.M.
	15-30	,, 3-30 P.M.
	21-30	Sonamganj, 9-30 P.M.
	23-0	Kalaigaon, 11 P.M.; Gauhati, 11 P.M.; Sylhet, 10-30 P.M.
,, 13	5-0	Nowgong, 4-48 A.M.; Gauhati, 5-30 A.M.
	15-0	Bengbari, 3-15 P.M.; Gauhati, 3 P.M.; Dhubri, 2-30 P.M.
,, 14	12-0	Gauhati, 12 noon; Kalaigaon, 12-15 P.M.
	12-15	Gauhati, 12-10 P.M.; Kalaigaon, 12-30 P.M.
,, 15	4-0	Mangaldai, 4-15 A.M.; Gauhati, 3-30 A.M.
	6-0	Salona, 6-8 A.M.
	24-0	Karimganj, about midnight.
,, 17	1-0	Naogaon (Rajshahi), about 1 A.M.
	11-30	Tamar Hat, 11 A.M.; Bogribari, 12 noon.
	17-30	Dhubri, 5-30 P.M.
	19-0	Bogribari, 7 P.M.
	21-30	Jorhat, 9-30 P.M.; Lakhimpur, 8-57 P.M.; Golaghat, 20-20 m.; Nowgong, 9 P.M.; Tezpur, 9 P.M.; Balipara, 9-30 P.M.; Mangaldai, 9-40 P.M.; Singribari, 9-15 P.M.; Gauhati, 9 P.M.; Tamar Hat, 9-0 P.M.; Rupsi, 9-20 P.M.; Kuch Bihar, 9 P.M.; Rangpur, 8-53 P.M.; Punkhabari, 9-4 P.M.; Tung, 9-2 P.M.; Nator, 10 P.M.; Dinajpur, 9 P.M.; Naogaon (Rajshahi), 8-30 P.M.; Tangail, 9 P.M.; Maimansingh, 9-10 P.M.; Sylhet, 9-30 P.M.; made some brickwork fall; Maulvi Bazar, 9 P.M.; Kalain, 9-30 P.M.; Katlicherra, 9-15 P.M.
,, 18	6-0	Serajganj, 5-45 A.M.
	22-0	Chandkhira (Sylhet), 10-15 P.M.
,, 19	3-0	Gauhati, 3-30 A.M.; Sylhet, 3 A.M.
	10-0	Bindukuri, 9-50 A.M.

November 19	17-0	Singribari, 5 P.M.
	21-30	Katlicherra, 9-30 P.M.
,, 20	1-30	Tamar Hat, 1 A.M.; Kaunia, 1-20 m.; Kuch Bihar.
	20-0	Dinajpur, 8 P.M.
,, 21	2-0	Borjuli, 2-20 A.M.; Mangaldai, 1-50 A.M.; Dhubri, 1 A.M.; Kuch Bihar, Rangpur, 2-15 A.M.; Punkhabari, 1-52 A.M.; Darjiling, 1-58 A.M.; Nilphamari, 1-30 A.M.; Bogra, 2 A.M.; Nator, 2 A.M.; Naogaon (Rajshahi), middle of night; Serajganj, 2-15 A.M.; Maimansingh, 2 A.M.; Sonamganj, 2 A.M.; Syhlet, 2-30 A.M.
	3-30	Gauhati, 3-35 A.M.; Tamar Hat, 3 A.M.; Bogribari, 4 A.M.
	5-0	Rangpur, 5 A.M.; Nator, 5 A.M.; Bogribari, 4 A.M.
	8-30	Bogribari, 8-30 A.M.
	17-30	Bijni, 6 P.M.; Dhubri, 16-58 m.
	21-0	Bogribari, 9 P.M.; Bijni, 9 P.M.
,, 22	2-0	Sherpur, 1-25 m.
	3-30	Maimansingh, 3-20 A.M.
	4-30	Kurigram, 4-30 A.M.
	8-0	Sonamganj, 8 A.M.
	19-0	Dinajpur, 7 P.M.
	21-0	Mangaldai, 9 P.M.; Gauhati, 9 P.M.
,, 23	1-0	Sylhet, 0-50 A.M.
	3-30	Bogribari, 3 A.M.; Bijni, 2 A.M.
	13-0	Karimganj, 12-40 P.M.
,, 24	2-0	Gauhati, 1-45 A.M.; Rangpur, 1-15 A.M.; Sylhet, 2-30 A.M.
	3-0	Rangpur, 3 A.M.
	21-30	Gauhati, 9 P.M.; Sonamganj, 10 P.M.; Sylhet, 9-45 P.M.
	23-0	Gauripur, 11-10 P.M.
25	2-30	Bijni, 3 A.M.; Dhubri, 2-20 A.M.; Kaunia, 1-55 m.; Tung, 2-30 A.M.; Sirajganj, 2-30 A.M.; Sherpur, 1-55 m.; Netrakona, 3 A.M.
	19-30	Gauhati, 7-30 P.M.; Rangpur, 7-15 P.M.
	21-10	Sylhet, 9-10 P.M.
26	10-30	Gauhati, 10-40 A.M.; Kalaigaon, 11 A.M.; Bijni, 10 A.M.; Kurigram, 10-15 A.M.; Rangpur, 10-15 A.M.; Sonamganj, 9-30. A.M.
	15-0	Salona, 2-30 P.M.; Gauhati, 3 P.M.
,, 27	4-0	Sherpur, 4-10 m.
	15-30	Bogribari, 3-20 P.M.
	17-19	Bindukuri, 5-18 P.M.
	22-0	Dibrugarh, 10-10 P.M.
,, 29	5-30	Rangpur, 5-20 A.M.
	15-0	Rupsi, 3-20 P.M.; Dhubri, 14-20 m.; Kuch Bihar; Rangpur, 2-47 P.M.; Dinajpur, 3 P.M.; Sherpur, 15-5 m.; Sylhet, 3-15 P.M.
	23-30	Bogribari, 11-50 P.M.
,, 30	3-30	Maimansingh, 3-35 A.M.
	4-0	Maimansingh, 4-0 A.M.; Karimganj, 4-10 A.M.
	19-0	Sonamganj, 7 P.M.
	19-30	Gauhati, 7-30 P.M.; Sonamganj, 7-30 P.M.
December 2	6-0	Tezpur, 5-23 A.M.
,,	13-0	Tezpur, 12-50 P.M.
	20-0	Gauhati, 9 P.M.; Sonamganj, 8 P.M.

ecember	3	7-0	Bogribari, 7 A.M.; Gauhati, 8 A.M.; Bogribari, 8 A.M.; Bijni, 8 A.M.; Kaunia, 6-29 m.
,,	4	0-30	Tung (Darjiling), 0-38 A.M.
		8-0	Bogribari, 8 A.M.
			Siliguri reports slight tremours on the 3rd and 4th, but too indistinct for their duration to be recorded; no time given.
,,	5	17-0	Gauhati, 5-10 P.M.; Bijni, 4 P.M.
		21-30	Gauhati, 9-30 P.M.; Bijni, 10 P.M., slight; Bogribari, 9 P.M.; Sonamganj, 8-50 P.M.
,,	6	2-0	Nowgong, 2 A.M.; Bijni, 2 A.M.
		5-30	Mangaldai, 5-30 A.M.; Gauhati, 6 A.M.
		9-30	Dhubri, 9-30 m.
		13-30	Maimansingh, 1-30 P.M,
		14-0	Nowgong, 2 P.M.
		4-0	Maimansingh, 4-10 A.M.
,,	7	13-39	Gauhati, 1-45 P.M.; Rupsi, 1-30 P.M.; Dhubri, 1-30 P.M.; Kaunia, 13-0 m.; Rangpur, 1-35 P.M.; Serajganj, 1-45 P.M.; Sonamganj, 1-35 P.M.
		16-30	Nowgong, 4 P.M.; Mangaldai, 4-40 P.M.
		22-0	Sonamganj, 9-55 P.M.; Sylhet, 10-17 P.M.
,,	8	6-3	Sylhet, 5-50 A.M.
		1-30	Dhubri, 2-30 P.M.; Jamalpur (Maimansingh), 2-34 P.M.; Sylhet, 3-15 P.M.
		15-57	Sylhet, 3-20 P.M.
		17-30	Sylhet, 5-30 P M.
		23-15	Gauhati, 10-10 P.M.; Tamar Hat, 11-20 P.M.; Dhubri, 22-45 m.; Rangpur, 10-20 P.M.; Tung, 11-25 P.M.; Nilphamari, no time given; Dinajpur, 11-30 P.M.
,,	9	1-30	Rangpur, 1-30 A.M.
		3-30	Tung, 3-25 A.M.
		19-0	Sonamganj, 7 P.M.
		23-30	Katlicherra (Sylhet), between 11-30 and 12 P.M.
,,	10	6-0	Bijni, 7-15 A.M.; Kurigram, 6-30 A.M.; Rangpur, 6 A.M.
		9-30	Dhubri, 9-30 A.M.
		10-30	Gauhati, 10-30 A.M.; Bogribari, 10 A.M.
		20-15	Sylhet, 8-15 P.M.
,,	11	1-0	Kurigram, 1 A.M.
		13-0	Sylhet, 1-8 P.M.
		20-30	Nowgong, 8-30 P.M.
		23-15	Sylhet, 11-15 P.M.
,,	12	3-0	Sonamgani, 3 A.M.
		6-0	Gauhati, 6 A.M.; Bijni, 7 A.M.; Bogribari, 7 A.M.
		12-0	Bogribari, 12 noon.
		18-0	,, 6 P.M.
		3-0	,, 3 A.M.
		5-30	Nowgong, 5-45 A.M.; Gauhati, 5-20 A.M.
		24-0	Dinajpur, 12 midnight, Maimansingh, 12 midnight.
,,	13	6-30	Sonamgani, 6-30 A.M.
,,	16	9-0	Chittagong, 8-55 A.M.
		19-30	Tamar Hat, 7-30 P.M.; Rupsi, 7 P.M.; Dhubri, 7-30 P.M.; Kurigram, 6-45 P.M.
		22-30	Rupsi, 9-20 P.M.; Dhubri, 10-30 P.M.; Kaunia, 21-50 m.;

December 16 .		Rangpur, 10-30 P.M.; Maimansingh, 10-30 P.M.; Sonamganj, 9-55 P.M.
„ 17 .	3-30	Jamalpur (Maimansingh), 3-30 A.M.
	6-30	Bogribari, 6-30 A.M.
	9-0	Gauhati, 9 A.M.; Sonamganj, 8-45 A.M.
	18-30	Dhubri, 6-30 P.M.; Sylhet, 6-27 P.M.; Sonamganj, 8-30 P.M.; Sylhet, about 8 P.M.
„ 18 .	1-0	Rangpur, 1 A.M.
	9-0	Bogribari, 9 A.M.
	21-30	Tezpur, 9-20 P.M.
„ 20 .	4-0	Maimansingh, 4-5 A.M.
„ 21 .	2-30	Nowgong, 2-30 A.M.
	15-30	Rangpur, 3-30 P.M.
„ 23 .	3-0	Salona, 2-50 A.M.; Bindukuri (Darrang), 3 A.M.; Rangpur, 2-35 A.M.
	6-0	Maimansingh, 6 A.M.
„ 24 .	3-0	Nowgong, 12-30 A.M.; Bindukuri, 3-15 A.M.; Gauhati, 2-1 m.; Tamar Hat, 2 A.M.; Dhubri, 2-10 m.; Rangpur, 1-10 A.M.; Netrakona, 1-55 A.M.; Sonamganj, 3 A.M.
„ 25 .	3-15	Silghat, 1-20 P.M.; Gauhati, noon.
„ 26 .	4-0	Dhuri, 4 A.M.
	13-0	Salona, 1-5 P.M.; Nowgong, 12-15 P.M.; Bindokuri, 12-49 P.M.
	18-30	Sonamganj, 6-30 P.M.
„ 27 .	3-0	Gauhati, 3-10 A.M.; Rupsi, 4-30 A.M.; Gauripur, 3 A.M.
	22-15	Nowgong, 12-20 P.M.
„ 28 .	3-0	Kurigram, 1-15 A.M.; Rangpur, 1 A.M.; Sherpur, 1-20 A.M.
	4-0	Dhubri, 4 A.M.; Kaunia, 3-30 m.; Rangpur, 4-0 A.M.; Maimansingh, 3-45 A.M.; Sonamganj, 3 A.M.; Chandkhira (Sylhet), 3-10 A.M.
	7-0	Dhubri, 7 A.M.
	10-15	Nowgong, 10-15 A.M.
	22-15	Gauhati, 21-30 m.; Dhubri, 21-42 m.; Kurigram, 9-20 P.M.; Rangpur, 10-15 P.M.
„ 29 .	4-0	Bogribari, 4-30 A.M.; Gaibhanda (Rangpur), 4-10 A.M.
	13-0	Borjuli, 12-50 P.M.
	19-0	Rupsi, 7 P.M.
	22-0	Kaunia, 21-30 m.; Gaibhanda, 10 P.M.
„ 30 .	19-0	Dhubri, 7 P.M.
„ 31 .	4-0	Rangpur, 4 A.M.

PART III.—1 JANUARY TO 31 DECEMBER 1898.

January 2 .	17-0	Gauhati, 16-12 m.; Bijni, 4-20 P.M.
„ 3 .	1-0	Bogribari, 1-30 A.M.; Rangpur, 1 A.M.
	22-0	Bogribari, 9-30 P.M.; Netrakona, 10 P.M.
„ 4 .	2-0	Bindukuri, 1-50 A.M.
	21-0	Gauhati, 9 P.M.; Rupsi, 9-30 P.M.; Dhubri, 9-45 P.M.; Kaunia, 20-30 m.; Kuch Bihar; Rangpur, 10 P.M.
„ 5 .	16-30	Bogribari, 4-30 P.M.; Bijni, 4-30 P.M.
	17-0	„ 5-0 P.M.; Bijni, 4-45 P.M.
„ 6 .	1-0	Messa (Nowgong), 1-45 A.M.; Gauhati, 0-1 m.

January	6	5-30	Gauripur, 5-30 A.M.
		21-30	Gauhati, 9-30 P.M.; Dhubri, 10 P.M.; Kurigram, 9 P.M.
		23-0	Gauhati, 11 P.M.; Bogribari, 11 P.M.; Bijni, 12 P.M.
,,	7	1-0	Maimansingh, 1 A.M.
		5-30	Bogribari, 5 A.M.; Kurigram, 5-30 A.M.
		9-0	Dhubri, 9 A.M.
		19-30	Gauhati, 7-10 P.M.; Rupsi, 8-15 P.M.; Dhubri, 7-53 P.M.; Kurigram, 7-30 P.M.
		23-0	Silchar, 11 P.M.,
,,	8	21-0	Dhubri, 9 P.M.
,,	9	2-0	Sonamganj, 2 A.M.
		2-30	Silghat, 3-30 A.M.; Nowgong, 2-45 A.M.; Bindukuri, 2-40 A.M.
		5-0	Sonamganj, 5 A.M.
		11-0	Bindukuri, 11 A.M.
		12-15	Nowgong, 9-12 P.M.; Gauhati, 9-12 P.M.
,,	10	4-30	Gauhati, 4-20 A.M.; Bogribari, 4 A.M.; Sonamganj, 4-30 A.M.
		23-45	Sherpur, 23-10 M.
,,	11	22-0	Rupsi, 10-10 P.M.; Kurigram, 9 P.M.; Rangpur, 10-5 P.M.; Netrakona of, 9 P.M.
,,	12	13-0	Kurigram, 1-10 P.M.; Kaunia, 18-13 m.; Rangpur, 6-40 P.M.
		18-45	Kaunia, 18-13; Rangpur, 6-40 P.M.
		20-30	Gauhati, 19-55 m.; Bogribari, 8 P.M.; Kurigram, 8 P.M.; Jamalpur, 7 P.M.; Maimansingh, 7-35 P.M.; Sonamganj, 8-30 P.M.
		22-0	Bijni, 9 P.M.; Dhubri, 10-10 P.M.
,,	13	2-0	Karimganj, about 2 A.M.
		3-30	Rangpur, 3-30 A.M.
,,	15	11-30	Rupsi, 11-30 A.M.
,,	16	13-30	Nowgong, 1-40 P.M.; Tamar Hat, 1-35 P.M.; Dhubri, 1-45 P.M.; Rupsi, 1-50 P.M.; Kurigram, 1-45 P.M.; Kuch Bihar, Sherpur, 3-5 m.; Karimganj, just before 2.
		23-0	Bijni, 1 P.M.; Kurigram, 10 P.M.
		23-25	Karimganj, 11-40 P.M.
,,	17	14-30	Gauripur, 2 P.M.; Maimansingh, 3 P.M.
		23-45	Karimganj, 11-46 P.M.; prolonged but feeble, the only time a rumble was heard here.
,,	18	0-15	Darjiling, 0-5 A.M.
		1-0	Bogribari, 1 A.M.; Rupsi, 1-30 A.M.
		3-30	Karimganj, 3-30 A.M.
		6-0	Rupsi, 6-10 M.; Bijni, 5-30 A.M.
		9-30	Jalpaiguri, 9-35 A.M.
		9-40	,, 9-40 A.M.
		10-0	Maimansingh, 10 P.M.; Karimganj, 9-10 P.M.
		24-0	Karimganj, midnight.
,,	19	1-30	Bogribari, 1-30 A.M.
		6-0	Bogribari, 5-0 A.M.; Dhubri, 6 A.M.; Rangpur, 6-30 A.M.
		14-0	Bogribari, 2 P.M.
		18-30	Maimansingh, 6-30 P.M.
			At Karimganj vague earthquake, suspicions are reported to have been pretty frequent on 16th, 17th, 18th, 19th January.
,,	20	0-30	Maimansingh, 0-30 A.M.
		7-30	Rangpur, 7-10 A.M.
		11-30	Maimansingh, 11-30 A.M.

January	20	14-30	Tamar Hat, 2-30 P.M.; Gauripur, 2-25 P.M.; Rupsi, 2 P.M.
,,	21	4-15	Nowgong, 4-23 A.M.; Tezpur, 4-24 A.M.; Borjuli, 4-20 A.M.
		13-30	Maimansingh, 1-30 P.M.
		16-0	Gauhati, 15-12 m.; Bogribari, 4 P.M.
		18-30	Gauhati, 6-30 P.M.; Gauhati, 9 P.M.; Bijni, 9 P.M.; Dhubri, 10-30 P.M.; Kurigram, 9-30P.M.; Rangpur, 8-30 P.M., Maimansingh, 10-30 P.M.
,,	22	14-0	Bijni, 2-30 P.M.; Dhubri, 1-30 P.M.; Rangpur, 1-30 P.M.
		23-20	Gauhati, 11-20 P.M.
,,	23	13-30	Jalpaiguri, 1-30 P.M.
,,	24	2-0	Bogribari, 2 A.M.
		12-30	Gauhati, 12-35 P.M.
		14-30	Jalpaiguri, 2-30 P.M.
		14-40	Jalpaiguri, 2-40 P.M.
		16-0	Bogribari, 4 P.M.
,,	25	5-15	Bogribarj, 5-10 A.M.
,,		23-0	Gauhati, 22-15 m.
,,	26	3-45	Nowgong, 3-47 A.M.
		16-0	Bijni, 4 P.M.; Dhubri, 4 P.M.
		20-0	Bogribari, 8 P.M.
,,	28	22-0	Gauhati, 10-5 P.M.; Bogribari, 10 P.M.; Bijni, 10 P.M.
February	1	2-45	Bogribari, 1-45 A.M.; Silghat, 3 A.M.; Borjuli, 2-50 A.M.
		3-0	Moriani (Sibsagar), 3 A.M.; Golaghat, 3-15 A.M.; Silghat, 3-3 A.M.; Salona, 3-10 A.M.; severer than experienced for some weeks; Tezpur, 3 A.M.; Borjuli, 3-10 A.M.; Gauhati, 2-3 m.; Bogribari, 2-0 A.M.; Dhubri, 2-53 A.M.; felt at Kuch Behar, Kurigram, 1-30 A.M.; Sonamganj, 3 A.M.; Sylhet, 2 A.M.
		7-0	Maimansingh, 7-7 A.M.
		9-0	Rangpur, 9 A.M.
,,	2	18-0	Maimansingh, 6 A.M.
		21-0	Gauhati, 20-13 M.; Bogribari, 9-30 P.M.; Bijni, 9 P.M.
,,	3	22-0	Maimansingh, 10 P.M.
,,	4		Karimganj, 3-20 A.M.
,,	5	2-0	Gauhati, 2-15 A.M.; Maimansingh, 2 A.M.
		10-0	,, 10 A.M.; Bijni, 10 A.M.
,,	6	12-0	Bogribari, 11-55 A.M.; Dhubri, 12-10 P.M.
		22-0	Bijni, 10 P.M.; Dhubri, 10-25 P.M.
,,	7	2-0	Netrakona, 2 A.M.
,,	8	15-30	Gauhati, 15-0 m.; Rupsi, 4 P.M.; Dhubri, 3-25 P.M.; Kuch Behar; Rangpur, 3-15 P.M.; Sherpur, 15-2 m.; Netrakona, 3 P.M.; Sonamganj, 3-40 P.M.; Sylhet, 3-45 P.M.; Rangpur, 5-30 P.M.
		21-30	Tamar Hat, 9-40 P.M.; Rupsi, 9-45 P.M.; Dhubri, 10-20 P.M.; Kuch Behar; Rangpur, 9-35 P.M.
,,	10	6-0	Dhubri, 6 A.M.
		22-30	Rangpur, 10-30 P.M.
,,	11	4-30	Nowgong, 3-50 A.M.; Gauhati, 3-52 M.
		6-0	Gauhati, 5-46 m.; Rupsi, 6 A.M.; Kaunia, 5-50 m.; Rangpur, 6-20, A.M.; Netrakona, 5-30 A.M.; Sonamganj, 6 A.M.
		12-30	Moriani (Sibsagar), 1 P.M.; Golaghat, 12-40 P.M.; Gauhati, 11-48 m.; Rupsi, 12-45 P.M.; Dhubri, 12-27 P.M.; Sonam ganj, 12 noon; Sylhet, 1-7 P.M.

February	11	16-15	Gauhati, 15-37 m. ; Bijni, 4-30 P.M.
,,	12	4-30	Nowgong, 4-25 A.M.
		13-0	Rungagun (Golaghat), 1-0 P.M. ; Nowgong, 1-0 P.M. ; Gauhati 2-10 P.M. ; Bijni, 2 P.M.
,,	13	13-0	Rangpur, 1 P.M.
		16-0	Gauhati, 15-28 m. ; Dhubri, 4 P.M.
		21-15	Tamar Hat, 8-38 P.M. ; Rupsi, 9-20 P.M. ; Dhubri, 9-10 P.M. Kaunia, 20-35 M. ; Rangpur, 9-5 P.M.
,,	14	3-45	Maimansingh, 3 A.M. ; Karimganj, 3-50 A.M. ; a long tremour.
		4-0	Karimganj, 4-20 A.M.
,,	15	6-45	Gauhati, 6-0 M. ; Rupsi, 6-40 A.M.
,,	16	14-30	Bogribari, 3 P.M. ; Bijni, 2 P.M.
,,	21	5-0	Tamar Hat, 5-0 A.M. ; Rupsi, 6 A.M. ; Dhubri, 5-10 A.M.
		20-0	Maimansingh, 8-0 P.M.
,,	22	20-30	Borjuli, 8-40 P.M.
,,	23	12-0	Dhubri, 11-55 A.M.
		14-0	Nowgong 2 P.M. ; Borjuli, 2 P.M. ; Gauhati, 1 P.M.
,,	24	22-0	Bijni, 9-30 P.M. ; Maimansingh, 10-30 P.M.
,,	28	13-30	Sonamganj, 1-30 P.M.
		21-0	Netrakona, 9-0 P.M. ; Sonamganj, 8-30 P.M.
March	1	21-0	Gauhati, 9-10 P.M. ; Netrakona, 9-0 P.M. ; Sonamganj, 9-30 P.M.
		17-0	Bogribari, 5 P.M. ; Bijni, 5 P.M.
,,	2	20-30	Rupsi, 8 P.M. ; Dhubri, 9 P.M. ; Rangpur, 9 P.M. ; Maimansingh, 7-30 P.M. ; Netrakona, 8 P.M. ; Sonamganj, 9-5 P.M.
		23-30	Bogribari, 11-30 P.M.
,,	4	14-0	Dhubri, 1-50 P.M.
		19-0	Gauhati, 7 P.M. ; Bijni, 8 P.M.
,,	5	3-0	Netrakona, 3 A.M. and 7-30 P.M.
		19-30	,, 7 30 P.M.
,,	6	19-30	Rupsi, 7-35 P.M.
		21-0	Kurigram, 20-15 m.
,,	7	6-30	,, 6-25 m.
,,	8	13-0	Dhubri, 12-47 P.M.
,,	17	6-0	Dhubri, 6 A.M.
,,	18	13-0	Fort Aijal, 1 P.M.
,,	19	20-0	Rangpur, 8 3 P.M.
		21-15	,, 9-15 P.M.
,,	20	9-30	Dhubri, 9-45 A.M. ; Rangpur, 9-30 A.M. ; Bogribari, 11-30 A.M.
,,	22	11-0	Bogribari, 11 A.M.
		24-0	Madura (Cachar), midnight, three shocks, two rather strong, one slight.
,,	24	18-30	Rangpur, 6-29 P.M.
,,	25	6-15	,, 6-10 A.M.
		11-45	,, 11-40 A.M.
,,	26	5-45	Bogribari, 5-40 A.M.
,,	28	1-30	Kaunia, 1-3 A.M.
		6-0	Kurigram, 5-30 m.
April	1	3-0	Karimganj, before 3 A.M.
		14-0	Dhubri, 2 P.M.
,,	2	23-0	Maimansingh, 11-5 P.M.
,,	3	6-30	Rangpur, 6-25 P.M.
,,	4	20-30	Sylhet, 8-30 P.M.
		23-30	,, 11-30 P.M.

April	4	23-45	Sylhet, 11-40 P.M.
,,	5	4-30	,, 4-35 A.M.
		4-45	,, 4-40 A.M.
,,	7	4-30	Bogribari, 5 A.M.; Bijni, 4 A.M.
,,	8	23-0	Karimganj, 11 P.M.; long tremour.
,,	11	...	Nilphamari, no time given, two feeble shocks.
,,	12	1-0	Rupsi, 0-30 A.M.; Rangpur, 1 A.M.
,,	13	3-0	Gauripur, 3 A.M.
		5-15	Dhubri, 5-10 P.M.
		19-0	Bogribari, 7 P.M.
,,	14	0-30	Kaunia, 0-3 m.; Rangpur, 1 A.M.; Sherpur, 0-35 A.M.
		2-30	Maimansingh, 2-30 A.M.
		5-30	,, 5·30 A.M.
		21-0	Gauripur, 8 P.M.; Rupsi, 8-30 P.M.; Kurigram, 20-0 m.; Rangpur, 9 P.M.; Sherpur, 10 P.M.
		23-30	Karimganj, 11-30 P.M.; a faint tremour.
,,	15	9-45	Dhubri, 9-45 A.M.
,,	16	20-30	Bogribari, 7-30 P.M.; Dhubri, 8-30 P.M.
,,	18	3-30	Gauripur, 3-30 A.M.; Silghat, 12-50 P.M.; Nowgong, 2-51 P.M.; Tezpur, 12-30 P.M.; Gauhati, 12-0 noon; Dhubri, 12-40 P.M.; Rangpur, 1-0 P.M.; Darjiling, 12-35 P.M.; Nator, 1-50 P.M.; Rampur Boalia, 1 P.M.; Berhampur, 12-30 P.M.; Maimansingh, 12-30 P.M.; Dacca, 12-20; Chittagong, 12-40; Sylhet, 12-57 P.M.; Karimgunj, 12-30 P.M.; Silchar, 12-40 P.M. Fort Aijal, 12-30 P.M.; Manipur, 12-53 P.M.
		5-0	Munshi Bazar, 5 A.M.
,,	19	5-30	Gauhati, 5-30 A.M.; Dhubri, 5-50 A.M.; Rangpur, 5-10 A.M.; Darjiling, 5-25 A.M.; Netrakona, 6 A.M.; Munshi Bazar, 5-30 A.M.
		23-0	Gauripur, 11 P.M.
,,	20	5-0	Dhubri, 4-21 m.
,,	21	6-30	Gauripur, 6-40 A.M.; Rupsi, 7 A.M.; Dhubri, 5-41 m.
,,	22	12-0	Netrakona, 12-noon.
,,	23	0-15	Karimganj, 0-10 A.M.; a distinct and long tremour.
		22-45	Maimansingh, 10-42 P.M.
,,	24	23-0	Karimganj, 11-0 P.M.
,,	25	17-0	Bogribari, 4 P M.; Rangpur, 5 P.M.
		22-0	Sherpur, 10-3 P.M
,,	26	6-30	Nowgong, 6-20 A.M.; Tezpur, 6-25 A.M.; Borjuli, 6-25 A.M.; Gauhati, 6-30 A.M.; Dhubri, 5-30 A.M.; Rupsi, 6 A.M.; Rangpur, 6 A.M.; Sherpur, 5-30 m.; Maimansingh, 6-30 A.M.; Kishorganj. 7 A.M.; Karimganj, 6-15 A.M.; Sylhet, 6-25 A.M.; Silchar, 6-20 A.M.; Hailakandí (Cachar), 6-15 A.M.
		16-30	Bogribari, 4-30 P.M.; Rupsi, 4-45 P.M.; Dhubri, 15-46 m.; Sherpur, 15-40 m.
,,	27	1-30	Rangpur, 1-30 A.M.; Kishorganj, 0-30 A.M.; Netrakona, 0 A.M.; Sylhet, 1-15 A.M.; Kalain, 1-15 A.M.
		14-0	Gauhati, 2 P.M.; Sylhet, 2-18 P.M.
		23-30	Karimganj, 11-30 P.M.; long tremors.
,,	28	0-0	Karimganj, 0-2 A.M., long tremors.
		6-0	Munshi Bazar, 6 A.M.
		15-0	,, 3 P.M.

April 29	1-30	Karimganj, at 11-30 A.M.
	16-30	Rangpur, 4-30 P.M.
,, 30	23-30	Karimganj, 11-35 P.M., long tremors.
May 1	1-0	Karimganj, 1-5 A.M., a long distinct tremor.
	1-15	,, 1-20 A.M., not so long.
	7-15	Sylhet, 7-15 A.M.
,, 2	14-30	Rangpur, 2-15 P.M.; Bijni, 2-30 P.M.; Silchar, 2-25 P.M.
	22-30	,, 10-30 P.M.
	24-0	Karimganj, midnight, a faint tremor.
,, 3	14-0	,, 2-5 P.M., a tremor.
	21-0	Rangpur, 9 P.M.
	23-15	Karimganj, 11-20 P.M. } very long faint tremor.
	24-0	,, 11-55 P.M. }
,, 4	23-30	,, 11-47 P.M., a long faint tremor.
,, 5	23-0	,, 11-5 P.M., a long faint tremor.
,, 6	10-0	Maimansingh, 10 A.M.
	13-0	Karimganj, between 12 and 2 P.M., a distinct tremor.
	18-45	,, 6-45 P.M., a faint tremor.
,, 7	9-0	Rupsi, 9-30 A.M.; Dhubri, 8-50 A.M.; Rangpur, 10-33 A.M.; Kurseong, 9 A M.
	14-0	Silghat, 2-10 P.M.; Nowgong, 1-48 P.M.; Jaipur, 1-52 P.M.; Borjuli, 1-54 P.M.; Gauhati, 1-10 P.M.; Rupsi, 1-50 P.M.; Dhubri, 1-40 P.M.; Rangpur, 1-30 P.M.; Kurseong, 12-24 P.M.; Sherpur, 13-0 m.; Maimansingh, 1-5 P.M.; Sylhet, 2-10 P.M.; Silchar, 1-40 P.M.
,, 10	21-45	Silghat, 9-40 P.M.
,, 11	15-30	Rangpur, 3-30 P.M.
,, 14	12-15	Bogribari, 12-10 P.M.
,, 16	0-15	Kaunia, 23-15 m. (of 15th.)
	13-30	Bogribari, 1-30 P.M.
,, 18	21-0	,, 9 P.M.; Rupsi, 9-5 P.M.; Dhubri, 9 P.M.; Kaunia, 20-10 m.
,, 19	23-0	Bogribari, 9 P.M.; Kaunia, 20-30 m.
,, 20	0-30	Dhubri, 0-35 A.M.; Rangpur, midnight; Kurseong, midnight; Sherpur, 1-15 A.M.; Netrakona, 0-30 A.M.
	20-30	Rupsi, 8-30 P.M.; Dhubri, 8-30 P.M.; Rangpur, 8-30 P.M.; Kurseong, 8-15 P.M.; Darjiling, 8-35 P.M.; Netrakona, 7-3 P.M.
	23-0	Dhubri, 10-45 P.M.; Kurseong, midnight; Darjiling, 11 P.M.
,, 21	6-0	,, 6 A.M.
	22-0	Darjiling, 9-55 P.M.
,, 25	12-30	Maimansingh, 12-30 P.M.
	13-30	Kalain (Cachar), 1-30 P.M.; Nowgong, 1-13 P.M.
	16-30	Rupsi, 5 P.M.; Dhubri, 4-30 P.M.; Rangpur, 4-21 P.M.; Maimansingh, 3-30 P.M.; Netrakona, 3 P.M.
,, 27	13-30	Maimansingh, 1-30 P.M.
,, 29	10-30	Bogribari, 10-30 A.M.
,, 30	8-40	,, 8-4 A.M.
,, 31	6-0	Kaunia, 5-30 m.; Rangpur, 5-37 A.M.; Maimansingh, 6 A.M.
	11-0	Silghat, 11-30 A.M.; Tezpur, 10-52 A.M.
	14-15	Rangpur, 2-10 P.M.; Kaunia, 13-40 M.
	20-30	,, 8-30 P.M.
June 1	4-0	Kurigram, 4-0 A.M.

June	1	6-0	Netrakona, 6-0 A.M.
,,	5	11-0	Dhubri, 11 A.M. ; Netrakona, 11-30 A.M.
		21-30	Bijni, 9-30 P.M. ; Dhubri, 9-34 P.M. ; Kaunia, 20-44 m.; Rangpur, 8-44 P.M. ; Netrakona, 9 P.M.
,,	7	7-0	Bijni, 7-15 A.M. ; Dhubri, 6-33 A.M. ; Kurigram, 7-30 A.M.
,,	13	8-0	Bogribari, 9 A.M. ; Kurigram, 8-5 A.M.
,,	14	0-30	Dhubri, 12-33 A.M. ; Kaunia, 0-5 m. ; Rangpur, 12-20 A.M.
,,	16	23-30	Kaunia, 22-50. M.
,,	18	1-30	Dhubri, 1-30 A.M. ; Kaunia 1-15 m. ; Rangpur, 2-30 A.M. ; Netrakona, 1 A.M.
		3-30	Netrakona, 3-30 A.M.
		8-15	Dhubri, 8-15 A.M.
,,	19	0-0	Dhubri, 12-10 A.M. ; Rangpur, 12 P.M. (of 18th).
,,	20	1-0	Darjiling, 1 A.M. ; Nator, 1-30 A.M.
,,	28	14-30	Rangpur, 2-32 P.M.
July	8	5-0	Bijni, 5-30 A.M. ; Kurigram, 4-0 A.M. ; Rangpur, 4-30 A.M.
,,	9	18-0	Dhubri, 6 P.M. ; Rangpur, 6-15 P.M.
,,	13	4-30	Sylhet, 4-30 A.M.
,,	19	4-0	Kaunia, 3-43 m.
,,	20	5-30	Sibsagar, 5 A.M. ; Golaghat, 5-30 A.M. ; Nowgong, 530 A.M. ; Borjuli, 5-40 A.M. ; Dhubri, 5-30 A.M. ; Rangpur, 5 A.M. ; Darjiling, 5-25 A.M. ; Sylhet, 5-0 A.M. ; Silchar, 5-40 A.M. ; Manipur, 5-30 A.M.
,,	21	14-0	Dhubri, 2 P.M. ; Kaunia, 13-40 m. ; Rangpur, 1-45 P.M.
,,	22	17-45	Kaunia, 17-30 m. ; Rangpur, 5-45 P.M.
,,	25	17-0	Kaunia, 16-3 m. ; Rangpur, 5 P.M.
,,	26	15-30	Rangpur, 3-35 P.M.
,,	28	14-0	Rangpur, 2 P.M.
		23-30	Tung (Darjiling), 11-20 P.M.
,,	29	17-30	Kaunia, 16-57 m.
		47-10	,, 17·3 m.
,,	31	16-45	Rupri, 3-30 P.M. ; Dhubri, 4-25 P.M. ; Kaunia, 16-10 A.M. ; Rangpur, 5-30 P.M.
		16-50	Dhubri, 4-31 P.M. ; Rangpur, 5-35 P.M.
August	1	16-30	Bijni, 3-30 P.M. ; Rangpur, 4-25 P.M.
,,	2	6-0	Nowgong, 6 A.M.,
			Bijni, 4 P.M. ; Kaunia, 16-5 m.
,,	3	0-15	Kaunia, 23-37 m .
,,	4	11-30	Kurigram, 11-30 A.M.
,,	14	17-0	Nowgong, 4-40 P.M. ; Dhubri, 5-20 A M.
		22-45	Nowgong, 10-55 P.M. ; Rupri, 10-30 P.M. ; Dhubri, 10-46 P.M ; Kaunia, 22-3 m ; Rangpur, 10-45, P.M. ; Darjiling, 10-30 P.M. ; Maimansingh, 10-35 P.M. ; Sylhet, 11-0 P.M.
,,	15	5-30	Bijini, 7 A.M. ; Dhubri, 5-55 A.M. ; Kaunia, 5-35 m. ; Rangpur, 4-30 A.M.
		6-0	Bijni. 7-30 A.M. ; Dhubri, 6-45 A.M. ; Kaunia, 6-5 m ; Rangpur, 5-0 A.M.
		13-30	Dhubri, 1-40 P.M.
,,	16	20-30	Rupsi, 8-15 P.M. ; Kaunia, 20-5 m.
,,	22	23-15	Rangpur, 11-10 P.M.
,,	23	2-0	Dhubri, 2-51 A.M. ; Rangpur, 2-5 A.M. ; Nilphamari, between 12 and 1 A.M.

August	23	22-0	Kurigram, 10-10 P.M.
,,	24	2-0	Dhubri, 3-50 A.M.; Kaunia, 1-58 m.; Rangpur, 2-20 A.M.; Dinajpur, 2 A.M.
,,	26	6-0	Darjiling, 6-10 A.M.
		11-0	Rupsi, 9-45 A.M.; Kaunia, 10-35 m.; Rangpur, 11-20 A.M.
		12-15	Dhubri, 12-13 P.M.
,,	27	6-30	Netrakona, 7- A.M.; Sylhet, 6-35 A.M.
September	4	5-30	Rangpur, 5-30 A.M.
		8-30	Rupri, 8-30 A.M.; Dhubri, 8-3 A.M.; Rangpur, 8 A.M.; Jalpaiguri, 9-30 A.M.; Alipur Duars, 8-30 A.M.; Darjiling, 8-23 A.M.
		15-15	Rangpur, 3-10 P.M.
,,	5	14-0	Nowgong, 2-23 P.M.; Gauhati, 2-0 P.M.
,,	7	11-0	Rangpur, 11-5 A.M.
,,	8	20-0	Sibsagar, 8 P.M.
,,	12	13-15	Dhubri, 1-20 P.M.; Kaunia, 12-35 m.
,,	15	11-15	Rangpur, 11-15 A.M.
			,, 11-20 A.M.
			,, 11-30 A.M.
,,	17	12-0	Rupsi, 1-30 P.M.; Dhubri, 12 noon.
		15-15	Rangpur, 3-15 P.M.
,,	18	12-0	Rangpur, 12 P.M. (? noon).
,,	20	0-15	Dhubri, 12 P.M.; Kaunia, 23-45 m.
,,	25	16-30	Rangpur, 4-30 P.M.
,,	27	3-30	Kurigram, 3 A.M.; Rangpur, 3-45 A.M.
,,	29	17-30	Rangpur, 5-30 P.M.
,,	30	9-30	Golaghat, 9-57 A.M.; Nowgong, 9-45 A.M.; Tezpur, 9-50 A.M.; Gauhauti, 10-15 A.M., Dhubri, 9-30 A.M.; Rungpur, 9-33 A.M.; Amjuri (Sylhet), 10 A.M.; Silchar, 9-50 A.M.; Hailakandi, 9-50 A.M.
			This shock, the worst since 2nd August 1897, was a more severe, and probably extensive one, than the above record would show. It overturned two of the cylinders of the seismometer at Shillong, and was severe enough to bring down plaster and break crockery: at Latlynkat, in the Khasi Hills, it cracked a masonry wall. According to the newspapers it was felt in Calcutta, but this is very doubtful.
October	7	2-0	Rangpur, A.M.
,,	9	9-0	Gauhati, 9-5 A.M.; Kurigram, 8-30 A.M.; Kaunia, 8-20 m.; Darjiling, 8-55 A.M.; Maimansingh, 8-59 A.M.
,,	10	6-30	Tezpur, 6-20 A.M.
,,	29	2-30	Kaunia, 2·12 m; Rangpur, 2-30 A.M.; Nator 3-30 A.M.; Darjiling, 2-40 A.M.
,,		22-45	Jaipur, 10-0 P.M.; Nazira, 10-15 P.M.; Golaghat, 10-15 P.M.; Darjiling, 9-55 P.M.; Manipur, 21-18 m.
November	10	22-0	Jaipur, 11-0 P.M.; Nazira, 10-55 P.M.; Golaghat, 10-30 P.M.; Darjiling, 10-30 P.M.; Manipur, 21-57 m.
		22-45	Jaipur, 11-0 P.M.; Nazira, 10-55 P.M.; Golaghat, 10-50 P.M.; Darjiling, 10-30 P.M.; Manipur, 21-57 m.
,,	26	16-30	Sibsagar, 4-55 P.M.; Kohima, 4-30 P.M.; Silghat, 5-15 P.M.; Nowgong, 4-45 P.M.; Tezpur, 4-40 P.M.; Gauhati, 4-35 P.M.; Chittagong, 4-30 P.M.; Moulvi Bazar (S. Sylhet), 4-40 P.M.; Hailakandi, 4-45 P.M.; Manipur, 4-_0 P.M.

November	29	19·0	Gauhati, 7-20 P.M.; Dhubri, 8 P.M.; Rangpur, 7 P.M.
December	6	4·0	Kurigram, 4 A.M.
		10-30	Rangpur, 10-15 A.M.
,,	10	6·0	,, 6 A.M.
,,	11	5·0	,, 4-45 A.M.
,,	14	5·0	,, 4-45 A.M.

MEMOIRS

OF

THE GEOLOGICAL SURVEY OF INDIA.

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MEMOIRS

OF

THE GEOLOGICAL SURVEY OF INDIA.

Geology of the neighbourhood of Salem, Madras Presidency, *with special reference to Leschenault de la Tour's observations.* By Thomas H. Holland, A.R.C.S., F.G.S., *Officiating Superintendent, Geological Survey of India.*

I.—INTRODUCTION.

The town of Salem and the Shevaroy hills are included in the north-west quarter of sheet 79 of the Indian atlas. This section of the sheet has been geologically mapped by Messrs. W. King and R. Bruce Foote, and described in their memoir "On the Geological structure of parts of the districts of Salem, Trichinopoly, Tanjore and South Arcot in the Madras Presidency.[1]" The few scattered geological observations which had been made previous to the systematic survey carried out by Messrs. King and Foote are summarised in their memoir, since the publication of which very little has been added to our geological knowledge of the area.

In 1889, however, Prof. A. Lacroix published a detailed petrographical description of a very interesting series of specimens, stated to be "from the neighbourhood of Salem," and collected by Leschenault de la Tour in the beginning of the century. It was with a view to obtaining information concerning the geological relations and precise localities of these rocks that I spent a short time in the year 1897 examining the immediate neighbourhood of Salem.

[1] *Mem., Geol. Surv., Ind.*, Vol. IV (1864), pp. 223—386.

Although a few of the rocks described by Lacroix can be identified with fair certainty in this locality, the majority of them could not be found near Salem. Some of the missing varieties, however, occur in the adjoining district of Coimbatore, and others occur in the Salem district at considerable distances from the capital town. At the time of my visit to Salem I was under the impression that the whole of the specimens collected by Leschenault de la Tour in South India were obtained during his "voyage à Karikal et à Salem", his paper describing these journeys being the only one quoted in the translation of Lacroix's paper.[1] Subsequently, however, I found on looking up the original papers, that Leschenault de la Tour had made much more extensive tours through the South of India than the two described in the paper just referred to, and that the itinerary given in a subsequently published summary of his travels[2] accounted very satisfactorily for many of the rocks described by Lacroix which closely resemble varieties recently found in widely separated localities in the Madras Presidency.

The expression "neighbourhood of Salem" used by Lacroix must, therefore, be given a more than usually wide meaning, and the expression "Salem district" even cannot be taken to mean the now well defined area controlled by a Collector and District Magistrate.

From the translation of Leschenault de la Tour's geological observations given in an appendix to this note, it will be seen that he must have travelled in the Madras Presidency through the districts of South Arcot, Salem, Coimbatore, Nilgiris, Tanjore, Trichinopoly, Madura and Tinnevelli. It is not certain, of course, that he obtained specimens from all these districts, but it is certain that some of the rocks described by Lacroix as "from the neighbourhood of Salem" really came from the Coimbatore district. As the districts of Salem and Coimbatore are each of the size of the

[1] *Rec., Geol. Surv., Ind.*, Vol. XXIV, p. 158, foot-note.

[2] "Relation abrégée d'un voyage aux Indes Orientales".—*Mém. du Mus. d'hist. nat.*, Vol. IX (1822), pp. 245—274.

principality of Wales and include a remarkably complex series of crystalline rocks, it is hardly safe to assume that rocks from these two districts are in the geological sense "associated with one another," and from this assumption to draw an analogy between them and the petrologically similar rocks found together, for instance, in some parts of France. It is stated, for example, that the garnetiferous pyroxenic and hornblendic gneisses (which can easily be identified near Salem) show their analogy with those of Finisterre by being associated with anorthite gneisses and cipolins.[1] But the "anorthite gneiss" was obtained by Leschenault de la Tour near Sithampundi, 36 miles south-south-west of Salem, whilst crystalline limestones of the kind described are well known near Coimbatore, where Leschenault made a considerable stay on three occasions. There are crystalline limestones, however, of a different kind about 20 miles from Salem, but none have been found so far actually associated with the pyroxenic rocks which abound in the immediate neighbourhood of the town itself. It is of course now well known that pyroxenic gneisses are often found in the neighbourhood of calciphyres and cipolins, and are then often, as Lacroix has pointed out, characterised by the presence of scapolite. But whilst these crystalline limestones so rich in accessory minerals are nearly always associated with the pyroxene-gneisses ("pyroxene-granulites"), the latter are more often—at least in Southern India—found without any crystalline limestones at all, and the neighbourhood of Salem is apparently an instance to the point.

The pyroxenic gneisses (pyroxene-granulites) which occur in the neighbourhood of Salem, and the similar rock forming such large masses, for instance, as the Nilgiri and Shevaroy hills, have always been regarded by the older members of the Geological Survey of India as belonging to the younger (upper) division of the gneisses; so far the correlation (proposed by Lacroix) with the subdivisions

[1] *Rec., Geol. Surv., Ind.*, Vol. XXIV, p. 175.

recognised on the geological map of France, is in agreement with the classification which has been so long recognised in India. But, apart from the internal evidence of composition and structure of the rocks themselves, some of the observations recently made as to the relations which these pyroxene-granulites present to their gneissose neighbours, can only be explained, so far as I can see, by assuming for them an igneous origin and an intrusive habit.[1] In a highly crushed country it is only natural to expect that the rocks which are old enough to show the general foliation of the area will have had most of their original structures mutilated if not totally destroyed. But the south of India offers an unusual number of chances for the preservation of the primary structures in our old rocks, for the reason that no crumpling, and practically no crust disturbances of any serious sort, have taken place in the peninsula of India since lower palæozoic times. In consequence of this circumstance many of the original structures in our oldest formations, and even in rocks like the pyroxene-granulites which we cannot remove from the Archæan group, are still preserved with little or no signs of secondary change. One is so surprised on discovering positive evidences of intrusion amongst the members of an old Archæan terrain (whose constituents are generally highly altered by the many disturbances which follow as a result of their great age), that it is only natural to regard these observations with some suspicion. But in the present instance there seems to be no other conclusion which satisfies the facts of the case, and, after all, when we consider the remarkable quiet which South India has enjoyed for such long ages, it ought not to be surprising to meet with phenomena in these rocks for which European experience would not prepare us.

During the course of this work I was fortunate in obtaining the advice of Mr. R. Bruce Foote, F.G.S., whose experience and knowledge of the older rocks in South India are unique.

[1] For a detailed account of the pyroxene-granulites of South India, under the name "charnockite series," see Mem., G. S. I., Vol. XXVIII, pt. 2.

II.—CLASSIFICATION OF THE ROCKS.

The rocks exposed in the immediate neighbourhood of Salem may be conveniently divided into the following groups, which are arranged in probable order of age :—

4. Younger igneous intrusions.
   c. The "White Elephant rocks".
   b. Peridotites of the Chalk hills.
   a. Basic dykes.
3. The "pyroxene-granulites" or charnockite series.
2. Schists of the Salem-Ahtúr valley.
1. Fundamental biotite-gneisses.

The old biotite-gneisses have the composition of granitic rocks, but no more direct evidence as to the nature of their origin is obtainable. The schists and leaf gneisses of the Salem-Ahtúr valley include the deformed products of probably both igneous and aqueous formations, whilst the "pyroxene-granulites" (charnockite series) present intrusive relations to both the above groups, and are consequently considered to be the youngest of the foliated rocks within this area. These rocks are considered to be Archæan in age, purely because they resemble petrologically the old gneisses and schists of Europe and America; they have been invaded and traversed by the younger igneous rocks forming group 4.

(1) Fundamental Biotite-gneisses.

The biotite-gneisses of this area present the usual characters of those which are generally considered to be members of the older (lower) division of the Archæan gneisses. The position given to these gneisses, merely on petrological grounds, is confirmed in the present instance by comparatively definite geological evidence which is detailed below (pages 109 and 121).

Occurrence and field characters.

Gneisses of this kind are exposed near the eastern foot of the hill west-south-west of Salem town (No. 11·892); at the foot of G. T. S. Nagaramalai, north-west of Salem (No. 11·902); along the northern boundary of the schists (group 2), 1 mile north of Karipatti and 9 miles east-north-east of Salem (11·925); south of Salem, in many places near and west of the Namakal road (11·890). The general direction of foliation varies from east—west to east-north-east—west-south-west, with a dip at very high angles generally northwards. The well developed foliation with sometimes even noticeable fissility, stands in striking contrast to the massive, imperfectly foliated, pyroxenic rocks which form large lenticular masses in the older gneiss and weather out into prominent hills.

General petrological characters.

None of these rocks can be considered to be quite fresh, the very evident crushing being accompanied by the formation of epidote in distinct crystals, and numerous spindle-shaped bodies with strong double refraction in the felspars; muscovite and granular colourless sphene are also often present and possibly represent secondary constituents. The list of minerals includes, without regard to origin, quartz, felspar, biotite, muscovite, hornblende, epidote, granular sphene, zircon, opaque iron-ores and apatite. The quartz-felspar and ferro-magnesian constituents generally present the usual quantitative proportions of the granites. The felspars often show distinct lamellar twinning, but generally of the undecided, ill-defined kind which seems to be so constantly displayed by the Archæan gneisses; microperthite is not uncommon.

Peculiar features.

The mineral composition and the structures are essentially the same in all the exposures of these gneisses; but the points enumerated so far are common to nearly all crushed biotite-gneisses, and so do not prove in themselves that the isolated exposures are all members of the same gneiss. But, besides this agreement in common characters, there is

a close resemblance in peculiar points, and, taken into conjunction with the fact that the gneisses present in all their occurrences essentially similar geological relations to the associated pyroxenic rocks, the evidence as to their identity is as satisfactory as can be expected in purely petrological correlations. The two chief peculiar points in common throughout these occurrences are the abundance of the highly doubly refracting needles and spindles in the felspars, and the bunchy grouping of the biotite, with its tendency to take on a green colour by passage into chlorite. These are both features of secondary origin, of course, but they are essential to show that the gneisses, besides having the same primary composition, have passed through similar secondary changes, which, within a limited area of only about 5 miles radius, ought to be sufficient to warrant their being mapped as isolated exposures of the same formation. The points of difference between the specimens are merely due to variation in size of grain and degree of alteration.

Identification of Dharwar conglomerates.

It is interesting to note that the features, which characterise these old gneisses around Salem, are repeated in a very striking manner in the gneiss pebbles of one of the schistose conglomerates of the Dharwar rocks in the adjoining State of Mysore. A section of one of these pebbles, kindly presented to the department by Dr. J. W. Evans, late State Geologist of Mysore, is so exactly similar to some of the Salem biotite-gneisses that it might almost have been cut from the same specimen, the differences between the Dharwar pebble and, for instance, the gneiss west-south-west of Salem (No. 11·892) being less than the variations which are presented in different parts of the area now under discussion. Another pebble from the Dharwar conglomerate is also derived from this old type of gneiss, though not so strikingly similar to the rocks in the vicinity of Salem.

It is not intended by this comparison to imply that the gneisses around Salem formed the source of the Dharwar pebbles; for the old

biotite-gneisses of this kind have a wide distribution in South India; but it is interesting to note that these pebbles agree with the old type of biotite-gneiss, and not with some others in Southern India which are fresher in character and not improbably younger in age. As these are probably the only instances so far of Dharwar pebbles being identified microscopically with the gneisses in an adjoining area, it is altogether too early to consider the value of negative evidence; but one naturally looks forward with some interest to a further examination of these pebbles as a means of confirming or criticising our conclusions as to the relative ages of different groups of crystalline rocks constituting the South Indian Archæan complex. One has, however, to be extremely cautious in generalising from correlations of this kind; for not only have we more than one group of biotite-gneiss among the South Indian crystallines, but it is very likely indeed that the old transition rocks distinguished as Dharwars cover a very wide range of time; so much so, that the identification of any one Dharwar conglomerate with a particular exposure of gneiss would be wholly insufficient to prove that the whole of the Dharwars are younger than the whole of the rocks forming the gneissic complex.

(2) Schists of the Salem-Ahtúr Valley.

Occurrence.

The thinly foliated schists, which are conspicuous along the Salem-Ahtúr road, trend about east and west past the southern foot of Godamalai, and stretch westward to a point about 7 miles from Salem, where they are cut off rather abruptly by a north-east—south-west "trap-shotten" band of gneiss which probably represents a transverse fault line (p. 38). The rocks referred to by Messrs. King and Foote as "talcose schists" are included in this group; but whilst many of the beds contain hydrated mica and chlorite forming the soft lubricant for the slip-planes in these highly crushed rocks, I have come across no

definite occurrences of the mineral talc. The thin, lustrous films of hydrous mica give them, however, a very talcose appearance in the field, and this character has enabled Messrs. King and Foote to trace them north-eastwards as far as Munnikul hill (lat. 12° 8′; long. 78° 47′), a distance of 46 miles.[1]

General characters.

These schists are very variable in colour, including bands of white, pink, grey, and green colour, giving them a very composite appearance; some of the bands are highly felspathic and often include "eyes" of uncrushed pink felspar, quartz and mica, such as might arise from the partial destruction of a coarse pegmatitic vein (11·922) in the original rock; others are simple hornblende schists, the result of deformation of basic bands of igneous rock.

Iron-ore beds.

But the most conspicuous members of the group are the iron-ore beds—Godamalai, which has been so graphically described by King and Foote,[2] being the chief example within this area. The beds forming this hill stretch westwards to a point about one mile north of Karipatti, where they become poorer in quality and thin out against the old gneiss; the well exposed section at this point also shows the perfect interlamination of the iron-ore beds with the other schists included in this group.

Mineral composition.

The rocks of the iron-ore beds are composed of quartz and a pale-green amphibole (grünerite) with a mixture of magnetite and hematite. Compared with the thicker masses in Godamalai, the western extension is poor in iron-ore, which forms about one-third only of the bulk of the rock (No. 11·924). The *quartz* is quite clear and colourless, occurring as small granules with sharp extinctions and in larger crystals with

[1] King and Foote, *Op. cit.*, p. 270.
[2] *Op. cit.*, pp. 281—284.

undulose extinctions and ragged granulated margins. The *amphibole* is of a very pale-green colour, almost colourless, in thin section. The double refraction is strong and the axes of optical elasticity distributed according to the usual arrangement in the hornblendes; the angle of extinction in clinopinacoidal sections ($c:\mathfrak{c}$) is 18°. The crystals are generally elongated slightly along the direction of the vertical axis, but show no definite crystallographic outline. Gliding planes parallel to the base are common; but definite twinning was observed in one case only. The crystals are stained by ferruginous depositions along cleavage and fracture cracks.

Intergrowths of hematite and magnetite.

The presence of *hematite* with *magnetite* in the iron-ore has been ascertained simply by determining the ratio of ferrous to ferric oxide by titration with permanganate of potash. In pure magnetite there is twice as much iron (Fe) in the ferric (Fe_2O_3) as there is in the ferrous (FeO) condition; but in specimens collected from the Godamalai beds the iron in the form of ferric oxide was found to be quite three times the amount occurring as protoxide, the actual figures for the average of four tests being 3·41 Fe as Fe_2O_3 and 1·10 as FeO. This corresponds to 4·86 Fe_2O_3 and 1·41 FeO, respectively, or to 4·54 parts of magnetite with 1·73 parts of hematite. This is the only specimen of Godamalai ore which I have tested, but on examining the results of the analyses made at the Imperial Institute it was found that practically all other Salem magnetic ores showed by excess of the sesquioxide the presence of a considerable proportion of hematite with the magnetite. The analyses published in the Imperial Institute Journal for June 1896 (Vol. II, p. 223), gave the amount of each oxide as well as the percentage of pure iron (Fe). By multiplying the percentage of FeO by $\frac{2}{9}$ (which represents the molecular ratio of FeO to Fe_3O_4), we obtain the amount of magnetite present, which, deducted from the total oxides, gives the hematite. This calculation, applied to the 16 analyses of Salem magnetic ores, brings out the fact that in 7 of the specimens the hematite exceeds the

magnetite, whilst in the remaining 9 ores the latter mineral predominates. The average percentage of the combined oxides is 77·04, of which 43·83 is in the form of magnetite, and 33·22 in the form of hematite. The following table shows the results of the calculations for each specimen :—

Salem Magnetic Ores.

Locality.	Oxides found by analysis.		Minerals calculated from analysis	
	FeO	Fe_2O_3	Magnetite. ($FeO\ Fe_2O_3$.)	Hematite. (Fe_2O_3.)
Kanjamalai	20·07	75·20	64·67	30·60
Ditto	3·56	48·10	11·46	40·20
Ditto	11·62	38·13	37·42	12·33
Ditto	30·03	66·72	96·75	*Nil.*
Ditto	17·72	70·98	57·12	31·58
Ditto	23·73	69·29	56·47	36·55
Kollimalais, south of . . .	22·38	74·77	71·72	25·43
Namagiripett	2·07	51·10	6·67	46·50
Ditto	17·68	78·07	56·96	38·79
Ditto	17·36	77·95	55·96	39·35
Ditto	4·14	41·00	13·34	31·80
Ditto	4·96	40·44	15·98	29·42
Mathurútú	16·10	68·12	51·90	32·32
Ditto	11·67	77·64	37·61	51·70
Ditto	14·09	77·51	45·41	46·19
Murugathumalai . . .	6·78	53·75	21·84	38·79
AVERAGE .	77·04		43·83	33·22

On examining the analyses made of 4 Malabar magnetic ores we obtain similar evidence of the presence of hematite with the magnetite, and in this case the two minerals are present in about equal quantities.

Malabar Magnetic Ores.

	Oxides found by analysis.		Minerals calculated from analysis.	
	Fe O	$Fe_2 O_3$	Magnetite. ($Fe O Fe_2 O_3$.)	Hematite. ($Fe_1 O_3$.)
Walluvunád taluk . . .	6·67	46·03	21·49	30·21
Ernád taluk	13·91	46·40	44·83	15·48
Ditto	6·35	57·37	20·46	43·26
Ditto	14·26	70·34	45·94	38·66
AVERAGE .	65·08		33·18	31·90

In some cases, as in the ores from Namagiripett, Salem district, the proportion of hematite is so high that the specimens give a decidedly red streak, and so the presence of hematite can be detected in the field; in fact this circumstance was noticed when collecting the ores.[1] I have made an attempt to determine the form in which the hematite exists in these ores by etching thin sections with dilute hydrochloric acid. The magnetite dissolved more readily than the hematite, with the result that the residue left by etching gave a distinctly red streak; but the intergrowth of the two minerals was altogether too intimate to determine in opaque sections their crystallographic relations. The results of the etching, however, leave no doubt that the minerals, besides forming distinct lumps which can be

[1] See *Rec., Geol. Surv., Ind.*, Vol. XXV, p. 138; and Imperial Institute Hand-book, No. 8, p. 3.

recognised in the hand specimen, also occur intimately intergrown with one another, in consequence of which the hematite is masked and the whole grain appears to be magnetic. This accounts for the fact that these ores have hitherto been described simply as magnetite.

Suggested origin of the magnetite.

Knowing that hematite is transformed into magnetite by heat, the discovery of the two minerals together in the well known ore-beds of South India suggests the natural inference that they represent a stage in the thermal metamorphism of hematitic quartzites, similar, for instance, to those which are well known further north as members of the Dharwar system. Indeed, there are so many points of correspondence between the ore-beds of south Salem and those of the Dharwars that one naturally enquires into the possibility of the former being merely highly metamorphosed outliers of the latter. The differences between the two are just those which we should expect to result from an advance in the degree of thermal metamorphism: the Salem magnetic beds are coarser in grain and generally more perfectly crystallized than those of the Dharwars; the hematite has been more completely changed into magnetite,[1] whilst the grünerite represents in the southern beds the chloritic minerals of the Dharwar schists. Knowing now that hematite exists side-by-side with magnetite in most, if not in all, of the magnetic ores of the south, the differences in the condition of the iron-ores become merely differences of degree, not of kind.

Having no fossils in any of the Peninsular transition rocks, the correlation of isolated exposures of the Dharwars rests purely on petrological similarities. If, then, these outliers of ore-beds differ from the typical Dharwars merely in degree of alteration, the reasons for excluding them from the Dharwar system must rest on the very slender assumption that the degree of metamorphism is a safe

[1] I have recently observed much magnetite also in many of the Dharwar hematitic quartzites.

quantitative index of age. If, on the contrary, we assume that these beds are merely altered outliers of the Dharwars, we must be prepared for the conclusion that the break between what we distinguish as Dharwars and what we class as Archæan has not been satisfactorily established for all South India; it is the latter assumption that I should feel inclined to favour. That some Dharwars are younger than some gneisses has been locally established beyond question by Mr. Foote; but we are still in want of direct evidence as to the greater antiquity of other very large formations of gneisses, notably the charnockite series.

(3) The Pyroxene-granulites, or Charnockite series.

General characters.

The most abundant rocks in the neighbourhood of Salem present the characters of the peculiar group known in Germany as "pyroxene-granulites," and in France as "pyroxene gneisses." In South India we have developed the habit of recognising these rocks under the name "charnockite series," the reasons for which, together with a general description of the whole group, are given in a separate paper, *Mem., Geol. Surv., Ind.*, Vol. XXVIII, part 2. These rocks occur in much larger masses in South India than is usually the case with their European equivalents; in the present area, for instance, the Shevaroy hills, forming a plateau of between 4,000 and 5,000 feet, and covering an area of over 100 square miles, are composed entirely of pyroxene-granulites. The lenticular habit of these rocks is very well illustrated in the neighbourhood of Salem, where the lenses vary in size from a few inches in length to small hillocks, rising abruptly above the general level of the plains, and through larger hills to mountain masses like the Shevaroys.

Previous classification.

These rocks which we now distinguish as the charnockite series were referred to by Messrs. King and Foote as "syenitoid gneiss"[1] on account of

[1] *Op. cit.*, p. 269.

their structure and the prevalence in them of hornblende, the hypersthene which always accompanies and often quite replaces the hornblende not being recognised till the rocks were microscopically examined at a much later date. As early as 1864 King and Foote had recognised this type of rock in other large mountain masses in South India, and called attention to its existence as the typical form of rock in the Nilgiri and Anaimalai hills. In later years it was identified at many other places in the south, and became distinguished by Mr. Foote as belonging to the Salem division of the gneisses, being considered to be younger than the granitoid type of Bellary and that of the Baramahal division of the Salem district. Although the observations which I have made in the neighbourhood of Salem point to the charnockite series ("Salem division of the gneisses") being younger than a biotite-gneiss in the same area, we have no evidence for connecting this biotite-gneiss with that of the Baramahal portion of Salem district to the north, or with the granitoid gneiss of Bellary district. The charnockite series have a long junction line with the Baramahal biotite-gneiss in the Salem district, but no attempt has been made so far to work out the relations of the two rock groups along this junction line. That the two are quite distinct in their characters, and therefore almost certainly different in age and origin, cannot be doubted; but as to their relative ages we have so far no direct evidence. Biotite-gneisses are altogether too common to permit the assumption that the biotite-gneiss near Salem belongs to the same formation as that of the Baramahal in North Salem district; indeed the two present differences which indicate that they are distinct. The results of the observations made near Salem have, therefore, no necessary bearing on the question of the relations between the charnockite series and its more northerly neighbour, the granitoid gneiss of the highland taluks (Baramahal) and the plateau of Mysore.

The "intermediate" varieties.

The rocks exposed in the neighbourhood of Salem include a

fairly complete list of the known varieties of the charnockite series, garnetiferous and non-garnetiferous. Those of "intermediate" composition are, however, by far the most abundant, and are typically represented in the Shevaroy mass, where they are as a rule non-garnetiferous.

Distinctive characters.

The varieties which are distinguished as "intermediate" are not only intermediate in specific gravity and bulk analysis between the acid and basic extremes, but microscopic examination shows each specimen to contain practically *all* the minerals which are generally found in the complete series; even in the same section we find hypersthene, augite and the peculiar brown-green hornblende, with quartz, potash-felspar, plagioclase and iron-ores, and these minerals exhibit a great tendency to aggregate into groups of granules of the same class, which gives the rock a very blotchy appearance. But notwithstanding this apparently composite character which the microscope thus exaggerates, a series of large hand-specimens taken from different parts of the Shevaroy mass are remarkably uniform in average composition. Even by taking small specimens, such as one uses for determination by a Walker's specific gravity apparatus, the local divergences from the mean result are not great. To obtain an idea of the average composition of the Shevaroy mass of rock, 48 specimens were taken indiscriminately from different parts of the hills and found to have an average specific gravity of 2·777, with very closely agreeing results for the averages of each exposure. This result is practically identical with the average (2·775) obtained for a smaller number of specimens collected at random by Dr. H. Warth in the South Arcot district. It is not difficult, nevertheless, to obtain in any large exposures small specimens which are basic in composition and others which are distinctly acid; but the rock most frequently met with in the Shevaroys is one in which this separation into distinctly basic and acid portions is not evident in

hand-specimen, although under the microscope the low powers are sufficient to show that differentiation has taken place on a small scale, the ferromagnesian silicates being concentrated in some areas and cleared away from others.

More complete segregation.

In some parts of South India the separation of acid from basic forms has resulted, as in the hill near St. Thomas' Mount, Madras, in a formation of a distinct and large mass having the specific gravity and chemical composition of a granite, associated with other masses uniformly basic in composition, with a constant specific gravity of 3·03 and the mineral constitution of the augite-norites. This formation of large distinct masses of the acid and basic forms of the charnockite series is, however, comparatively rare; the exposures most frequently met with belong to the "intermediate" group in which the differentiation into acid and basic phases has proceeded to a very limited degree, sufficient merely to produce a blotchy character in the rock. The significance of this constancy in average composition and of the limited range of variation are discussed more fully in the separate paper on the charnockite series.

The charnockite series of the Shevaroy hills are even-grained, blue-grey, or greenish-grey rocks in which it is generally difficult in hand-specimen to distinguish the quartz from the felspar, both being very fresh and presenting the characteristic colour of the series.

Blue quartz.

This colour is probably due to the innumerable, minute, acicular inclusions which are found, on microscopic examination, to be included in the felspars as well as in the quartz. The acicular inclusions have apparently a definite crystallographic disposition within both minerals, and the simple optical characters of the uniaxial quartz permit the determination of the main crystallographic directions, from which the positions of three of the sets of needles have been obtained. The needles

are also arranged in definite lines and probably planes in the felspars, but the want of idiomorphic outlines prevents their determination. For the quartz three sets of needles have been found to be arranged as follows :—

(*a*) parallel to the lateral crystallographic axes, and thus in the principal planes of symmetry.

(*b*) parallel to the vertical axis.

(*c*) parallel to the face of the unit rhombohedron and lying in the secondary planes of symmetry.

The needles lying in the basal (isotropic) sections of quartz show straight extinction, but being thinner than the quartz in which they lie the distribution of the axes of elasticity in such sections could not be determined.

Whenever the hair-like inclusions occur in the quartz and felspar of these rocks, the hypersthene and other ferromagnesian silicates show the ordinary schiller inclusions in the form of black and brown rods and plates, whilst in the basic garnetiferous varieties, the garnets also contain acicular inclusions; these last have been described in a separate paper.[1]

Mineral composition of the intermediate forms.

With regard to the other constituents of the charnockite series, the augite is the ordinary pale blue-green variety characteristic of these rocks, the hyphersthene is highly pleochroic and the hornblende, a strongly pleochroic, brown-green variety. Opaque iron-ores, zircon, apatite and biotite occur as accessories. Microperthitic structures and "quartz of corrosion" are very common in the "intermediate" members of the charnockite series.

Schlieren.

The ordinary massive and well foliated rocks are traversed by acid, coarse-grained veins (contemporaneous or segregation veins) in which there is often a considerable quantity of titaniferous iron-ore. In other places

[1] *Rec., Geol. Surv., Ind.*, Vol. XXIX (1896), p. 16.

basic segregations are found; these are generally more hornblendic and finer in grain (Nos. 11·910, 11·911) than the ordinary rock in which they appear to be included. At their margins these bodies are found on careful microscopic examination to pass gradually, though rapidly, into the general main mass of the rock. They correspond exactly to the basic *Schlieren* which are so commonly found in granites, syenites and other plutonic igneous masses, and are considered to be portions of the magma which have consolidated in advance of the main mass. Their fine-grained structure, basic composition and hornblendic character are all features generally displayed by the border facies of these rocks. In Coorg, where dykes of the charnockite series have recently been discovered, these special points of character distinguish the selvages from the central portions of the dykes. Sometimes the basic, early-formed *Schlieren* become broken up and the pieces cemented by the subsequently consolidated, more acid, rock, producing a sort of primary eruptive breccia or protoclastic structure; numerous cases of this kind are to be seen in the Shevaroy hills.[1]

Corrosion of biotite-gneiss by charnockite.

Important light is thrown on the nature of the charnockite series by a section exposed near the Namakkal road, 3½ miles south of Salem. The quarry in which this section is exposed occurs at the junction of the charnockite series which forms the main-mass of the Jarugamalais, lying to the east, with the old biotite-gneisses which stretch away to the west and crop up at intervals in the well cultivated plain. On the freshly exposed rock-surface, tongues of the charnockite series, proceeding from the direction of the great Jaruga hill-mass, are seen to protrude into the biotite-gneiss, running obliquely to the foliation planes of the latter. The charnockite is slightly more basic than the average intermediate kind, having a

[1] For a fuller discussion of these structures see the Memoir on the Charnockite Series (Vol. XXVIII, pt. 2).

specific gravity of 2·80. The biotite-gneiss contains much quartz and is distinctly acid in composition. In petrological characters also the two rocks are quite distinct: the charnockite is a compact, blue-grey, fresh-looking rock, whilst the biotite-gneiss is well foliated and mottled by patches of a dark-green, micaceous mineral lying in dirty-white felspar and pale-blue quartz with, frequently, shreds of pyrite. Under the microscope the charnockite is found to be composed of hypersthene, pale blue-green augite, felspar and a little quartz, with lumps of opaque black iron-ores, all showing a common type of rock amongst the charnockite series, and displaying practically no signs of dynamo-metamorphism. The biotite-gneiss, on the other hand, is not only highly crushed, but its minerals all show signs of alteration of a kind not seldom found in definite contact cases: epidote and muscovite are formed in the felspars, pyrite and rutile are fairly abundant, and the ferro-magnesian silicates have completely lost their individuality, being replaced by an

Fig. 1.—Altered biotite-gneiss near its contact with charnockite, 3½ miles south of Salem. (Section magnified by 20 diameters.)

indeterminate felsitic product surrounded by radiate fringes of micaceous and hornblendic minerals, now far gone in the processes of chloritization (fig. 1). If these two rock masses, biotite-gneiss and the charnockite series, merely existed as adjacent formations it is possible that one of them might suffer dynamo-metamorphism without alteration of its neighbour; but when thin tongues of the two are so completely dove-tailed, it is difficult to see how the charnockite could escape the metamorphism which has been so evidently disastrous to the tongues of the gneiss. The most straightforward inference is that the charnockite attained its present position after the crushing of the gneiss, that in fact it has trespassed across the foliation planes of the latter. This implies that the charnockite has behaved after the fashion of an igneous rock, and that it is younger than this particular biotite-gneiss.

But there are two facts, however, which detract from the simplicity of this conclusion and introduce an element of doubt: one is the absence of chilled selvages at the junction of the charnockite with the gneiss, and the other is the presence in the charnockite of indistinct dark patches parallel to the dark patches in the gneiss. These two facts show that the charnockite tongues have not been intruded into fissures in the gneiss after the fashion of a simple igneous injection; but rather that the "trespass" was more of the nature of corrosion, imperfect pseudomorphs of the old structures being preserved by the corroding charnockite magma. Here, because we have no exact parallel among our simple igneous intrusions, we approach the dangerous ground of speculation. But it must always be kept in mind that the phenomena displayed when an igneous magma attacks a rock already highly heated at great depths are not likely to be analogous in all respects to the phenomena presented when an igneous rock is injected into a cold formation.

Basic varieties.

Basic varieties, besides occurring as small autoliths in the

Form and mode of occurrence.

more prevalent type of the series, form separate and comparatively large masses of a roughly lenticular shape in the old biotite-gneiss. Several of these masses, standing up as small, but conspicuous, hills, are seen near Salem and in the wide flat valley stretching eastwards towards Ahtúr. These are not the result of the irregular pinching out of thick bands; for the long axes of the lenses, although parallel to one another and to the general foliation of the country, are not in line, but are arranged *en echelon*. Their lenticular shape is generally well shown by the contours of the hills, and in one case, ¾ mile east-north-east of Karipatti, a small river has cut across the end of a lens exposing its tapering edge in the highly crushed schists. The rocks composing the lenses are generally without signs of severe crushing and often quite massive, whilst the other gneisses around, particularly at the edges of the lenses, are highly crushed, sometimes to form real "leaf gneisses."

Lacroix's correlation.

Some of the rocks described by Lacroix under his *b* division of the pyroxenic and hornblendic gneisses[1] were probably obtained by Leschenault from these small hills near Salem; others, however, cannot be found near Salem, but were almost certainly obtained at considerable distances from the town, and have no known connection with the rocks now under description. Lacroix correlates these rocks with the pyroxenic gneisses of North Finisterre, which are regarded as young members of the French survey division ζ'.

Distribution.

Some of the basic lenticular masses are without garnets and resemble very exactly the basic hornblendic schlieren (autoliths) found in the more acid Shevaroy mass; good examples of these rocks occur in the Salem-Ahtúr valley (Nos. 11·923, 11·926, compared with 11·910, 11·911, 11·917). Others, generally coarser in grain, contain garnets and

[1] *Rec., Geol. Surv., Ind.*, Vol. XXIV, p. 175.

are well shown in the rocky hill immediately west south-west of Salem and in Nagaramalai near the Chalk hills (Nos. 9·683, 9·684, 11·903). The latter rocks are almost always associated with pyroxenite (*vide* page 26).

Non-garnetiferous forms.

The non-garnetiferous basic forms are composed almost always of pale-green augite, hypersthene, brown-green hornblende, felspar, iron-ores and apatite. Variations in the relative proportions of the first three constituents and in size of grain are frequently observed, but the resemblance in the essential features of the large lenticular masses to those of the small schlieren is so complete that there can be little doubt that the isolated small hills in the Salem-Ahtúr valley are composed of rocks related to those in the Shevaroys.

Garnetiferous varieties.

In the garnetiferous varieties the garnets sometimes attain the size of a fist, and are often surrounded by large crystals of hornblende and augite, forming patches in the rock having the composition of hornblende-eclogites. Under the microscope the garnets show a very spongy structure through inclusion of blebs and granules of a colourless mineral resembling quartz. Frequently the garnets are seen to be grown, coronal fashion, around the hypersthenes ; in such cases vermiform

Fig. 2—Hypersthene with corona of spongy garnet, Nagaramalai (No. 11·903).

cavities are arranged radially, whilst near the hypersthene the garnet is particularly spongy (fig. 2). In some sections the garnets

form complete rings surrounding a perfectly granulitic fine-grained mass of quartz (fig. 3).

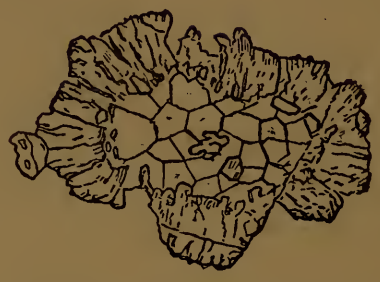

Fig. 3—Coronal ring of spongy garnet surrounding granular quartz, Nagaramalai (No. 11·903).

The disposition of these garnet crowns around the hypersthenes, and the peculiar structure they exhibit, suggest their secondary formation at the expense of the ferromagnesian silicate; in this case the colourless quartz would represent the supplementary silica relieved by the formation of the less siliceous garnet from pyroxene.

Some pyroxenic rocks in Bengal described elsewhere[1] show a similar formation of spongy garnet with concomitant separation of quartz; but in the Bengal rocks the formation of the garnet is preceded by amphibolization of the pyroxene, and the details of the change can be more perfectly traced than in these Salem rocks.

Conditions favourable to the formation of garnets.

The garnetiferous basic members of the charnockite series in the neighbourhood of Salem are often quite massive, and show no signs of crushing after consolidation. There are many features in them, however, which indicate that the garnets are not simple primary constituents, and of course we have many other instances in which there is no possible doubt about the garnets being of secondary origin. Simple dynamo-metamorphism is evidently not essential to their

[1] Holland. "On the origin and growth of garnets and of their micropegmatitic intergrowths in pyroxenic rocks." *Rec., Geol. Surv., Ind.*, Vol. XXIX (1896), p. 20.

production; for in these rocks there is no sign of crushing. The change which takes place when garnet is formed at the expense of pyroxene is of the kind which Dana[1] termed *metachemic*, and results in the elimination of silica with concomitant formation of quartz. Pyroxene is stable at high temperatures, whilst it readily changes to amphibole by dynamic action at low temperatures; but perhaps at some intermediate temperature, below the actual melting point, the pyroxenic molecular compound breaks up into two bodies—the basic garnet and the siliceous residue, quartz. The heat caused by, or the heat accompanying, dynamo-metamorphism is probably essential to this metachemic change; but the change may occur when the requisite temperature conditions are fulfilled without dynamic action.

Acicular inclusions in garnets.

Lacroix has called attention to the acicular inclusions sometimes found in the garnets of these rocks near Salem; these he regards, however, as rutile needles,[2] whereas the inclusions which I have found in, for instance, the Nagaramalai garnets, show very wide extinction angles and are probably monoclinic in crystallization. They are arranged with remarkable regularity of crystallographic disposition within their host the garnet, having their long axes parallel to the edge of the octahedron, their orthopinacoidal faces parallel to the rhombic dodecahedron and their clinopinacoidal faces parallel to the cube.[3] Diller found similar inclusions in a fragment of granulite near the peridotite of Elliott County, Kentucky,[4] and Harker has mentioned the wide extinction angles exhibited by the needles found in the garnet of an eclogite from Port Tana in the north of Norway.[5]

[1] *Amer. Journ. Sci.*, Vol. XXXII (1886), pp. 69-71.

[2] Lacroix, *Rec., Geol. Surv., Ind.*, Vol. XXIV, p. 176.

[3] Holland, *Rec., Geol. Surv., Ind.*, Vol. XXIX, p. 16.

[4] Diller, *Bull. U. S. Geol. Surv.*, No. 38 (1887), p. 27.

[5] *Geol. Mag.*, 3rd decade, Vol. VIII (1891), pp. 170, 171. Harker compares these needles to kyanite in his original paper, but in his "Petrology for Students" (2nd edition (1897), p. 327) refers them to rutile. The disposition of the needles parallel to the dodecahedral faces, and many details about the other constituents of the rock strongly recall these occurrences near Salem.

The appearance of the needles in the garnets seems to be always accompanied by schillerization of the associated constituents of the rock, and on this account it has been suggested that the schiller inclusions in the pyroxenes, amphiboles and felspar are due to a cause similar to that which produced the needles in the garnet and, in the acid members of this series, the needles found in the quartz (*supra*, page 17).

Coincident schillerization of the other constituents.

It is very interesting to observe that all the old rocks in the neighbourhood of the Chalk hills, including the Shevaroys, are well schillerized. It is just possible that the great peridotite intrusions of the Chalk hills may have been connected with the circumstances which favoured this schillerization of the rocks around; and in this connection it is worthy of note, though it may be a mere accidental coincidence, that the garnets, in which Diller found needles similar to those herein referred to, were found near a peridotite intrusion.

Ultra-basic forms.

It is quite common, especially in the immediate neighbourhood of the basic garnetiferous varieties, to find lenses, bands and small dyke-like formations practically devoid of felspar. In the majority of these pyroxene predominates, whilst in others the hornblende is in excess of the pyroxene. Trains of lenses of the former kind, pyroxenite, occur along the northern foot of the hill west-south-west of Salem (11·900). The lenses are very variable in size, but are often a foot or two wide and some four to six feet long. Although these lenses are distributed along the foot of the hill parallel to the foliation of the basement rocks, they do not occur strictly confined to one band, but are arranged *en echelon*; this indicates that they have not been

Pyroxenites and Amphibole rocks.

formed by the pinching out of a single band, but more probably are the result of intrusion between the folia. Further masses of pyroxenite are exposed in Nagaramalai (11·904, 11·914) the uppermost rocks of which are precisely similar to those of the hill west-south-west of Salem. About half-way up the south-western slopes of the Shevaroys there are large masses of these rocks in which hornblende greatly exceeds the pyroxene in quantity. These rocks are essentially the same as the pyroxenites of Pallavaram (Nos. 9·394, 9·667, 9·672, 8·756) and the hornblende-pyroxenites or amphibolites of Tiruppur (9·309) and South Arcot (9·809). The ultra-basic forms —pyroxene and pyroxene-amphibole rocks—so abundant in the neighbourhood of Salem do not appear to have been described by Lacroix, although they are always associated with, and are certainly related to, the basic pyroxenic gneisses. Most of them contain small quantities of olivine and a green spinel. Details concerning their microscopic characters will be found in the separate paper on the charnockite series.

(4) Younger igneous intrusions.

The igneous rocks, which appear to be quite independent of the direction of foliation, and which were therefore probably intruded after the folding movements in South India had ceased, form three groups, whose relative ages cannot be determined with certainty for the reason that they do not come into contact with one another. These are—

(*a*) Augite-diorite (diabase) dykes with micropegmatite.

(*b*) The magnesian series of the "Chalk hills."

(*c*) The "White Elephant rocks".

4a.—Augite-diorite (diabase) with micropegmatite.

Shevaroy dyke.

The most prominent of the basic trap dykes in the area under discussion runs in a north-west—south-east direction completely across the Shevaroy

mass. As it often does when cutting through the charnockite series, this dyke determines the direction of a depression instead of standing up above the rocks around. On the south-east side it passes through the valley which separates the so-called Twin Hills, and from there it may be traced north-westwards to the Kadiampatti (Atúr) ghat where a small stream rushes down approximately parallel to the course of the dyke, and has cut out the depression along which the ghat road from the Kadiampatti railway station to the top of the plateau has been constructed. Whilst this dyke can be traced completely across the plateau from one edge to the other, it is not known beyond the limits of the Shevaroy mass.

Karipatti dyke.

Another dyke, similar in size (that is about 50 yards wide) and in general characters, commences abruptly at a point about one mile south-east of Karipatti, and thence runs south-eastwards. Although these two dykes are similar in size, direction and petrological characters, they are not exactly in line with one another, and no trace of a dyke has been found at any intermediate point. A third dyke has, however, been found much further to the westward, near the south-eastern corner of the larger area of peridotites. This exposure of the rock is about as wide as it is long; and its edges being covered with talus material, it is difficult to determine its direction.

Petrology of the dykes.

All these rocks are augite-diorites (diabases) with micropegmatite, and in all three exposures they show the essential features of the least basic division of the rocks which in South India are generally regarded as the dyke-representatives of the Cuddapah lava-flows. These Cuddapah dyke-rocks are divisible into three groups, which, however, are not sharply marked off from one another, but pass by insensible gradations from one to the other, and present throughout a similarity of certain peculiarities which indicate that they were derived from the same magma, differing from one another merely through

original differentiation. The most basic types contain olivine, and show an excess of enstatite over augite ; the members of the next division are without olivine and show a tendency for the augite to replace the enstatite, whilst in the third division the augite exceeds the enstatite in quantity and the rocks then always contain a certain quantity of micropegmatite. It is to this last, the most acid division of the dyke-rocks, that these three exposures in the neighbourhood of Salem belong.

Relationship of the dykes.

In all their original characters these three exposures are in perfect agreement with one another, and with the usual type of this division of the South Indian dykes.[1] They consist of pyroxene and plagioclase with micropegmatite. The pyroxene crystals are pale-coloured, and are often composed of intergrowths of the rhombic and monoclinic forms ; the plagioclase (near labradorite) is generally brown through included dust, and the micropegmatite often contains lumps or skeletons of opaque black iron-ores. In the immediate neighbourhood of the micropegmatite the augite has been changed to a green hornblende (and sometimes biotite), as is commonly the case with these rocks. So far as our experience goes, these points are peculiarities which distinguish what we regard as Cuddapah dykes from some others, like the augite-plagioclase dykes of Coorg, for instance, which are probably representatives of the younger Deccan traps.

Differences due to secondary causes.

Whilst the dyke near Karipatti shows all these peculiar features in the most typical manner, the exposure in the Shevaroys, and the one near the Chalk hills, show certain peculiarities which I am inclined to regard as secondary. For instance, the plagioclase has lost its brown colour, but is instead crowded with distinct black rods

[1] *See* "Augite-diorite group" in the paper "On some norite and associated basic dykes and lava-flows in Southern India." *Rec., Geol. Surv., Ind.*, Vol. XXX (1897), p. 31. Also *Quart. Journ., Geol. Soc.*, Vol. LIII (1897), p. 405.

and plates, after the style of schillerized felspars, whilst there is a greater development of secondary green hornblende at the expense of the pyroxene than is usual in these dykes. As all the rocks in the neighbourhood of the Chalk hills, including the Shevaroy mass, are schillerized, and as the phenomena of schillerization are generally held to be due to secondary causes, these points of difference between the Karipatti dyke and those further west are of no importance. But one point remains, however, unexplained, namely, the brown colour of the felspars in the Karipatti dyke which is the usual thing in these rocks, and the clear colourless character of the felspars in the other two dykes which is an unusual character. Personally, I am inclined to regard this brown dust in the felspar as original, whilst the rods and plates constituting the schiller phenomena are secondary, and manufactured by secretion and subsequent deposition of the compounds of the brown dust along planes of chemical weakness. For this assertion the evidence is not yet sufficiently clear to constitute anything approaching proof, and the point should therefore be kept in abeyance. But with the exception of this one point, whose meaning is doubtful, the three dyke exposures near Salem belong essentially to the same rock, and almost certainly are the result of the same eruption. But whether or not the three detached exposures were originally irrupted into the same fissure, is an important question which is less easy to decide. If we could but settle this point, we should have a simple guide as to the nature and amount of disturbance which has taken place in this area since the formation of the dykes (*vide* page 39).

Narrow subsidiary apophyses.

Besides the large dykes measuring some 50 yards wide, narrow apophyses run out into the surrounding rocks, and often continue for some distance approximately parallel to the large dyke. The composition of these narrow dykes is essentially that of the large ones, but they show

the usual[1] differences in structure due to more rapid cooling (Specimens Nos. 11·933 and 11·934). Sections taken from near the selvage of a three-inch dyke (11·934) show very prettily the rapid transition from the black opaque, probably glassy, matrix to the pilotaxitic base, in which the porphyritic crystals of pyroxene and plagioclase are imbedded.

4b.—The Magnesian Series.

The peculiar rocks forming the so-called "Chalk hills" were mapped by Messrs. King and Foote, and their field characters described with accurate detail in their memoir published in 1864.[2] The prevalence of peridotites within this area was established by me in 1892,[3] the detection of these as the primary rocks leading to a simpler explanation for the origin of the secondary magnesite in this and in the many similar occurrences of peridotite subsequently found in South India.

Prevalent forms.

The prevailing type of peridotite in the Chalk hills is olivine-rock, containing, like the similar dunite of New Zealand, quantities of magnetite and chromite with sometimes enstatite. It is accompanied by dyke-like masses of mica-augite picrites which sometimes show very fine poikilitic structures.

Alteration products.

Secondary alteration of these rocks has resulted in the formation of magnesite, chalcedony, serpentine (principally in the form of picrolite) and talc. The white appearance of the area due to the large quantities of magnesite gave rise to the ill-chosen name "Chalk hills."

Chromite.

The chromite occurring in the dunites of the "Chalk hills" is as usual in these rocks very irregular in its distribution, a circumstance due to its segregation

[1] See *Rec., Geol. Surv., Ind.*, Vol. XXX, p. 36.
[2] *Op. cit.*, p. 312.
[3] *Rec., Geol. Surv., Ind.*, Vol. XXV, pp. 143, 144.

into nodules and bands (*schlieren*) during the early stages of consolidation of the rock.[1] Besides the larger nodules, such as those at one time worked by the Porto Novo Iron Company, chromite occurs as isolated granules with magnetite disseminated through the dunite.

The prevalence of magnesite.

We now know of a large number of occurrences of similar peridotites in the Madras Presidency, Mysore and Coorg, and in all cases so far examined magnesite, occurring in veins, constitutes the chief product of secondary change in the dunite, whilst serpentine occurs only in comparatively very small quantities. In view of the fact that the latter mineral (serpentine) is the most abundant secondary product in the better-known occurrences of peridotite in Europe and America, this remarkable abundance of magnesite in the Madras Presidency becomes a feature which deserves special consideration.

Origin of the magnesite.

There is one fact which on further investigation may point to the correct explanation of this abundance of magnesite; most, if not all, the peridotite eruptions of South India are accompanied by masses and veins of pure white quartz, which always contain considerable quantities of liquid carbonic acid. The constancy of this association of peridotite with pure quartz suggests a genetic relationship between the two, and it is not unlikely that the quartz is the end-product of the eruption in each case.[2] If, now, the carbonic acid is present in large

[1] For summary of facts concerning chromite deposits, see J. H. L. Vogt's "Beiträge zur genetischen Classification der durch magmatischen Differentiations-processe und der durch Pneumatolyse enstandenen Erzvorkommen: Ausscheidungen von Chromeisenerz in Peridotiten." *Zeitschr. für. praktische Geologie*, 1893, p. 268, and 1894, p. 382.

[2] There appears to be no theoretical objection to this idea of peridotite and quartz being derived from the same magma. The protoxides of iron and magnesia, which are so abundant in the peridotites, require a small amount of silica to produce olivine, and, in the absence of alumina and other bases, the excess of silica must crystallize as free quartz; this, in fact, only shows how very imperfectly our ordinary classification by silica percentage expresses the natural genetic relationships between our different types of eruptive rocks, for the peridotite and quartz would ordinarily be placed at opposite extremes of the eruptive list.

quantities and under high pressure, as is shown to be the case by the quartz, it would naturally attack the unstable silicate of magnesia (olivine) forming carbonate of magnesia and free silica, which is found abundantly in the magnesite and its associates. Whether the quartz is derived from the same magma as the peridotite, or whether it is a separate subsequent eruption, the argument still holds. This account of the formation of the magnesite disagrees with that put forward by Messrs. King and Foote only in recognising the fact that the rocks which have been altered were originally peridotites and not metamorphic rocks. After giving an account of a large number of such magnesite areas included within sheet 79 of the Indian Atlas, Messrs. King and Foote say: "These phenomena of the re-metamorphism of metamorphic rocks are of such a peculiar character that there can be but small grounds for hesitation in ascribing them to the action of water (probably of such elevated temperature as to have acted in some cases in the form of steam) aided by the presence of corrosive gases, especially carbonic acid gas."[1]

This inference, based on purely theoretical considerations, is abundantly confirmed by the discovery of liquid carbonic acid in the associated quartz; for in these cavities we have specimens of the carbonic acid preserved in a form which shows that, at the time at which the quartz crystallized, the gas was under very high pressure as well as at a high temperature.

Limited degree of hydration.

Small quantities of serpentine have also been formed by hydration of portions of the olivine which escaped the action of the carbonic acid; but compared with the magnesite, the serpentine is extremely small in quantity. It has been abundantly shown by the freshness of olivine, elæolite and other delicate minerals in very old rocks, that decomposition by subaërial agencies has been very superficial and limited in South India;[2] and the recognition of the evidences which show

[1] *Op. cit.*, p. 325.

[2] See *Rec., Geol. Surv.*, Vol. XXX, p. 40; *Mem., G. S. I.*, Vol. XXVIII, pt. 2. See also *Gol. Mag.*, decade IV, Vol. VI, 1899, p. 540.

that the magnesite is due to subterranean not to subaërial agencies removes our South Indian peridotites from the class of exceptions to this rule.

As the result of a detailed survey made in 1895 for the purpose of determining the distribution of the magnesite and chromite, Mr. Middlemiss, whilst confirming my previous discovery of the peridotites in the Chalk hills, grouped the minerals chromite and magnesite together as the results of secondary changes in the dunite. He says,[1] "there can be no doubt that originally nearly the whole of the Chalk hills area was composed of this extreme form of peridotite known as dunite. But mineral changes rapidly set in, and the two first of these changes that must be noticed are (*a*) the alteration, partially or wholly, of the olivine into serpentine, and (*b*) the segregation of the chromite into nodules and veins . . . . . Subsequent changes . . . . brought about the conversion of much of the serpentine into magnesite [and] effectually destroyed any ornamental qualities it might have possessed by giving it a dull earthy appearance."

As to the chromite, it seems safer, in the absence of unusual features, to follow the ordinary practice of regarding it as a mineral of early consolidation segregated into nodules and bands during the processes of primary crystallization.

The magnesite and serpentine are, according to my view, formed by secondary processes wholly distinct and independent of one another, and the order of these secondary changes is possibly the reverse of that indicated by Mr. Middlemiss. The magnesite, which is by far the most abundant alteration product, was formed, as stated by King and Foote, by the subterranean action of carbonic acid at high temperatures, attacking, nevertheless, true eruptive, not metamorphic, rocks. The serpentine was formed by simple hydration of parts of the remaining ferromagnesian silicate, to some extent

[1] *Rec., Geol. Surv., Ind.*, Vol. XXIX, pp. 33 and 34; also p. 32.

possibly by superficial (subaërial) agencies. The picrolite is in all probability the result of hydration of the olivine by subterranean water accompanying the carbonic acid and included in the original magma. This mineral may thus have been formed before, during or after the formation of the magnesite, whilst the serpentinous product, which has resulted from the action of subaërial agents, must have been formed last and at the expense of the remaining portions of the olivine. There is not, in my opinion, any evidence to show either that the dunite suffered an early serpentinization, or that the magnesite was formed by alteration of the serpentine. The two were formed independently, and, on the whole, the magnesite, which is the more abundant, was probably also the more early-formed of the two.

4c.—The "White Elephant rocks."

Two masses of white quartz are exposed on the southern face of the Shevaroy hills, one on either side of the Gundur spur. The eastern, which is the larger and most conspicuous, has been very accurately described in the memoir by Messrs. King and Foote; its appearance is very well shown in the photograph reproduced in plate II, which also shows the thick tangled nature of the jungle surrounding the rock, and which makes it so difficult of access.

The rock consists wholly of quartz, which is in coarse interlocking crystals, sometimes colourless and transparent, but generally white through innumerable cavities containing a liquid which passes into gas at about the critical temperature of carbonic acid. At the ordinary temperature bubbles are always found in the cavities, the very minute ones sometimes showing spontaneous movement.

Messrs. King and Foote grouped these masses of quartz with the younger acid intrusives, and the microscopic characters of the crystals confirm their conclusion as to the eruptive origin of the rocks. There are no signs of a clastic structure, such as we often get in a quartzite, and no regular arrangement of the crystals as is

generally the case with infiltrated vein quartz, whilst the liquid inclusions arranged in trains are quite characteristic of plutonic quartz. The absence of the blue-grey colour and the minute needles, to which I think this colour is due, serve to distinguish the "white elephant rocks" from the quartz of the charnockite series by which they are surrounded.

There is no direct evidence for connecting these masses of quartz with any particular eruption in the neighbourhood. But the nearest eruptives are the peridotites of the Chalk hills, and as every peridotite intrusion in South India seems to be accompanied by masses of pure white quartz, it is not unlikely that these masses belong to the Chalk hills province, and represent the end-product of that eruption (*vide* page 32).

III.—EVIDENCES OF LOCAL EARTH-MOVEMENTS.

Whilst the area now under consideration has probably suffered from no intense folding movements since the consolidation of the charnockite series, it has nevertheless suffered from earth-movements of a milder kind; indeed it is hardly likely that any region of the globe has submitted to the differential effects of uninterrupted denudation without the production of at least normal faults. As it must always be a matter of some difficulty to determine the nature and amount of earth-movements in areas covered only by crystalline rocks, the conclusions here based on the recognition of lines of dislocation must only be regarded as working hypotheses to be checked by more extended observations.

So far as can be judged by the limited number of observations which have hitherto been made, the south of India was subjected to at least two main systems of folding in pre-Cuddapah times. The last of these produced folds in a N.-W.—S.-E. or N.-N.-W.—S.-S.-E. direction, and outlined the position of the Western Ghâts, as well as of the N.-W.—S.-E. tongues of Dharwars which run obliquely across the Mysore State and adjoining districts. It is the effect of this folding which I believe to be shown in the neighbourhood of Salem in the form of N.-E.—S.-W. transverse dislocations. In probably every region which is folded such transverse dislocations,[1] or "heaves" as the miners call them, are formed by unequal compression of different parts of the same fold, and in many parts of the south of India the existence of these in the older rocks ought to be brought out by careful mapping.

Brecciation ("trap-shotten") bands.

In the area under discussion the evidence, though of a limited nature, appears to point to the fact that such a dislocation line runs

[1] "Transversale Horizontalverschiebungen," "Blätter," or "decrochements horizontaux (Heim and Margerie, "Die Dislocationen der Erdrinde," 1888, p. 71).

along the south-east face of the Shevaroys. Near Salem and to the north-eastward the rocks show a well marked "strain-slip" cleavage [1] and the peculiar phenomenon which King and Foote named "trap-shotten" gneiss on the supposition that the strings and tongues of hardened black mylonite were injected "trap," which they really do closely resemble in microscopic characters. In the neighbourhood of Salem the most pronounced of these so-called "trap-shotten" bands runs N.-E.—S.-W., and in some places accompanies a very thorough brecciation of the rocks. Good examples may be seen showing the direction of the brecciation bands in a field at about ¾ mile south of the seventh milestone from Salem on the old Cuddalore road; on the western spur of Jarugamalai, 3 miles south of Salem, and further to the south-west on the west side of the Namakal road. The first-mentioned locality is not far from the western end of the strip of leaf-gneisses described in a previous section of this paper (pages 8 to 14), and in fact the abrupt ending of these gneisses along a line running N.-E. from this point suggests that they have been cut off by a subsidiary N.-E.—S.-W. fault.

These so-called "trap-shotten" bands have been more fully discussed in a memoir on the charnockite series,[3] where it is shown that the black colour and compact character of the mylonite may be artificially imitated by crushing up charnockite and raising it to a white heat in a furnace. At a white heat the dust begins to frit and at the surface becomes glazed, forming a hard black cake which in microscopic characters closely resembles the black tongues of

Bonney, *Quart. Journ., Geol. Soc.*, XLII (1886), 95. Synonyms:—*Ausweichungs-clivage* (Heim, "Mechanismus der Gebirgsbildung," II, 53); a spurious or pseudo-cleavage as opposed to the true schistose structure or *ultimate-structure cleavage* of Sorby (*cf.* Harker, Brit. Assoc. Report for 1885, p. 836).

[2] *Op. cit.*, p. 271.

[3] *Mem., Geol. Surv., Ind.*, Vol. XXVIII, pt 2. Although this peculiar phenomenon was studied first in connection with charnockite, and has been described in the writer's memoir on that series in South India, the same structure is found in other gneisses and has no known petrological limitations.

supposed trap in the breccia. The strings and tongues of this black material in microscopic structure do not resemble any known trap or any substance which has solidified from thorough fusion.

The heat which has fritted the mylonite in these brecciated bands was probably produced by the friction during the process of brecciation, for the peculiar structures show that the dislocation must have been of a violent kind. Slow deformation of a rock would crush the constituents throughout the mass, but strains more quickly produced would result in dislocation along any narrow band, and so in addition to this *primâ facie* reason for concluding that the dislocation was violent, the fact that its effects are confined to a narrow band would account for the local rise of temperature and consequent fritting of the mylonite.

Apparent dislocation of trap-dykes.

The three exposures of dyke-rock described in a previous part of this paper are so very similar in all their primary characters, that one naturally examines the possibility of their having been originally injected into one great fissure, and of having formed a single dyke which subsequently became dislocated by earth-movements. In the case of the two which are sufficiently extended to show the direction of the fissure which they occupy, both dykes run N.-W.—S.-E., but are nevertheless not in line with one another. An extension of the line of the Karipatti dyke would meet the Shevaroys at a point near Gundúr, $3\frac{1}{2}$ miles from the S.-E. end of the Shevaroy dyke, which would indicate, if these dykes were originally in line, the total amount of dislocation which has occurred in the intermediate valley. Careful search for the dyke has been made in the valley, but without success. In fact the Shevaroy dyke, whilst extending continuously from edge to edge of the Shevaroy mass, has not been found in the low country at all, either to the N.-W. or to the S.-E (see Plate I).

It is thus not unlikely that the Shevaroy mass is structurally as well as petrologically distinct from the rocks of the country below

and immediately around it. The former circumstance might very well be the outcome of the latter, for in any great earth-movements such a strong, homogeneous mass would more readily part connection with the surrounding country than submit to internal deformation. There is thus a *primâ facie* reason for expecting evidence of dislocation at the foot of such distinct and large massifs as the Shevaroys and Nilgiris.

Apart from the question of movements due to crust-folding, it is questionable if uninterrupted denudation could proceed for such long ages without disturbing the isostatic balance by its differential effects.[1]

Besides the N.-E.—S.-W. dislocation lines which are so plainly exhibited near Salem, there is less satisfactory evidence of fracture in a more northerly direction running along the western face of the Shevaroys, and separating the normal charnockites from the basic garnetiferous varieties of the Nagaramalai type. The peridotites of the Chalk hills occur along this line, and if one could only be more certain of the evidence outlined above as to the north-easterly displacement of the Shevaroy mass, this mass of peridotite at the south-west angle might be regarded as the accompaniment, if not in part the cause, of the disturbance. Here, however, the deductions, in the absence of sufficient evidence, approach mere speculation, and it will probably be more profitable to allow the observations to stand in

[1] C. E. Dutton, "On some of the greater problems of Physical Geology." *Bull. Phil. Soc., Washington*, Vol. XI (1892), p. 51. For the condition of equilibrium of figure to which gravitation tends to reduce a planetary body, irrespective of whether it be homogeneous or not, Dutton proposed the name *isostasy*. Whilst pointing out that the earth's crust would not be strong enough to permit any great departure from the isostatic condition, Dutton admits that it is impossible to state with precision to what extent differential denudation and deposition may be carried before producing movement towards the restoration of isostasy. Judging by the instances he quotes (and which show that the geological is more precise than the mathematical estimate) a mass of rock covering 100 square miles and ranging between 3,500 and 5,500 feet above the surrounding country could not be maintained without deformation to restore the isostatic balance. I expect we shall find that large homogeneous masses like the Nilgiris, the Shevaroys and other hills in South India have, by this means, all become separated by fault lines from the rocks of the plains around; this may account for their very steep scarps.

their present crude form till they can be checked by more extended survey of the South Indian crystalline rocks. It should be remarked, however, that bands of breccia are sometimes found with this N. by E. direction near Salem, as well as in many other places in the Salem district.

Messrs. King and Foote [1] have called attention to the evident connection between the main joint planes and the form of the hill masses in this area. Wider observations will probably show some connection between these directions and the leading foldings of South India ; but the observations are still too few to permit safe generalizations.

[1] *Mem., Geol. Surv., Ind.*, Vol. IV, p. 306.

SUMMARY OF RESULTS.

In 1889 Prof. A. Lacroix published a description of an interesting series of pyroxenic and scapolitic gneisses said to have been obtained by Leschenault de la Tour from the neighbourhood of Salem and Ceylon. But as the result of a special investigation of the area made in August 1897, for the purpose of determining the localities and geological relations of the rocks referred to by Lacroix, it was found that many of the types were not obtainable at all from the immediate neighbourhood of Salem, and some of them closely resembled occurrences known in other parts of the civil district, as well as in the adjoining district of Coimbatore. Leschenault de la Tour, however, visited many South Indian districts besides Salem, and to facilitate the further identification of localities an annotated translation of his geological observations is given as an appendix to this paper (pp. 1—3 and Appendix).

The districts of Salem and Coimbatore, from which Leschenault apparently obtained most of his specimens, together cover an area of 15,000 square miles, and include a remarkable complex of ancient gneisses, as well as younger, plutonic, hypabyssal members of nearly every petrographical family. The specimens described by Lacroix were consequently obtained from localities far too widely separated to permit the assumption that they were obtained from formations which are in the geological sense associated with one another. Whilst, therefore, Lacroix's interesting description of the South Indian pyroxenic and scapolitic rocks is valued by the Geological Survey as an important contribution to our mineralogy, his geological conclusions concerning the origin of the rocks, based on petrographical similarities to the French divisions of gneisses, have yet to be confirmed by field observations.

The correlation of our "pyroxene-granulites" (charnockite series) with the younger division of the French gneisses is, however,

in general agreement with the long-established conclusions of the Geological Survey of India. But the characters which indicate the comparatively young age of this group are the result, according to my observations, of their having been introduced as irruptive rocks near or at the close of the great folding movements in Peninsular India (see "The charnockite series," *Mem., Geol. Surv., Ind.*, Vol. XXVIII, p. 2).

The following are the principal groups of rocks now exposed in the neighbourhood of Salem:—

(4) Post-Archæan eruptives.
(3) Pyroxene-granulites or charnockite series.
(2) Thinly foliated schists and leaf-gneisses.
(1) Older biotite-gneisses.

The *biotite-gneisses* are much altered and in one place corroded by fresh tongues of charnockite. They present an aspect quite different to the great biotite-gneiss formation of the northern taluks of Hosur and Krishnagiri which are also within the Salem civil district, but whose geological relations to the charnockite series have not yet been worked out. Pebbles of a gneiss similar to the formation herein described in the immediate neighbourhood of Salem town have been found in the Dharwar conglomerates of Kolar (pp. 5—8).

The *schists* of the Salem-Ahtúr valley are very composite in character, including highly crushed gneisses, hornblende-schists, chloritic rocks and ferruginous quartzites. The last-mentioned rocks are composed of quartz, grünerite, magnetite and hematite. The two oxides of iron are apparently intergrown with one another as well as found occurring in isolated crystals, and analyses showing the relative proportions of ferrous and ferric oxides reveal the interesting fact that many, perhaps most, of the Salem magnetic ores, contain almost as much hematite as magnetite. In general composition these schists recall the petrological characters of the Dharwar system, from

which they are distinguished merely by being more thoroughly crystalline (pp. 8—14).

The *charnockite series* includes members of the acid, intermediate, basic and ultra-basic divisions which are described in a separate paper (*Mem., Geol. Surv., Ind.*, Vol. XXVIII, part 2). The lenticular habit, especially of the basic forms and associated pyroxenites, is very well illustrated near Salem. The garnets found so abundantly in the uncrushed varieties are considered to have originated as the result of metachemic alteration of the pyroxenes at a high temperature short of actual fusion, the silica eliminated by the process generally crystallizing as granular clear quartz included in the spongy garnets (pp. 14—27). The so-called "trap-shotten" bands frequently displayed by the charnockite series near Salem are not due to injection of basic material, but are brecciation lines along which the mylonite has been fritted into a compact black mass by heat, probably the heat generated by friction (p. 37).

For the reason that they do not come into actual contact with one another, the relative ages of the *younger eruptives* cannot be determined in the neighbourhood of Salem. The three exposures of wide trap-dykes, and their lateral subsidiary apophyses, are augite-diorites (diabases) with micropegmatite, and are similar to those described in a separate paper (*Rec., Geol. Surv., Ind.*, Vol. XXX, p. 31) as the probable dyke-representatives of the Cuddapah lava flows. The magnesian rocks of the so-called "Chalk hills" are chiefly dunites (much decomposed to form magnesite), mica-augite peridotites and picrites. The "White Elephant rocks" in the Shevaroy hills are masses of quartz having the characters of plutonic quartz and containing much liquid carbonic acid (pp. 27—36).

Messrs. King and Foote suggested (*Mem., Geol. Surv., Ind.*, Vol. IV, p. 325) that the *magnesite* of the "Chalk hills" was formed

by the action of carbonic acid at high temperatures upon the original rocks of the "Chalk hills." I pointed out, however, in 1892 that the original rocks of the Chalk hills were peridotites with dunite as a predominant type, not metamorphic rocks. This was confirmed in 1896 by Mr. Middlemiss who, however, regarded the magnesite as the result of the alteration of serpentine previously formed by hydration of the olivine rocks. This additional revision of the original explanation appears to be unwarranted by the facts: serpentine exists in small quantities, but there are no signs of general hydration; the magnesite forms veins of all sizes down to microscopic developments along the characteristically irregular cracks through the olivine crystals, and the presence of much liquid carbonic acid in the associated masses of white quartz considerably strengthens the theory first suggested by King and Foote (pp. 32—35).

There are many such examples of peridotites in South India largely altered to magnesite, and they are often, if not always, accompanied by masses of white quartz containing liquid carbonic acid. The association of two such extremes—dunite and quartz—is far too frequent to be merely fortuitous; and it is not unlikely that the two are genetic relatives, the quartz representing the siliceous end-product of the eruption, which, in the absence of alumina and alkalies, must consolidate as simple quartz instead of forming alumino-alkaline silicates. Elsewhere evidence has been cited which indicates that in a crystallizing igneous magma the water excluded to the final stages of consolidation may attack and decompose an early-formed ferro-magnesian silicate (*Quart. Journ. Geol. Soc.*, LIII (1897), 413). In the present instance the water may have given rise to the formation of picrolite, whilst carbonic acid similarly excluded to the siliceous residue, has acted in an analogous manner on the separated olivine, forming magnesite by its action on the pre-formed ferromagnesian silicate.

APPENDIX.

Geological observations made by Leschenault de la Tour during his travels in Southern India (1816—20).

INTRODUCTION.

Leschenault de la Tour's stay of over four years in the south of India, between 1816 and 1821, was devoted mainly to botanical researches with a view to the economic development of Pondicherry and other French possessions in the East. At the same time he recorded a number of interesting geological observations, which were supplemented by a valuable collection of some 1,500 specimens now preserved in the "Muséum d'Histoire Naturelle" in Paris. Some of these—the pyroxenic gneisses and their associates—have been described by Prof. A. Lacroix in an elaborate memoir "Contributions à l'étude des gneiss à pyroxène et des roches à wernerite."[1] Lacroix has generally referred to the rocks as having been obtained from the neighbourhood of Salem. Leschenault made more than one stay at Salem, and there became acquainted with J. M. Heath who, as a "Junior Merchant" in the E. I. Company's service, was then "Deputy Commercial Resident" at Salem. Heath, who took a keen interest in the minerals of South India, had collected largely from his own and the adjoining district of Coimbatore, and gave of his abundance to Leschenault. This circumstance possibly accounts for the frequent occurrence on Leschenault's labels of the expression "environs de Salem," occasionally rendered more indefinite by the addition "et autres endroits." In 1898 I had the privilege, through the courtesy of M. Lacroix, of examining the Leschenault collection in Paris, and was able to identify many of the specimens with well-known occurrences in the Salem and Coimbatore districts. Some of these are referred to in the notes below.

[1] Bull. de la soc. fr. de Min., Vol. XII (1889), p. 83. Translation by *Mallet, Rec., Geol. Surv., Ind.*, Vol. XXIV (1891), p. 155.

In this appendix I have given an account of Leschenault's observations in South India, together with explanatory notes which will probably help towards identifying the localities of the specimens already described by Lacroix, as well as of those which may be described in future. Many of the field observations are, however, interesting in themselves ; such as, for instance, the description of the corundum in its matrix at Sithampundi near Sholasigamani (Sholasiramani) in the south-west part of Salem district. It was from rocks identical with these, and almost certainly from the same locality (which was worked for corundum before Leschenault's time), that Count de Bournon obtained the material for his famous memoir on corundum, and its associate, anorthire (indianite). Many of the original labels are marked "Coromandel," which has since been changed to "Côte de Coromandel," and in this form the localities for these rocks have got into more recent literature. Because of the trade with the old East India Company's ports on the east coast the expression Coromandel (*Chôramandala*, or realm of Chora, an ancient Tamil dynasty) has become restricted by Europeans to the eastern coast.

It is rather remarkable that Leschenault nowhere mentions the corundum and elæolite-syenite of Karutapalaiyam in the Coimbatore district. The road along which he must have travelled to visit the aqua-marine mine (see Note 24) crosses the ridge of these rocks at a point 3½ miles from Kangayam, between the conspicuous Sivamalai and Karutapalaiyam, where the villagers raise considerable quantities of corundum by grubbing near the junction of the elæolite-syenite and felspar rocks. These interesting rocks are described in a separate memoir (vol. XXX, part 3).

The five papers by Leschenault de la Tour,[1] from which I have

[1] "Relation d'un voyage à Karikal et à Salem."—*Mém. Mus. d'Hist. Nat.*, Vol. VI (1820), pp. 329—348. Paper signed, 30th May, 1818.

"Rapport sur les résultats d'un voyage fait à Salem, ville de l'interieur de la Peninsula de l'Inde, située à cinquantes lieues dans l'ouest de Pondicherry."—*Ibid.*, Vol. VI, pp. 349—359

taken this account of his geological observations, are published in the "Mémoires du Muséum d'Histoire Naturelle de Paris." In giving the references for each statement in the following pages the number of the volume in Roman figures and the page in ordinary figures invariably refers to these memoirs.

"Extrait d'une lettre de M. Leschenault à M Dufussieu, contenant des observations sur quelques espèces d'orties." Dated Calcutta, 30th November, 1819.—*Ib.*, Vol. VI, pp. 359, 360.

"Relation abrégée d'un voyage aux Indes Orientales."—*Ib.*, Vol. IX (1822), pp. 245—274.

"Sur la Roue du Lapidaire dont on se sert dans les Indes Orientales pour tailler les pierres fines."—*Ib.*, Vol. XI (1824), pp. 230, 231.

Translation of Extracts.[1]

Leschenault arrived at Pondicherry [2] towards the end of September, 1816 (IX, 245) and visited Karikal, a French settlement, 30 *lieues* [3] (75 miles) south of Pondicherry, on one of the branches of the "Kolram" (Coleroon) river [4] (VI, 329, 331 ; IX, 246).

After returning to Pondicherry, he set out at the beginning of 1818 for Salem, a town 50 *lieues* (120 miles) west of Pondicherry (VI, 333 ; IX, 248).

The first rocks met with on the way to Salem, at about one *lieue* (2½ miles) west of Tirnavalour (? Tiruvananallur),[5] are of the nature of *jade*,[6] of which there are a few outcrops only standing up through the soil. The formation, however, appeared to stretch in a N.—S. direction with, judging from what one sees at the surface, a thickness of about 200 paces in an E.—W. direction. This beautiful rock is very hard and compact ; its colour is a pretty apple-green, mottled by numerous red and grey spots, which appeared to be small fragments of quartz intimately united with the jade.

[1] All the geological observations have been translated in full ; but the itinerary, given in the third person, is merely an abstract of the essential details.

[2] After being taken by the Dutch once and the English three times, Pondicherry was finally restored to the French in 1816, the year in which Leschenault de la Tour was sent out.

[3] The old French league (*lieue*) is equivalent to about 4 *kilometres*, or 2·49 English miles.

[4] The Coleroon (or Kolidam) is the largest and most northerly branch of the Cauvery river, from which it separates below Seringham near Trichinopoly, and after a course of about 80 miles debouches into the sea at a point 3 or 4 miles south of Porto Novo between the South Arcot and Tanjore districts.

[5] Tiruvananallur is on the south bank of a branch of the Panar river at about 2 miles from the boundary marked on the Geological Map (sheet 79, N.-E.) between the crystalline rocks and the alluvium. As this is on the Pondicherry-Áhtúr road, it is presumably the place referred to by Leschenault as Tirnavalour.

[6] In the later paper (IX, 248) this is referred to as jasper (*jaspe*). We have, however, no record of a rock of the kind described.

The fracture is sharp and irregular. This rock takes on a very beautiful polish which would make it suitable for the manufacture of magnificent tables, columns and vases. The exploitation of the quarry would afford valuable material, if there were lapidaries locally available for polishing the large pieces of rock (VI, 333 ; IX, 248).

Two or three *lieues* (5 or 6 miles) further on one begins to meet with masses of rock of which several are rolled and others embedded in the soil ; they appear to be a kind of syenite, and are composed of amphibole, quartz, felspar and mica in different proportions, which determine their variations of colour and texture. The most beautiful varieties were obtained at 20 *lieues* (50 miles) west of Pondicherry, on the banks of the " Kongrépaléon ".[7] Several fragments of corundum were found in the bed of this river (VI, 333, 334 ; IX, 248).

In several places in the neighbourhood of the mountains, stones and calcareous concretions[8] were noticed, and appeared to have been brought from the high grounds by the streams (VI, 336).

Thence he passed on to " Atour " (VI, 336 ; IX, 249), a fine village 35 *lieues* (87 miles) west of Pondicherry, situated on the banks of a river between two mountains. The neighbouring mountains are rich in iron, which is smelted by the natives and brought to " Atoúr " (Ahtur) in the form of blooms weighing several pounds, where it is forged by means of charcoal. The quality of the iron is said to be rather inferior (VI, 336, 337).[9]

[7] The " Kongrépaléon " river has not been identified ; but the Ahtúr road crosses two tributaries of the Vellaur at about this distance from Pondicherry (11° 38′ ; 79° 10′). The occurrence of corundum at this point is unknown to us. Amongst the Leschenault collection in Paris, there are specimens of mica and hornblende-granite with pink felspar, labelled " du Congrepaleum, Coromandel."

[8] Probably ordinary calcareous kankar which is irregularly distributed over South India.

[9] Ahtúr is the head-quarters of a taluk. The great mass of the Kalroyen malais lies to the north, and the Paithúr (Pythoor) malais to the south of the

From Ahtúr, M. Leschenault went on to Salem, which is about 11 or 12 *lieues* (29 miles) distant (VI, 337; IX, 252).

He was unable to visit the high mountains,[10] but explored the lower ones in the immediate neighbourhood of Salem. The slopes of these are steep and the rocks generally well exposed; these consist of granite or syenite (or gneiss, with garnets and amphibole, IX, 255) in which amphibole and quartz form different bands (VI, 342,343).

A mountain to the south-west [of Salem] is almost entirely composed of rocks in which amphibole predominates, on the surface of which coarse, opaque garnets are disposed in plates.[11]

town. The ore beds from which the native iron smelters obtain their iron-ore lie to the south and south-west. Leschenault mentions that the iron is brought to the town of Ahtúr in the form of blooms, but the large slag heaps, now to be seen near the bazar, show that smelting has also been carried on in the town itself. In 1892 the remains of six furnaces were to be seen, whilst one was still at work. The industry was confined to the pariahs (*Rec., Geol. Surv., Ind.*, XXV, 148).

[10] The high mountains are presumably the Shevaroys (over 5,000 feet), the Tainanda and Kalroyen malais (about 4,000 feet) to the north of the Salem-Ahtúr valley.

[11] The town of Salem stretches out to within a mile of the north-eastern foot of this hill; so its bearing would depend upon the part of the town from which the observation was made. From the centre of the town (near which the town-hall is situated) the hill is, more strictly speaking, W.-S.-W. of Salem. Leschenault's bearings, however, are not quite correct; the three points which he has given in the neighbourhood of Salem, for instance, are all turned too much to the left: this hill is stated to be S.-W. instead of W.-S.-W., Kanjamalai (see Note No. 19) is given as S.-S.-W. instead of S.-W. by W. or W.-S.-W., and the "white elephant rock" as N.-W., whereas one of these two large masses of quartz is N.-N.-E. and the other N.-E. by N. of Salem town. The small hill, which stands up abruptly W.-S.-W. of the town to a height of about 300 feet, is a bare, steep-sided mass of rocks, elliptical in plan and about ½ mile long. It is principally composed of a medium to coarse-grained massive rock with hypersthene, pale-green augite, brown basaltic hornblende, plagioclase and red garnets which are badly fractured and sometimes attain the size of a fist (No. 11·895). Similar rocks occur in Nagaramalai, N.-N.-W. of Salem (Nos. 9·683, 9·684, 11·903) and other small hills in the neighbourhood. These rocks belong to the division *b* of Lacroix's "pyroxenic and hornblendic gneiss" (*Rec., Geol. Surv., Ind.*, XXIV, 175; see also p. 21 of this paper). They appear to stand out as great lenticular masses in the old (biotite) gneisses and are generally associated with smaller lenses of pyroxenite (pyroxene-rocks).

Amongst the rolled fragments found at the foot of the mountains were :—

(1) A kind of granite with a granular texture, containing small round garnets of the size of peppercorns abundantly disseminated through the rock.[12]

(2) A species of beautiful jade-like stone · · · veined with deep-green and yellowish green colours, and forming a tolerable imitation of certain variegated fabrics.[13]

(3) Much milky quartz. There is a great rock-mass of very pure quartz in one of the mountains to the north-west named the "Elephant Rock";[14] the inhabitants who delight in multiplying the objects of their religion have consecrated it to their divinities (VI, 343).

On the plains near Salem, M. Leschenault discovered a white rock veined with green, which he at first took to be a quartzose rock containing pieces of carbonate which effervesced with sulphuric acid. The rock is veined and marked with large spots of a deep-green colour, some of which are amygdaloidal in shape and resemble chlorite (VI, 343, 344).

Examples of these occur at the northern foot of this hill, W.-S.-W. of Salem (No. 11· 900), where also occur the lighter-coloured members of the charnockite series (pyroxene-granulites) with a general E.-N.-E.—W.-S.-W. trend of foliation. A small mass of quartz-felspar pegmatite with magnetite and hematite cuts these.

[12] The pyroxene-granulites (charnockite series) so abundant in the neighbouring hill-masses are often garnetiferous.

[13] Probably a felspathic rock containing veins of pistacite. There is a polished specimen of this kind in the Paris collection labelled "environs de Salem."

[14] There are two of these large masses of quartz known as the (White) Elephant rocks. One, the smaller, is situated on the west and the other on the east side of the Gundur spur of the Shevaroy hills; the latter, which is the larger and a prominent object in the hill-side, is more often known as the "white elephant rock," and is probably the one referred to by Leschenault. Its characters have been described by Mr. R. Bruce Foote, F.G.S. (*Mem., Geol. Surv., Ind.*, IV, 335) and its microscopic characters given on a previous page of this paper (page 35). The name "Elephant rock" is given to more than one prominent mass of rock in South India and Ceylon.

The principal additions to his collection were the gifts of Mr. Healt,[15] colleague and brother-in-law of Mr. Carpenter, commercial resident [at Salem]. He collected all the objects of mineralogical interest in the country, and presented Leschenault with several specimens of corundum,[16] iron-ore,[17] garnets, a fragment of aqua-marine in its matrix, several pieces of a beautiful graphic granite in the

[15] In Leschenault's paper the name, probably through a misprint, is given as Healt. Mr. Mallet in tracing out the locality of the tscheffkinite collected by Leschenault (*Rec., Geol. Surv., Ind.*, XXV (1892), 123), suggested that this was a mistake for Heath, and the subsequent paper by Leschenault (IX, 257) confirms the suggestion. To be quite certain on the point, however, I referrred to Colonel D. G. Pitcher, Director of Land Records and Agriculture in Gwalior, who is a relative of Mr. Heath ; and he has kindly informed me that Heath had a brother-in-law of the name of Carpenter at Salem, which agrees with Leschenault's statement. To Heath we are indebted for our most accurate information concerning the native iron-smelters of South India (*Journ. Roy. As. Soc.*, Vol. V ; Mushet's " Papers on iron and steel " (1840), pp. 666—672), as well as the discovery of corundum, chromite, aqua-marines and many other things of economic value and mineralogical interest. Mr. Heath also started the manufacture of iron and steel on a large scale in South India, and though unsuccessful, more through legal entanglements than otherwise, has given us our best data as to the richness and purity of the ores which bear directly on the question, now under discussion, of reviving this industry. The fact that Leschenault received many specimens from Heath increases the importance of the collection now in Paris ; for Heath was no ordinary observer. The term " Commercial Resident " used by Leschenault was the correct title of the official whose work at Salem agreed in part with that of the modern " Collector." According to C. C. Prinsep's " Record of Services of the E. I. Company's Civil Servants in the Madras Presidency from 1741 to 1858, " we find Chas. Carpenter recorded as Commercial Resident at Salem, where he died on the 4th June 1818 (p. 22), whilst J. M. Heath is described as Deputy Commercial Resident from 1812 to 1820, when he is recorded as "out of employ," having then resigned the Civil Service for the purpose of undertaking his " venture " in mining.

[16] Corundum is found in several parts of the Salem district as well as in the adjoining district of Coimbatore near the place from which Heath obtained his aqua-marines (Manual of Economic Geol., Ind., 2nd Ed. (Corundum), p. 37).

[17] *Fer natif*, in the absence of native iron, must mean native-made iron, *i.e.*, the iron made by the native smelters then flourishing in the Salem district.

fissures through which one finds the aqua-marine in a matrix which Leschenault believed to be an aluminous tufa [18] (VI, 344).

About two *lieues* (5 miles) to the south-south-west of Salem, in the mountain of Kantiamale (Kanjamalai),[19] there is a mine of iron-sand which is collected in the ravines. It is very rich and the iron obtained from it produces an excellent steel, from specimens of which very good razor blades have been manufactured in England. To convert the iron into steel the native workers place small pieces of it, weighing about one pound, into a clay crucible ; for the cementation the metal is surrounded with three-sevenths of its weight of the powdered, dry bark of the *Cassia auriculata*, to which are added a few green leaves of the *Asclepias gigantea*, or of the *Jatrophia curcas*. The crucible is then tightly sealed with clay and heated with wood charcoal to effect fusion [20] (VI, 344 ; IX, 255).

After returning to Pondicherry, Leschenault started, in October 1818, intending to visit the Western Ghâts. On the way he visited the localities where the Carnatic corundum had been obtained. The place

[18] As Heath in the following year (1819) worked, under lease from the East India Company, the aqua-marine mine near Kangayam in the Coimbatore district, there is not much doubt about the origin of these specimens (see note No. 24). The handsome graphic granite occurring in, and abundantly around, the aqua-marine pit may well have attracted Leschenault's attention ; he gives a fuller account of the rocks after visiting the mine in the course of a subsequent journey (see IX, 261, 262).

[19] There can hardly be a doubt, as Mallet has pointed out (*Rec., Geol. Surv., Ind.*, XXV, 124), that notwithstanding the bearing given (south-south-west instead of west-south-west) Leschenault here refers to the well-known iron-ore beds of Kanjamalai about 5 miles from Salem.

[20] The description of the native manufacture of steel by cementation in crucibles shows that the process practised in the Salem district as long ago as 1818 was essentially similar to that still carried on to a small extent in the adjoining Trichinopoly district, though the industry appears to have disappeared from Salem ; in the latter district, however, pariahs still make wrought-iron by a direct method of smelting, and a kind of steel by decarburization of cast-iron shot (Imperial Inst. Handbook, No. 8 (1892), pp. 15—22 and *Rec., Geol. Surv., Ind.*, XXV, 145).

whence the best material is obtained is situated on the east of the Cauvery river, at a place about 3 miles from the village of Sholasiramani (Sholasiramani, or Sholasigamani), 70 *lieues* (174 miles) west-south-west of Pondicherry. Leschenault collected some fine specimens of red, rose-coloured and greenish corundum in its matrix. The gneissose rock in which the corundum occurs is 10 or 12 feet below the soil; the ground is undulated and forms small hillocks; the vein in which the corundum is most abundant is perhaps 200 fathoms wide, and its direction is south-east—north-west [21] (IX, 256).

With corundum reduced to a more or less fine powder and mixed with lac-resin, the Indian lapidaries manufacture wheels upon which they cut the more valuable stones (IX, 256). Leschenault states that the corundum *sane* or wheel is composed of two parts of corundum powder mixed with one part of lac-resin (XI, 230, 231), his description of the mode of manufacture agrees fairly well with the modern practice in India.[22]

After arriving at Coimbatore at the end of November he was taken ill with fever, and consequently, as soon as he was able to travel, returned, *viâ* Salem to Pondicherry, without carrying out his intention of visiting the mountains to the west (IX, 257).

Soon afterwards, however, he made a second journey to Coimbatore, *viâ* Trichinopoly, and then visited the Nilgiri hills where he

[21] This description enables us to identify the locality of the "anorthite-gneisses" described in detail by Lacroix (*Rec., Geol. Surv., Ind.*, XXIV, 183), who not only examined Leschenault's specimens, but also those used by Count de Bournon for his memoir on corundum. Besides Leschenault's description of the position and the nature of the corundum occurrences near Tsholasiramani (which is evidently the same as Sholasiramani), his labels state the specimens were obtained 14 *lieues* (34 miles) south-south-west of Salem, which is about the correct distance and bearing of Sholasiramani, or Sholaseraumunny, as it is spelt on the Atlas Sheet (No. 61). The subsequent descriptions by Newbold, Warth and Middlemiss serve to confirm this point (Economic Geology, Ind., 2nd Ed., pt. I, p. 39).

[22] See Manual, Economic Geology of India, 2nd Edition, pt. I (corundum), p. 56.

stayed 20 days and gave a brief account of the hill tribes, the Todas, Kotas and Badagas [23] (IX, 257, 258).

On the return journey to Pondicherry he visited the mine from which aqua-marines had been obtained. The mine had been leased to Mr. Heath, Commercial Resident, and was situated at Pataly, 22 *lieues* (53 miles) south-west of Salem. The vein in which the aqua-marines were obtained measured not more than one foot in thickness and was enclosed in a handsome pegmatite at about 15 feet below the soil, the water which abounded in the pit made the exploitation a difficult matter : the aqua-marines were considered by Leschenault to be superior to those of Siberia.[24]

In September 1819, Leschenault started for Bengal, returned to Pondicherry in January 1820, and started in April of the same year to explore the south of the Indian Peninsula and Ceylon.

[23] Although no mention seems to have been made of rocks collected on his way to Coimbatore and the Nilgiris, he must have met many exposures of, amongst others, the pyroxene-granulites which are the most abundant rocks in the Nilgiri hills. It is not unlikely, too, that he must have known of the crystalline limestone, 6 miles south of Coimbatore, much of it being used for building purposes in the town. This crystalline limestone agrees in many respects with those described by Lacroix and is also associated with scapolitic rocks.

In the journey from Trichinopoli to the Nilgiris, *viâ* Coimbatore, Leschenault probably crossed the crystalline limestone bands near Koolitalai (10° 55′; 78° 29′) and passed by road through Karur (10° 57′ ; 78° 9′), Paramatti (10° 57′; 77° 58′), Vellakovil (10° 56′; 77° 45′), and Kangayam.

[24] Pattalai (Coimbatore District Man., 1887, pp. 23 and 443), is about 7 miles north-west of Kangayam in the Coimbatore district, and between 50 and 60 miles south-west of Salem. The pit from which the aqua-marines are said to have been obtained is still pointed out ; large veins of graphic pegmatite are seen to cut through mica schists, and many of the pegmatite fragments on an adjoining rubbish heap are seen to contain several well-crystallized minerals such as garnet, albite, etc. : the aqua-marines were probably found in such drusy cavities of the coarse-grained, miarolitic rock. These pegmatites cut the micaceous rocks in all directions, and have no known genetic relationship with the pyroxenic and other gneisses described by Lacroix (*Rec., Geol. Surv., Ind.*, XXIV, 170). The whole area in the neighbourhood of Pattalai is geologically complicated : about 3 miles to the south-east there are large masses of an elæolite-syenite containing graphite, and associated with augite-syenite and felspar rock containing corundum. To the north-west there are pyroxenic and hornblendic gneisses associated with quartz iron-ore rocks.

On this journey he visited Tanjore and the town of Vallam, where rolled pieces of yellow brown, white and violet rock-crystal are found scattered through the alluvium.[25] These are cut at Tanjore and more especially at Trichinopoly (IX, 262—264). From Tanjore he went to Pudukattai [26] and Madura, visiting the Cottalam (Courtallum)[27] mountains which are situated at 12 *lieues* (30 miles) north-north-west of Cape Comorin (IX, 265). Thence he passed

This reference by Leschenault to the aqua-marine mine at Pattalai is interesting because it not only gives us a clue to the locality of the pegmatites described by Lacroix, but also of the garnetiferous rock with the remarkable pegmatoidal coronæ of hornblende said to be from "Perindoré" (*Rec., Geol. Surv., Ind.*, XXIV, 181). To visit the Pattalai mine Leschenault probably went *viâ* Palladam to Kangayam, and in order to pass through Perindoré (Perundurai) on his way from Kangayam to Salem he must have crossed the band of rock, 1½ mile south-west of Chennimalai, which contains the garnets with the pegmatoidal coronæ of hornblende. [Since the above was written I have examined the specimens in Paris. The old label "Chinamalé Coromandel" removes the last trace of doubt about the locality of these interesting rocks.] As these rocks are well exposed on the road-side for about a quarter of a mile, and the large garnets with their coronæ are quite conspicuous, they could hardly have escaped Leschenault's notice. As Perindoré was the next convenient halting place these rocks might have had their locality indicated as "near Perindoré." Close to the garnetiferous rocks there are exposed pegmatites, containing pearly-white felspars similar to those which Lacroix describes as having also been obtained from Perundurai (Perindoré).

[25] Tanjore was then a Native State ruled over by Sarfoji who died in 1832. Vallam is still the head-quarters of the new British Collectorate of 3,600 square miles; the cutting of rock crystal for spectacles and ornamental purposes is still carried on, and some of the rock-crystal, especially the colourless material, is brought from other districts (Pattalai near Kangayam for instance, see note No. 24) for the manufacture of the "Vallam diamonds"; most of the raw material is, however, obtained from the Cuddalore (Tertiary) conglomerates (see King and Foote, *Mem., Geol. Surv., Ind.*, Vol. IV, pp. 36 and 370).

[26] Púdúkattai is a Native State of 1,046 square miles, populated principally by the Kollari race and ruled over by a Raja (Tondaman).

[27] References to the geology of the mountains in the neighbourhood of Courtallum have been made by Dr. W. King (*Rec., Geol. Surv., Ind.*, XV, 90) and Mr. R. Bruce Foote (*Rec., Geol. Surv., Ind.*, XVI, 23). Courtallam itself is, however, much more than 30 miles north-north-west of Cape Comorin; so Leschenault presumably refers to the mountains which stretch southwards from Courtallam where the Arangole pass leads across into Travancore.

through Tinnevelly,[28] embarking at Tuticorin at the end of July (IX, 266). After exploring parts of Ceylon he started in August 1821 for Bourbon, and thence, on the 5th of February 1822, for France (IX, 271).

Index of places referred to in the translation of Leschenault de la Tour's travels.

Locality.	Page.	North Latitude.	East Longitude.
Ahtur ("Atour")	152	11° 36′	78° 40′
"Caricall" (see Karikal) . . .	...	...	...
Coimbatore	157	11° 0′	76° 0′
Coleroon river (mouth) . . .	151	11° 25′	79° 52′
Comorin, Cape	159	8° 4′	77° 36′
Cottalam ("Courtallum") . . .	159	8° 56′	77° 19′
Chennimalai	159	11° 10′	77° 38′
"Elephant Rocks"	154	11° 45′	78° 16′
Kangayam	156, 158	11° 0′	77° 38′
Kanjamalai ("Kantiamalé") . .	153, 156	11° 38′	78° 10′
Karikal	151	10° 55′	79° 54′
Madura	159	9° 55′	78° 10′
Nilgiri hills	157	11° 25′	76° 45′
Pattalai ("Patalie")	158	11° 4′	77° 33′

[28] Madura and Tinnevelly were finally put under British rule in 1801. Leschenault makes no mention of specimens collected during this last journey through the south of India; but he might have obtained pyroxene-granulites from several places in the Madura and Tinnevelly districts.

Index of places referred to in the translation of Leschenault de la Tour's travels—concld.

Locality.	Page.	North Latitude.	East Longitude.
Perundurai ("Perindoré") . . .	159	11° 16′	77° 38′
Pondicherri	148—158	11° 56′	79° 53′
Pudukattai	159	10° 23′	78° 52′
Pulladam	159	10° 59′	77° 21′
Salem	148, 153, 157	11° 39′	78° 12′
Sholasiramani	149, 157	11° 14′	77° 56′
Tanjore	159	10° 47′	79° 22′
Tinnevelly	160	8° 44′	77° 44
"Tirnavalour" (? Tiruvananallur) .	151	11° 51′	79° 26′
Tranquebar	159	11° 2′	79° 55′
Trichinopoli	157, 159	10° 50′	78° 45′
Tsholasiramani (see Sholasiramani) .	...	...	...
Vallum (Valam)	159	10° 43′	79° 12′

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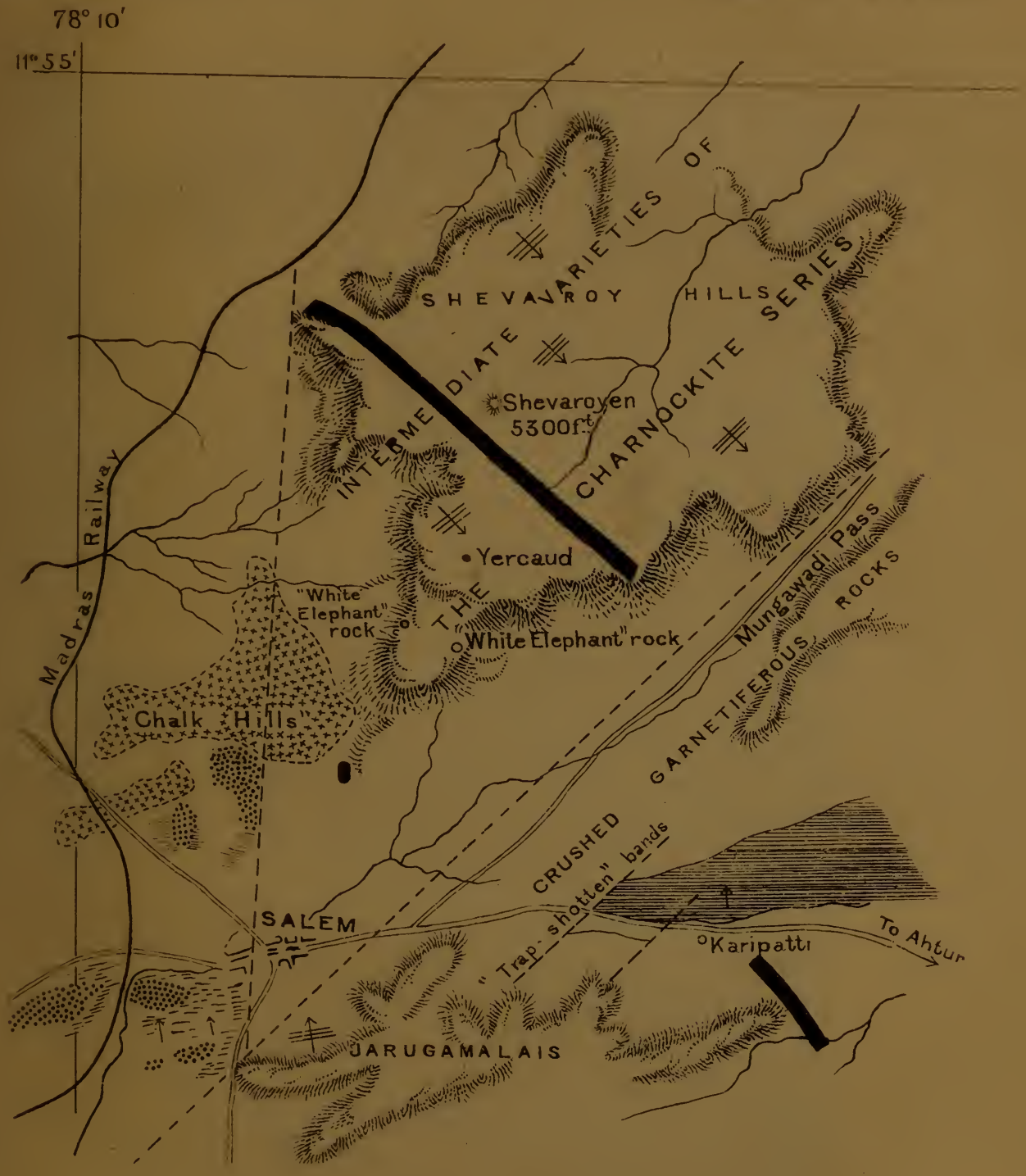

SCALE, 1 INCH = 4 MILES.

Magnesian series — Diabase - dykes

Schists near Karipatti — Biotite - gneiss

Exposures of the Charnockite series unshaded except Basic Garnetiferous forms

MAP OF THE SHEVAROY HILLS AND NEIGHBOURHOOD OF SALEM

Photogravure.

Survey of India Offices, Calcutta March 1900

THE "WHITE ELEPHANT" ROCK, SHEVAROY HILLS

From a photograph by T H Holland.

MEMOIRS

OF

THE GEOLOGICAL SURVEY OF INDIA.

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MEMOIRS

OF

THE GEOLOGICAL SURVEY OF INDIA.

The SIVAMALAI SERIES *of* ELÆOLITE-SYENITES *and* CORUNDUM-SYENITES *in the* COIMBATORE DISTRICT, MADRAS PRESIDENCY. *By* THOMAS H. HOLLAND, A.R.C.S., F.G.S., *Officiating Superintendent, Geological Survey of India.*

I.—INTRODUCTION.

In his description of the corundum-bearing areas in the Salem and Coimbatore districts, Mr. C. S. Middlemiss has described the rock of Sivamalai as a pale-grey gneiss "composed almost wholly of plagioclase felspar and microcline in a granular condition" with biotite or hornblende, iron-oxide and zircon (?) as accessories. This rock is said to be invaded by veins of a coarse, red granite, from which the villagers have for many years extracted considerable quantities of corundum, especially from diggings made near the junction of the two rocks.[1]

Whilst examining sections of these rocks the author detected the presence of graphite in some, and clæolite in all the

[1] *Rec. Geol. Surv., Ind.*, Vol. XXIX (1896), p. 47.

specimens taken from the Sivamalai mass, and subsequent examination of the area, in company with Mr. Middlemiss, resulted in the discovery of coarse-grained "contemporaneous" veins in which the crystals of elæolite sometimes measured five inches across. At the same time it was discovered that the elæolite-syenite is accompanied by masses of augite-syenite—a feature characteristic of its typical occurrences in other parts of the world. The present occurrence of this interesting rock is remarkable for the constant presence in it of graphite and calcite, both of which are regarded as primary constituents, and for the association with it of corundiferous albite-orthoclase rock.

Notwithstanding the foliation of these rocks and at first sight their resemblance and apparent conformity to the general crystalline schists of the area in which they occur, the structures they present, their chemical composition, petrological characters and associations are in agreement with the peculiar features usually presented by the family of elæolite-syenites, and with these rocks, consequently, the elæolite-bearing members of this area are grouped.

The so-called coarse red granite is very poor in ferromagnesian minerals, practically devoid of quartz, and is essentially a felspar-rock in which corundum sometimes occurs in quantity.

The geological bearing of this paper is in consistent extension of the principles defined in a previous memoir,[1] where reasons are given for separating the charnockite series from the other crystalline schists, and raising the family to the dignity of a petrographical province. In the present instance we are dealing with a complex composed of rocks varying considerably in composition, but nevertheless believed to be genetically related to one another, and, in fact, to form a definite petrographical province, igneous in origin and geologically very ancient, possibly Archæan in age.

[1] *Mem. Geol. Surv., Ind.*, Vol. XXVIII, p. 119.

II.—GEOLOGICAL RELATIONS AND ORIGIN.

Disposition of exposures.

Sivamalai (Shivenmulla of the Atlas Sheet, No. 61 ; lat. 11° 3′ N., long. 77° 36′ E.) stands up abruptly on the dry monotonous plain, three miles north-west of Kangayam in the Dharapuram taluk, Coimbatore district. Looking across the Tirrupur-Kangayam road from the summit of Sivamalai a row of six or seven, small, rocky hillocks may be seen stretching in a west-north-west or west by north direction as far as the village of Karutapalaiyam. These small hillocks are found to be composed of precisely the same rock as that which makes up the main mass of Sivamalai, forming in fact a series of lenticular masses of elæolite-syenite lying in the crystalline schists, which in this area have a general west-north-west—east-south-east strike of foliation.

Foliation.

As is usual with such lenticular masses in the crystalline schists, the elæolite-syenite forming Sivamalai and the string of small hills shows a marked linear arrangement of its constituents parallel to the general foliation of the rocks around. This foliation of the elæolite-syenite, though not accompanied by definite banding, is so well marked as to be quite noticeable in hand-specimens, and as the most prevalent variety is comparatively fine in texture, and distinctly even-grained for an elæolite-syenite, the rock might very well be mistaken, on casual examination, for a common biotite-gneiss, as it was indeed originally described.

We are here confronted at once with a phenomenon which constantly puzzles workers in a crystalline country, namely, the occurrence amongst the ordinary crystalline schists of foliated lenticular masses which in petrographical composition are essentially similar to known eruptives. The pyroxene-granulites, pyroxenites, amphibolites and peridotites are amongst the most prominent rocks whose occurrences in this form have given rise to much controversy

as to nature and origin. But in the present instance we have a rock which has never yet been found as a normal member of the crystalline schists. Although foliated forms have often been described as local structural modifications of the normal rock, all previously described occurrences of elæolite-syenite have invariably been classed with the eruptives.

Presence of graphite.

In the Sivamalai occurrence additional interest arises from the presence of graphite in the elæolite-syenite as a normal and evenly distributed constituent. Graphite is a well-known constituent of many members of the crystalline schists, and has generally been regarded as the metamorphic product of carbon originally derived from organic sources. Indeed, the presence of graphite in the crystalline schists, and its absence from normal igneous rocks, have led to its being adopted by some as part of the criteria for determining the origin of the rocks in which it is found. In 1896 Professor F. D. Adams,[1] in referring to this question in his report on the geology of a portion of the Laurentian area lying north of the Island of Montreal, said, "the presence of carbon in the form of graphite or any graphitic mineral, disseminated through a gneiss or schist, points to a sedimentary origin, as such substances do not occur in igneous rocks."

Here then we are met with a new difficulty, namely, the presence in one and the same rock, as primary constituents, of graphite which is supposed to indicate a sedimentary origin, and of elæolite which is known only as a constituent of igneous rocks. It is evident, therefore, that we must now revise our views as to the origin of one or other of these two minerals. The nature of this change in our views will depend upon our conclusions as to the origin of the elæolite-syenite itself.

To commence with, it must be confessed that there is no direct evidence obtainable at Sivamalai as to the *intrusive* nature of

[1] Annual Report, Geological Survey of Canada, 1896, Part J., p. 36.

elæolite-syenite. The rock is foliated parallel to the direction of the surrounding crystalline schists, and, so far as can be made out, it occurs merely as lenticular masses. But on the other hand, examination of the rocks in the field reveals many points which are characteristic of *igneous*, and especially of eruptive, masses of elæolite-syenite. For instance, the ordinary foliated, fine-grained rock is traversed by very coarse-grained veins composed largely of elæolite and felspar, and with only small quantities of the ferromagnesian silicates, graphite and iron-ores. At their edges these coarse veins pass gradually into the fine-grained rock and frequently include "horses" of the latter; in fact they are strictly comparable to the so-called contemporaneous veins so commonly found in plutonic rocks. Again, we frequently meet with basic fine-grained autoliths in which the ferromagnesian constituents are concentrated—phenomena also common to igneous masses. Chemical analysis shows the Sivamalai rock to resemble the ordinary elæolite-syenites in composition, and but for the graphite it would agree also in mineral composition, with many previously described eruptive forms; even in the characters of the felspars and ferromagnesian silicates the Sivamalai mass shows the peculiarities which serve to distinguish the remarkable family of elæolite-syenites from the commoner plutonic rocks. Calcite occurs well distributed through the rock, apparently as a primary constituent similar to that in the elæolite-syenite of Alnö, Sweden, and of Hastings county, Ontario. Finally, the Sivamalai rock, like most elæolite-syenites, is associated with an augite-syenite, which resembles Brögger's laurvikite in containing olivine and zircon, as in the well-known occurrences of South Norway.

Evidence of igneous origin by analogy of structure and composition.

Against the presence of graphite we have, therefore, a large number of points of agreement between the Sivamalai mass and the usual type of eruptive elæolite-syenite, and as for the gneissose structure, if not a distinctly secondary character, it is at most the result of an accident attending

Significance of foliation.

consolidation. With the very large number of instances now known of foliation and even banding, of igneous rocks, no one probably would consider this structure antagonistic to the evidences which point to the eruptive origin of a rock. But when definite intrusion, which is the main point of evidence, is wanting, and when a rock-mass appears amongst the crystalline schists with conformable foliation, it is only natural that a conclusion in favour of its igneous origin should be more than ordinarily criticised. And in the present instance the presence of graphite, as an evenly disseminated constituent, would naturally be regarded as a feature which corroborates the evidence of the foliated structure and geological relations of the rock in pointing to its membership with the crystalline schists.

Significance of graphite.

With regard to the graphite we are not, as is the case with the foliation structure, supplied with instances of its occurrence in unequivocal igneous rocks. At the same time graphite has been found more than once under circumstances, as for instance in some pegmatites, where its presence could hardly be explained by metamorphism. The ultimate origin of the graphite is, of course, not the point under discussion; but its occurrence in pig-iron and the Greenland iron-basalt shows that it can be crystallized after simple fusion. In the case of the graphite occurring in the pegmatites the crystals are moulded around by quartz, which shows that it is not a product of sublimation, but is a constituent older at least than the quartz. Similar evidence shows that it is not a sublimated product in the Sivamalai elæolite-syenite: it is older than the felspar and is not found merely in the coarse veins, but scattered through the fine-grained rock, in the same way as it is generally found in crystalline limestones. The question of its origin, therefore, is confined to the two remaining explanations, namely, crystallization from fusion or metamorphism of organic carbon.

Luzi [1] reserves the name *graphite* for the variety which shows the

[1] *Berichte d. deutsch. chem. Ges.*, XXIV, 4085—4095, 1891; XXV, 214—217, 1892; XXVI, 890—895, and 1412—1414, 1893.

phenomenon of "sprouting" on heating after treatment with fuming nitric acid, whilst he distinguishes the variety which does not "sprout" as *graphitite*. According to Moissan[1] the former variety is produced by crystallization from fusion, whilst the non-sprouting graphitite is formed by the metamorphism of amorphous carbon at high temperatures. It is not known to what extent this generalization may be extended, for the precise mode of origin of many of the graphites examined by Luzi must be a matter of doubt. Moissan's conclusion is satisfactory as far as the Sivamalai elæolite-syenite is concerned, for its graphite "sprouts" most distinctly. But I also find this property to be displayed by the graphite of the crystalline limestone of Sagyin in Burma, though I see no theoretical reason for objecting to the suggestion that this limestone has been in a state akin to fusion. Calcite is evidently a primary mineral in this elæolite-syenite and appears as such in other occurrences of this essentially igneous rock.

Balance of evidence as to origin.

The balance of evidence is most distinctly in favour of considering the Sivamalai elæolite-syenite to be eruptive in immediate origin: it presents the features generally displayed by plutonic masses, as well as the peculiar characters of the occurrences of elæolite-syenites which *are* known to be eruptive. Judged by the test of chemical composition, which Rosenbusch[2] has suggested as a means for distinguishing gneisses of eruptive from gneisses of sedimentary origin, there should be no hesitation in classing this rock with the chemically similar eruptive elæolite-syenites; no sedimentary rock has ever been found with such an abundance of alkalies as the Sivamalai rock shows. If an eruptive origin then be ascribed to this rock, the presence of graphite as a constant primary constituent adds another variety to the remarkable group of elæolite-syenites, of which almost every

[1] *Comptes Rendus*, CXXI, 538—540 and 540—542, 1895.

[2] Zur Auffassung der chemischen Natur des Grundgebirges. *Tschermak's min. und petr. Mittheil.*, Volume XII (1891), p. 49.

separate occurrence presents a peculiarity of its own. The whole complex—elæolite-syenite in all its varieties, augite-syenite (laurvikite), corundiferous felspar-rock (corundum-syenite), and probably acid pegmatites with beryl—are regarded as the products of the differentiation of highly alkaline and aluminous magma, intruded into the crystalline schists at a period unknown, but in all probability geologically very ancient.

III.—PETROLOGICAL CHARACTERS.

The following are the principal types of rocks found associated with one another in the neighbourhood of Sivamalai:—

1. **Elæolite-syenite**, consisting of—
   - (*a*) An even-grained, foliated, grey variety which is the prevalent form and contains graphite, biotite and magnetite, as the dark constituents. The felspar is chiefly microperthite.
   - (*b*) Contemporaneous veins of a coarse-grained variety, consisting more largely of elæolite and microperthite, and cutting through (*a*).
   - (*c*) A granulitic form devoid of graphite, but containing a large proportion of opaque iron-ores with biotite. The felspars are microcline and plagioclase.
   - (*d*) A variety containing hornblende and calcite, but devoid of graphite and magnetite.
   - (*e*) Basic "Schlieren" with barkevikitic hornblende and calcite.
2. **Augite-syenite.**
3. **Felspar-rock** with **corundum** and other accessories.

It is very probable indeed that this list does not exhaust the catalogue of associated rocks near Sivamalai; amongst the elæolite-syenites alone there are probably more varieties, as we were compelled to limit the field work to a few days only, and new phases of the rock turned up on nearly every day. Such variations within a limited area are, however, quite consistent with the usual experience amongst the elæolite-syenite family.

1.—Elæolite-syenite.

1 (*a*). Foliated elæolite-syenite.

In Sivamalai and the small hillocks which are aligned to the

west-north-west of it the prevalent form of elæolite-syenite weathers into tors of pale yellowish-brown blocks. The superficial removal of the easily decomposed elæolite has resulted in the formation of pitted surfaces, which form a characteristic feature in the weathering of these rocks. The discolouration produced by atmospheric agents is found to be absolutely superficial, a new fracture of even small stones showing the grey colour of the fresh rock. The rock is remarkably even in grain, with crystals measuring up to 2 or 3 mm. in diameter. The foliation is always apparent even in hand-specimens, but is due merely to a linear arrangement of the constituents, especially of the noticeably inequiaxed crystals like the biotite and graphite. With a lens it is easy to distinguish the grey felspar from the oily-yellow elæolite grains, and the graphite, though never in large quantities in this variety, can be distinguished from the biotite, and may be removed by a needle for special examination (Specimens of the rock, No. 11,460).

The average specific gravity of the rock is 2·593.

Excepting the graphite, which occurs in little six-sided plates, and possibly the opaque iron-ores, it is impossible under the microscope to decide the relative ages of the constituent minerals: in common with most of the rocks which form these curious lenses in the crystalline schists, the prevalent type of elæolite-syenite in Sivamalai is granulitic in structure, and the crystals have so interfered with one another that none of them can be said to show idiomorphic outlines. There is occasionally a sign of hypidiomorphic structure, but generally the crystals are panidiomorphic.

The chief constituents are elæolite and felspar with biotite as the principal, generally the only, ferromagnesian silicate, graphite and opaque iron-ores. These are the usual constituents of the most prevalent grey gneissose form on Sivamalai, but in some sections there occur zircon, calcite and, very rarely, hornblende (*Cf.* 1*c* and 1*d*). Generally the biotite distinctly exceeds the graphite in quantity.

The *elæolite* crystals always show numerous fracture cracks

along which highly double-refracting decomposition-products have in some cases been formed; but otherwise they are perfectly clear, colourless and remarkably fresh. The fracture cracks are apparently determined by stresses on the rock, for they often extend across adjoining felspar-crystals. The elæolite crystals have been identified by their low double refraction, and in thick sections by the negative character of the uniaxial figure. They are easily decomposed by hydrochloric acid with the formation of a siliceous jelly which absorbs carmine staining. On evaporation the soluble portion yields cubes of the alkaline chlorides (for chemical composition, see p. 12).

The *felspar* is light-grey in colour, and in thin section shows the peculiar "moonstone" effect due to a cryptoperthitic structure. Some of it is a definite plagioclase showing lamellar twinning, but by far the larger quantity of felspar in the prevalent grey type of this syenite is orthoclase or anorthoclase with a microperthitic or cryptoperthitic structure. Microcline is unusual, but its structure is often badly imitated by presumably an intergrowth, which between crossed Nicols gives the felspars the structure of a stretched and distorted mesh. The threads of the mesh present a red of the first order, whilst the interspaces polarize with yellow of the same order. Sometimes these two constituents of the crystal extinguish almost simultaneously, and from this they may vary up to 9° between their positions of extinction. The crystals occasionally show slight kaolinization.

The *biotite* is noticeable for the almost complete absorption of the rays vibrating parallel to the cleavage, and for the olive-green to yellow-green colour of the rays vibrating at right angles to this direction. In convergent polarized light the flakes give the usual figure, indicating a very narrow optic axial angle and negative character of double refraction.

The *iron-ores* show their crystal outlines in section, and their clean edges, as well as shapes, serve to distinguish them from the opaque graphite on the same section. The granules separated from

the crushed rock are highly magnetic, but give also reactions for titanium when tested chemically.

The *graphite*, separated by means of Sonstadt's solution from a weighed sample of the crushed rock, was found, after thorough cleansing with hydrofluoric acid, to amount to 0·58 per cent., which in so light a mineral occurring in thin plates is as much as might be expected from the show it makes in hand-specimens. Its low specific gravity (large flakes from the coarse veins gave a sp. gr. of 2·25) is sufficient to distinguish it from molybdenite for which it might excusably be mistaken in the rock, and which, according to our previous ideas, might with greater likelihood be expected in this association. The special tests applied confirm the determination of the specific gravity and leave no doubt as to the identity of the mineral.

Although much more abundant in the felspar-rock associated with the elæolite-syenite, *zircons* are sometimes found in the same section as elæolite. Treatment of the crushed rock with dilute acid invariably gives rise to noticeable effervescence, due to the *calcite* which is seen occasionally as small granular crystals in sections of the rock.

Chemical composition of the Elæolite-syenite.

For the purposes of chemical analysis, a large specimen of the prevalent type—the grey, even-grained rock of Sivamalai—was selected (No. 11,460). The specific gravity of the specimen was 2·593. The *graphite* was separated from the crushed rock by means of Sonstadt's solution, washed, and, after treatment with hydrofluoric acid to remove all silicates still adhering to the scales, dried and weighed. Although the layer of scales made a good "show" when floating on the Sonstadt's solution, the graphite amounted when weighed to 0·58 per cent. only of the rock taken. The other constituents of the rock have been determined by my

colleague, Dr. T. L. Walker, in the ordinary way, with the following results:—

Chemical Analysis of Rock No. 11,460.

Silica	55·68
Alumina	23·81
Ferric oxide (calculated as Fe_3O_4)	4·84
Lime	1·69
Magnesia	0·65
Potash	5·16
Soda	9·23
Graphite	0·58
Ignition	0·34
	101·98

The results of this analysis agree with those of the ordinary elæolite-syenites in the high percentage of alumina, very small quantity of lime and magnesia and high proportion of alkalies (14·39 per cent.). The silica percentage in the elæolite-syenites usually ranges between about 50 and 56 ; a slightly lower result than 55·68 would have been obtained in this case if the separation of the titanic acid had been accomplished; it can only be present, however, in very small quantities. Except for the graphite, then, the Sivamalai rock shows no noteworthy divergences from the chemical composition of the ordinary elæolite-syenites.

Loewinson-Lessing's scheme[1] brings out this relationship to known elæolite-syenites very clearly.

Reducing the total to 100 and calculating the molecular ratios for the oxides, we obtain for the Sivamalai rock :—

SiO_2	0·910		
Al_2O_3	0·227	0·247	
Fe_2O_3	0·020		
FeO	0·020	0·065	0·265
CaO	0·029		
MgO	0·016		
K_2O	0·054	0·200	
Na_2O	0·146		

[1] F. Loewinson-Lessing, "Studien über die Eruptivgesteine," C. R., VIIth Congrés Géol. Internat., St. Petersburg, 1897, pt. 3, 194.

The molecules of bases are thus 55·6 per cent. of those of silica, and the acidity co-efficient (α) = 1·81, whilst the ratio of the alkalies to other bases is 3 : 1.

Loewinson-Lessing gives for 12 elæolite-syenites :—

SiO_2	0·928		
Al_2O_3	0·214	0·231	
Fe_2O_3	0·017		
FeO	0·020	0·063	0·268
CaO	0·031		
MgO	0·012		
K_2O	0·064	0·205	
Na_2O	0·141		

Molecules of bases amount to 54 per cent. of the silica; acidity co-efficient (α) = 1·91 ; ratio of alkalies to protoxides is 3·2 : 1.

By determining the proportion of the rock soluble in hydrochloric acid, the approximate proportion which the elæolite bears to the other constituents has been calculated. The powder was treated with hydrochloric acid, and the liquid evaporated to dryness in order to reduce the gelatinous silicic acid to insoluble silica. The soluble salts were then removed in the ordinary way; the residue so obtained was composed of the insoluble constituents of the rock, *plus* the silica of the decomposed elæolite, and amounted to 77·4 per cent. of the rock taken. As the only two minerals in the rock appreciably soluble in hydrochloric acid are the elæolite and the magnetite, the iron in the solution must have been practically all derived from the magnetite. Deducting the iron, which amounted to 3·63 per cent. (calculated as Fe_3O_4), from the dissolved materials, the remainder, 18·97, must be due to the alumina and alkalies of the elæolite. Knowing from the separate analysis of the elæolite that its bases constitute 56 per cent. of the mineral, 18·97 per cent. of bases would be equivalent to nearly 34 per cent. of the mineral in the rock. These estimates, 34 per cent. of elæolite and 3·63 per cent. of magnetite, are probably close approximations to the composition of the ordinary grey form of elæolite-syenite in Sivamalai. The felspars are too variable in their composition to permit of the

safe application of the data obtained by the analysis of the large crystals of microperthite in the coarse-grained veins. But even by assuming that the microperthite has a constant composition throughout, a calculation based on its potash gives a result which is not far removed from an estimate made by microscopic examination of sections. Deducting, for instance, the amount of potash from the rock analysis due to 34 per cent. of elæolite, we have 5·16 — 1·88 = 3·28 due to the microperthite, which would contain nearly all the remaining potash of the rock. Assuming the analysed felspar to be the average type of microperthite in the rock, this amount of potash would indicate 3·28 × 100 ÷ 5·86 = 56 per cent. microperthite. As there is always a certain amount of ordinary plagioclase in the rock, the soda and lime determinations cannot be used to check this result; the total given for soda and lime, however, exceeds that which would be contained in this amount of microperthite, which is consistent with the fact that a small quantity of plagioclase is known to replace some of the microperthite amongst the felspars.

The estimates thus obtained for the mineral composition of the ordinary, medium-grained, grey form of elæolite-syenite are as follows:—

	Per cent.
Elæolite	34
Microperthite	56
Magnetite	3·6
Other constituents, biotite, plagioclase, graphite, etc.	6·4
	100·0

So far as can be judged by microscopic examination of sections, these results are not far removed from the truth; so the remarks made below as to variations in the mineral proportions of the five separate varieties may be taken to apply to departures from this estimated composition of the ordinary and most common variety in Sivamalai.

1 (*b*). Contemporaneous Veins.

Elæolite-syenite-pegmatite.

The prevalent, gneissose, grey variety, darkened by a comparative abundance of biotite, graphite and iron-ores, is cut through by lighter-coloured, coarse-grained veins composed principally of large crystals of oily-yellow or pink elæolite and grey microperthite, with occasional flakes of biotite and graphite or lumps of iron-ore. These vary from merely local modifications of the fine-grained variety to definite veins two or three feet wide; but in all cases at the edges of the veins the crystals interlock across the border, showing a rapid, though not sudden, passage into the commoner type of the rock. Patches of the fine-grained rock are found as autoliths in the coarse-grained veins, and show too an ill-defined junction with the coarse material in which they lie.

The relation which these coarse-grained veins bear to the finer-grained elæolite-syenite which they cut is precisely the same as that existing between some acid pegmatites and the finer-grained granites which they traverse. Such veins, distinguished by the older geologists as "contemporaneous veins," were thought to belong to the same general period of eruption as the fine-grained rock which they cut, though naturally there must have been a succession in time between the formation and actual consolidation of the two. Reyer[1] would regard these veins as a special kind of *Schlierengänge* distinguished under the name *Secret-Gänge* or *Secret-Blätter*, on account of the supposition that they are formed by the exudation into local rifts of the mother-liquor from the partially solidified rock-mass. Charpentier, when writing of the Pyrenean granite in 1823, suggestively described these veins as the "after-births" of the granite, whilst Carne referred to the similar phenomena in Cornwall as "contemporaneous veins," distinguishing them from the "true veins," which were either products of a distinct and subsequent eruption,

[1] Theoretische Geologie, 1888, p. 101.

or the mineral lodes which filled-in subsequent dislocations affecting the granite and the neighbouring rocks alike. Charpentier's expression conveys most perfectly the idea which presents itself to geologists who have studied these phenomena, especially in granites where they are so common, whilst Carne's term, both on account of its economic bearing and its scientific expressiveness, has obtained a wide usage with English writers. As a means then for expressing a genetic relationship between these veins and the rocks which they cut, I would prefer to stick to the time-honoured term "contemporaneous veins," notwithstanding recent assumptions that it is a misuse of terms and contradictory.[1] The value of a term lies in the meaning it conveys, and the meaning of this term is precisely the same to-day as when Carne first used it to distinguish veins genetically related to the granite from those which are totally distinct and subsequent in origin.[2]

The basic secretions, which present the appearance of inclusions in, and the contemporaneous veins, which cut through, the predominating form in a great rock-mass represent opposite extremes of the process of differentiation in the original magma, or more probably of segregation during the process of consolidation. In the case of the granites the contemporaneous veins form the

[1] *Trans. Roy. Irish Academy*, XXX (1894), 477; *Quart. Journ. Geol. Soc.*, LIII (1897), 419.

[2] Carne. "On the relative ages of the veins of Cornwall." *Trans. Roy. Geol. Soc. of Cornwall*, Vol. II (1822), page 49. I am unable to say who first used the term "contemporaneous veins." Dr. John Davy in 1818 (*Ibid.*, Vol. I, pp. 20, 26) referred to quartz veins traversing the granite of Porth Just as belonging "to that class of veins commonly considered contemporaneous." Those which were formerly called "contemporaneous veins" were in 1834 (Boase, "Primary Geology," p. 355) known as veins of segregation, a term introduced by Professor Sedgwick at the suggestion of Whewell "to express that they have been formed by a separation of parts during the gradual passage of the mineral masses into a solid state." This is the sense also in which the term "segregation" is used by Professor H. Louis in the second edition of Phillips' "Ore deposits" (1896), p. 11, foot-note.

most acid phase, being the consolidation product of the more siliceous mother-liquor; in this elæolite-syenite the processes of differentiation have tended to a concentration of the alkalies, and so the contemporaneous veins now under consideration represent the highly alkaline mother-liquor, containing not less than 16 per cent. of soda and potash.

The weathered surfaces of these coarse veins in the elæolite-syenite very strikingly show the difference between the elæolite and the felspar in their resistance to the action of the atmosphere: the surfaces of the former are depressed, often quite a quarter of an inch below the latter, and the decomposition products which fill in cracks in the elæolite stand out like a network of minute strings. Rounded boulders of pure elæolite weighing 2 to 4 lbs. are frequently found lying in the débris at the foot of the hills.

Besides the elæolite, microperthite, biotite, graphite and iron-ores, a crystal of white mica was found in one of these coarse veins; it was hexagonal in shape, measured half an inch across the basal plane, and showed the wide angle and correct position of the optic axial plane for *muscovite*. This was the only specimen of muscovite found in these rocks, but the rarity of this mineral in the elæolite-syenites makes it worthy of record.

The large size of the crystals of *elæolite* facilitates the examination of their properties. The mineral shows a very imperfect basal cleavage which, however, is sufficiently pronounced to obtain flakes showing the negative character of the uniaxial figure in convergent polarized light. In the small hills lying west-north-west of Sivamalai the elæolite is of a yellowish-brown colour; but in Sivamalai itself it generally has a pink tinge. The differences in chemical composition between these two varieties has not been tested, but to all other tests they present similar reactions.

The specific gravity is 2·62, all determinations being in very close agreement, which might be expected from the freshness of the material.

Chemical analysis of the yellow variety of elæolite gave the following results :—

Silica	43·35
Alumina	34·32
Ferric oxide	1·02
Lime	0·82
Potash	5·52
Soda	14·62
Loss on ignition	0·75
	100·40

Neglecting the iron-oxide, which is probably present as an impurity though in larger quantity than one would expect from the microscopic appearance of the mineral, this analysis indicates a formula of $(NaK)_2OAl_2O_32SiO_2$ with a molecular ratio of $K_2O : Na_2O = 1 : 5$. The lime and iron have not been considered in calculating the formula, although it is of course possible that they have in part replaced some of the protoxides and sesquioxides, as the silica found by analysis is slightly higher than would be given by the above formula which takes into consideration only the soda, potash, alumina and silica for the molecular ratios, $RO : R_2O_3 : RO_2$.

The light-grey *felspar*, which is associated as large crystals with the elæolite in these contemporaneous veins, was found to have an average specific gravity of 2·594. A chemical analysis made by my colleague, Dr. T. L. Walker, gave the following results :—

Silica	64·70
Alumina	22·63
Ferric oxide	0·43
Lime	1·34
Magnesia	0·49
Strontia	(?) trace
Potash	5·86
Soda	6·02
Loss on ignition	0·09
	101·56

This analysis shows a mixture of potash, soda and lime felspars in about the ratio of 5 Orthoclase : 8 Albite : 2 Anorthite, a mixture which would give, theoretically, the following analysis :—

Silica	65·22
Alumina	20·50
Lime	1·48
Potash	6·23
Soda	6·57
	100·00

The chemical composition of the felspar agrees with the variety so common in the elæolite-syenite family which Rosenbusch has proposed to call *anorthoclase*. But the microscopic sections give the characters of microperthite; the principal mass of the mineral being monoclinic in its optical behaviour, whilst the long spindle-shaped inclusions show highly inclined extinctions on the clino-pinacoidal sections, with narrow extinction angles on basal sections. The soda and lime are, however, higher than would be expected, unless the soda is accounted for on the supposition that the mono-clinic felspar is the soda-orthoclase which Brögger suggests is merely a sub-microscopic intergrowth of orthoclase and albite (cryptoper-thite).[1] The microscope shows that the grey felspar is almost en-tirely microperthitic in its structure. In one of the orthopinacoidal sections of this felspar there were found a series of minute opaque inclusions of a black mineral forming ragged laths, four or five times as long as broad, and apparently formed by an aggregation of octa-hedral crystals in parallel grouping, with the long axis of the lath or group of crystals lying in the clinodome. Each black inclusion is surrounded by a zone showing slightly higher double refraction than

[1] Dr. Walker thinks it unwise to base too severe a criticism of the felspar on this analysis, as the chemicals used were by no means above reproach. The microscopic evidence may, therefore, be considered more reliable till a fresh analysis can be made.

the ordinary felspar. When the Nicols are arranged parallel to the vertical and orthodiagonal axes of the felspar, that is when extinction occurs, these zones around the black inclusions show a black cross

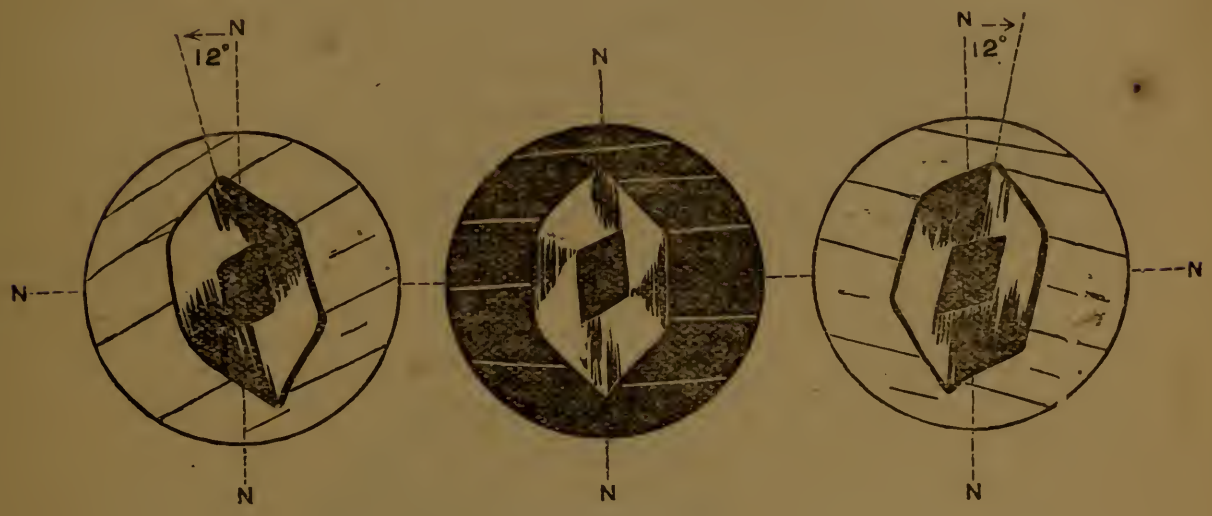

Fig. 1.—Opaque inclusions with polarising "court" in microperthite.
(Magnified by 300 diameters.)

distorted by strain; when the Nicols are turned to the right 10—12°, the upper right-hand and lower left-hand sectors of the zone extinguish. Similarly when the Nicols are turned 10—12° to the left the upper left-hand and lower right-hand sectors became dark; imperfect lamellar twinning is at the same time shown by the opposite polarising sectors. The basal cleavage-cracks which cross the orthoclase stop short at the edges of these zones around the opaque inclusions. The phenomena are too regular and too clearly defined for accidental strain phenomena, and are probably the result of the development of some other felspar around each opaque inclusion. These inclusions are near the position of the minute interpositions which characterise the schillerized variety murchisonite. Some of

the felspar-crystals are almost carmine-red to the naked eye. This is found to be due to innumerable platy, orange-coloured inclusions which, however, are not surrouuded by the peculiar polarizing zone described above.

A feature worth note in this coarse form of the elæolite-syenite is the frequent occurrence of a thin film of *plagioclase* between the elæolite and the orthoclase (microperthite) crystals. This narrow strip of plagioclase is very varied in thickness, but shows crystallographic parallelism often for very long distances, and a strip at the edge of a microperthitic crystal may even be crystallographically parallel to a zone surrounding an included lump of elæolite (see fig. 2).

Fig. 2.—Layer of albite separating elæolite from microperthite. (Magnified by 25 diameters, Nicols crossed.)

The lamellar twinning in these plagioclase strips is very sharply defined and shows a maximum angle of about 20° between the positions of extinction in alternate lamellæ. These strips of plagioclase are, in their disposition, comparable to the well-known

"reaction rims" which are so often found separating olivine and plagioclase in the olivine-norites. In the present instance, however, the reaction borders are more irregular and consist of one mineral only, which, nevertheless, is probably the result of the orthoclase having stolen all the potash from its immediate borderland and having left a "crystal-court" residue which has consolidated as pure plagioclase. These strips of plagioclase, though very common, are by no means constantly found separating the elæolite and orthoclase crystals. They are more constantly seen, for instance, when orthopinacoidal sections of the orthoclase adjoin elæolite crystals, and are often not discoverable when the orthoclase section shows its microperthitic structure. But this of course may be due to twinning of the plagioclase strips according to the albite law, in which case such sections would not always show the lamellar twinning.

The coloured minerals, which occur in relatievly small quantities in the contemporaneous veins, do not differ essentially from those which occur more abundantly in the fine-grained, grey rock—large flakes of graphite, dark-green biotite and lumps of magnetic iron-ore being the usual accessories.

The lumps of the common fine-grained type occasionally found in the contemporaneous veins are merely pieces of the ordinary rock, separated from the general mass and caught in the mother-liquor which formed these coarse-grained veins. If the contemporaneous veins were regarded as subsequent and distinct intrusions of a different composition, these "horses" of fine-grained rock would be regarded as xenoliths; but it seems unnecessary to regard them as "foreigners" when it is so very evident that the coarse and the fine-grained elæolite-syenites are derived from the same magma and represent merely two phases in the general consolidation of one great eruptive mass. They are consequently regarded as true autoliths.

At the summit of Sivamalai another form of the rock occurs as veins. These consist principally of granular grey microperthite and pink elæolite, but also with crystals of the biotite, often the green

form, graphite and zircon. The felspar and graphite show a tendency to concentration along certain lines to the exclusion of the elæolite; these are coarser in grain than the portions in which the elæolite is concentrated. The pink elæolite often shows the commencement of alteration, with the production of hydrated products; but the change is quite insignificant and probably only superficial.

1 (*c*). Variety containing microcline and plagioclase, but without graphite.

This type is based on specimens collected by Mr. Middlemiss in 1895 from the western extension of the Sivamalai range (No. 10,385). The principal points in which it differs from 1(*a*) are, first, the absence of graphite, and, second, the presence of microcline associated and often intergrown with a well twinned plagioclase. The opaque iron-ores, which are chiefly titaniferous magnetite, are also relatively more abundant than in the other types. The microperthite so characteristic of 1(*a*) and 1(*b*) occurs in very small quantities only and is always of a coarser type, the spindle-shaped inclusions being easily distinguished with the low power.

The *plagioclase* is remarkably fresh and shows very sharply defined twin-lamellæ. The maximum angle between the positions of extinction in the albite lamellæ is 20°, which would be true for either albite or andesine, but in a rock too fine-grained for the isolation of the constituents the species cannot be stated with certainty. Albite would, however, be more consistent with this association, and has been found presenting similar characters in other occurrences of elæolite-syenites, and it has been identified in the associated felspar-rocks. Rosenbusch mentions that albite sometimes accompanies older, well corroded crystals of microcline-perthite, and sometimes forms narrow borders around the latter mineral.[1]

[1] Mikroskop. Phys. der mass. Gest. (1896), p. 151.

The plagioclase in this rock agrees in presenting these characters, and it resembles very closely that which forms the narrow zones separating the elæolite from the microperthite in the coarse-grained veins (p. 22). Until its characters can be worked out more fully, therefore, this mineral may be referred to albite.

Oscillations in the order of crystallization.

The relations of the white minerals in this rock are of a most irregular kind. Rounded lumps of elæolite are found in both albite and microcline. Irregular shreds of albite are often found scattered through microcline, having an optical parallelism with one another as well as with an adjoining large, well-twinned albite crystal. On the other hand, isolated lumps of microcline, crystallographically parallel to an adjacent large crystal, are found lying in the albite lamellæ. And yet there is no definite granophyric structure, nor is there any approach to poikilitic structure. The rock may, however, have possessed the former structure and may have since become granulated by disturbance during, or by crushing after, consolidation. The very imperfect local approaches to granophyric intergrowth lend colour to this view, which is supported by the crystallographic parallelism so frequently observed in the two mutually entangled felspars. The fact that the elæolite crystals, occurring as merely isolated rounded lumps in both felspars, never show any trace of crystal outline would suggest a corrosion and trespass by the felspar ; in fact the structures in this rock suggest altogether an imitation of the processes which gave rise to the narrow bands of albite seen so frequently to separate the elæolite from the potash-felspar crystals in the coarse contemporaneous veins. There has been corrosion of some sort, but the evidence is not sufficiently abundant to be conclusive as to the direction in which the changes have taken place. This sort of contradictory evidence as to the order of succession amongst the constituents seems to be quite characteristic of some members of the crystalline schists. The pyroxene-granulites, for example, are especially prone to inconsistencies in the order of crystallization of their minerals.

An unaltered eruptive rock, on the other hand, usually shows a fixed order of succession amongst its constituents. Exactly why there should be this difference between simple eruptives and the old crystalline rocks has not been explained; but the evidence of these elæolite-syenites and of the pyroxene-granulites in South India tends, in my opinion, to show that the contradictions and apparent oscillations in the order of crystallization are due to disturbances during consolidation, just as, according to Professor Judd, the ophitic intergrowths of augite and plagioclase give rise to a granulitic structure when the basic rocks are moved during the process of crystallization.

1 (*d*). Variety containing hornblende and calcite, but without graphite.

This type contrasts with those described above in the following points:—

(1) There is almost a complete absence of opaque iron-ores, which in the varieties described above are much more abundant than is usually the case with the elæolite-syenites.

(2) Biotite occurs only in very small quantity, being replaced by a barkevikitic hornblende, which is gathered into granular groups measuring half an inch or more across, and giving the rock a mottled appearance in hand-specimen.

(3) Calcite is present in granular crystals, which are more particularly abundant within the dark hornblendic patches, although isolated crystals occur also in the felspathic groundmass.

(4) Elæolite is much less abundant than in the grey rock (1*a*, *b* and *c*). It occurs in small crystals which tend to aggregate, like the calcite, within the hornblendic areas.

The smaller size and lesser quantity of the elæolite are noticeable on the weathered surfaces of this rock, very few of the small pits being detected.

This rock forms large masses on the western face of Sivamalai; but its precise relations to the other rocks could not be made out. The dark hornblendic patches are too evenly distributed to suggest a mixing of two types, though it is not unlikely that this is a stage in the aggregation of the hornblendic constituents, which in other parts of the hill form large, black lenses (1*e*). Like all the other rocks of Sivamalai this variety is roughly foliated.

I have more than once had occasion to refer to the peculiar tendency which granulitic rocks of this kind show towards an aggregation of constituents into groups of like kind. It is quite a common feature of the charnockite series, especially the intermediate varieties,[1] and is due in my opinion to movement of the magma during the process of consolidation, whereby the crystallizations around definite centres are disturbed, and what would have been a crystal of large size under quiet conditions is converted into an aggregate of minute granules. For this structure Loewinson-Lessing has recently proposed the name *glomero-plasmatic structure* as an analogue of Judd's glomero-porphyritic structure.[2] The structure is illustrated in Fig. 3, which represents the natural size of a piece

[1] *Mem. Geol. Surv. Ind.*, XXVIII, pp. 152, 241.

[2] F. Loewinson-Lessing. "Geologische Skizze der Besitzung Jushno-Saosersk und des Berges Deneshkin Kamen im nördl. Ural", Jurjew (Dorpat) 1900, p. 208. Describing a hypersthene-gabbro-norite of the Deneshkin Kamen, Loewinson-Lessing says, "Ein rosenfarbener deutlich pleochroitischer Hyperthen kommt ausschliesslich in abgerundeten Körnern vor, die zum Theil vereinzelt im Gestein verstreut, theils in Aggregate gruppiert sind, wodurch das Gestein in ganz eigenartiges Gepräge enthält. Solcheine Structur, welche durch die Gruppierung eines oder mehrerer Gemengtheile in körnige Aggregate gekennzeichnet wird, die in eine körnige Masse von anderer Zusammensetzung eingeschlossen sind, weist eine grosse Analogie mit der glomeroporphyrischen Structur auf und könnte als *glomeroplasmatische Structur* bezeichnet werden. Im vorliegenden Fall sehen wir körnige Hypersthen-aggregate, die als dunkle Flecken im Fond eines normalen leukokraten körnigen Gabbronorits hervortreten.

of hornblende-elæolite-syenite (No. 11,470) from Sivamalai. Such

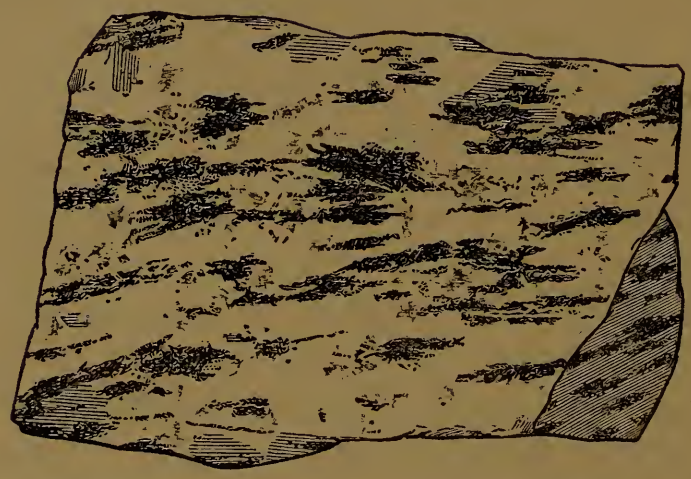

Fig. 3.—Hornblende-elæolite-syenite shewing glomero-plasmatic hornblendic patches distorted to produce gneissose structure. No. 11,470 (Natural size), W. face of Sivamalai.

hornblendic patches are on a small scale strictly analogous to schlieren, and illustrate the formation of gneissose structures, and, by further development, banding through distortion of a schlierig rock-mass. This explanation, which I have already applied to the charnockite series,[1] was suggested ten years ago by Bonney and McMahon as the cause of banding in the granulitic group of the Lizard in Cornwall, and was proposed by them as a sufficient explanation of banding in many Archæan gneisses.[2] The same idea has been more than once since applied, especially to banded basic rocks.

[1] *Mem. Geol. Surv. Ind.*, XXVIII, 1900, 221.

[2] Bonney and McMahon, "Results of an examination of the crystalline rocks of the Lizard district." *Quart. Journ. Geol. Soc.*, XLVII, 1891, 478.

The *biotite* which occurs in this rock is brown in colour, and presents a peculiar corroded appearance due to ramifications of one of the white minerals, producing a structure not unlike the "quartz of corrosion" in many gneisses and granulites. The *hornblende* is olive-green to brown-green in colour according to the direction of the section, with a very strong pleochroism: a = brownish yellow; b = deep olive-green, almost black on account of the intense absorption, and c = as dark as b. Some sections consequently remain almost black in all positions of the Nicols. The extinction-angle ($c : c$) is about 12°. The *felspar*, which forms the main mass of the rock, is almost wholly microperthite, and occurs in granular crystals devoid of idiomorphic outlines.

The principal feature of interest is connected with the presence of *calcite* in granular crystals, with apparently as much right as any of the others to be considered a primary constituent. The crystals form isolated granules, and there are no signs of secondary decomposition, or structures which suggest its infiltration into the rock. This is not the first time that calcite has been found as a constituent of elæolite-syenite and been regarded as primary in origin, and the low silica percentage in this group of rocks removes the chief theoretical difficulty to its crystallization from a molten magma as a normal constituent of an igneous rock. In the Alnö occurrence, well known from the description by Törnebohm, the more recent researches of Högbom tend to show that the large masses of crystalline limestone, as well as the scattered granules of calcite, have been fused in the magma without decomposition, and that during the process of solidification calcite has crystallized out of the magma in precisely the same way as the other minerals.[1]

[1] Högbom. "Ueber das Nephelinsyenitgebiet auf der Insel Alnö." *G. F. i Stockholm Förhdl.*, Vol. XVII (1895), pp. 100 and 214. Abstract in *Min. Mag.*, Vol. XI (1897), p. 250, and Rosenbusch, *Mikr. Phys.* (1896), pp. 169 and 171.

1 (*e*). Basic lenses with basaltic hornblende and calcite.

At several places in Sivamalai and especially near the summit, black, fine-grained patches occur, generally with a roughly lenticular shape and presenting an approach to foliation by linear disposal of the constituents. By microscopic examination these are found to be composed principally of a brown, barkevikitic, hornblende, with subordinate quantities of elæolite, orthoclase, plagioclase, calcite, biotite, purple augite, graphite, iron-ores and sphene. The structure is generally granulitic, which is probably due, as usual, to the breaking up of complicated intergrowths by movement during the process of consolidation; sometimes in fact the hornblende has been preserved in its original form, showing a crystallographic parallelism in several isolated sections, and producing a micropoikilitic structure, whilst at other times the hornblende is gathered into groups of variously orientated granules, which is probably due to the mere breaking up of the delicate poikilitic or ophitic systems. I believe this to be very often, if not constantly, the cause of the granulitic structure, as well as the "blotchy" character, of these rocks, which form slightly foliated lenses in the crystalline schists. In the pyroxene-granulites (charnockite series), for instance, of South India the pyroxenes are frequently so found to form groups of granules of one species, whilst less often the optical continuity of isolated neighbouring sections has escaped destruction.

The *hornblende* is deep-brown in colour and intensely pleochroic: a = straw-yellow; b and c = deep-brown, almost black, through strong absorption. The *biotite* is brown and often forms large plates stretching across three or four of the ordinary granules of its fellow constituents. The purple *augite*, which is so often found in the elæolite-syenites, occurs in some specimens of this rock in very small quantities, but in one specimen a pale-green, slightly pleochroic augite occurs abundantly. The presence of *sphene*, too,

is noteworthy on account of its general absence from the other varieties of this area.

The white constituents are about evenly divided in quantity. The *orthoclase* is without the microperthitic structure so commonly seen in these rocks; the *plagioclase* agrees in character with that already described, and appears to be albite. The *elæolite* is perfectly fresh and wholly resembles that already observed in the ordinary types. *Calcite* forms isolated granules, generally well twinned into lamellæ.

The *iron-ores* and *graphite* exist only in very small proportions.

2.—Augite-syenite.

As is so commonly the case with elæolite-syenite, the rock of Sivamalai is accompanied by an augite-syenite, which resembles Brögger's laurvikite of the well-known elæolite-bearing area of South Norway in containing olivine.

This augite-syenite forms a hill composed of red, rounded masses of rock lying to the north-east of Sivamalai, and in a more coarsely crystallized form at the north-east foot of Sivamalai, that is, between the main mass of elæolite-syenite and the hill composed of the finer-grained form of augite-syenite. Both the coarse and the fine-grained varieties are dark-green in colour when freshly fractured, and dark-red on the surfaces exposed to the weather. They are essentially the same in mineral composition.

The constituents are, in approximate order of abundance, felspar, chiefly microperthite, green non-pleochroic augite, opaque black iron-ores, olivine, zircon, greenish-brown hornblende, hypersthene, apatite and biotite. No trace of elæolite has been found. These rocks, in common with the elæolite-syenite, show a very imperfect foliation, and as usual the ferromagnesian silicates display a tendency to gather into glomero-plasmatic groups. The hornblende, apatite and iron-ores occasionally show idiomorphic outlines, but

oftener they and all the other constituents present no definite crystal faces.

Fig. 4—Crystal of olivine, partially enveloping green augite in laurvikite. Rock No. 11,463, magnified by 40 diameters.

As already stated, the felspars are mainly *microperthite*, similar to that in the elæolite-syenite; but often, especially in the coarse-grained forms, there are very complicated intergrowths of a well twinned *plagioclase* with either common microperthite or with microperthitic microcline. The individuals interlock with very irregular borders, but show no constant tendency to extension along any definite crystallographic direction.

The green *augite* is scarcely pleochroic in thin section, but shows a series of well-defined gliding planes often accompanied by lamellar twinning.

The *hornblende* is partly the common, highly pleochroic, brownish-green variety which in cross-section often shows traces of the forms (110) and (010). Other crystals present the characters of Brögger's *barkevikite*.

The *olivine* forms rounded irregular lumps with finger-like extensions (fig. 4). There is a tendency to grouping in rich patches, and

in these groups adjacent but isolated sections may show simultaneous extinction. The crystals are cracked in characteristic fashion, with the development of yellow serpentine. The most interesting feature in connection with the mineral is the occasional occurrence of a narrow zone of rhombic pyroxene following the outlines of the olivine and enclosing it partially in a shell, a feature which has also been recorded for the olivine-bearing augite-syenite of South Norway.

The remaining constituents call for no special remark. The *iron-ores* are the only ones occurring in considerable abundance.

3.—Felspar Rock with Corundum
(Corundum-syenite.)

Felspar-rock is about the most expressive name to apply to the rock which is found in such large quantities around each of the small hillocks of elæolite-syenite, as well as at the foot of, and sometimes at considerable heights on, Sivamalai itself; but neither its precise affinities to the elæolite-syenite and augite-syenite, nor all its curious variations have been worked out. It is, however, almost certainly a genetic relative of both, due to differentiation of the magma. On account of its general occurrence on the low ground it is covered with detrital material which is often cultivated. This rock occurs in two degrees of texture— (1) a medium-grained and granulitic form, traversed by (2) its own coarse-grained pegmatite. They agree approximately in composition, being composed largely of felspar which in the granulitic form is microperthite and in the coarser type is an irregular intergrowth of albite and orthoclase. The finer-grained form often contains a red garnet, which contains much magnesia besides iron and alumina,[1] magnetite and other

[1] I have been unable to obtain sufficient material for a quantitative analysis of this garnet, but the qualitative tests show that it is a mixture of pyrope and almandine similar to the variety rhodolite which has been found by Judd and Hidden to be intimately associated with ruby-corundum in North Carolina (*Min. Mag.*, XII, 1899, 145).

black spinelloids, besides tabular six-sided crystals of corundum, larger than any of the other constituents and sometimes measuring half an inch across. The corundum is very irregular in its distribution through these rocks.

Near the western end of the row of small hillocks very coarse-grained, pink felspar-veins occur, carrying crystals of corundum measuring sometimes over six inches across. In this rock several other accessory minerals occur, like *biotite*, *muscovite*, *deep-blue apatite*, *zircon*, *zinc-spinel* (automolite) and a sulphur-yellow platy form of *chrysoberyl*[1] ($BeO.\ Al_2O_3$). The *felspar* is a complicated intergrowth of more than one species in which a well twinned albite and orthoclase are prominent forms.

The felspars are too intimately intergrown to permit of separation for independent examination, but chemical analysis of a fragment having a specific gravity of 2·594 shows that the felspar consists of a mixture of orthoclase with almost pure albite. Microscopic examination shows the development of a small amount of muscovite and kaolin in the felspars, in consequence of which the silica is a little lower and the alumina a little higher than they otherwise would be in this analysis.

Analysis of fragment of No. 11,465, consisting of intergrown orthoclase and albite, with a small quantity of secondary muscovite and kaolin.

Sp. Gr. of piece analysed 2·594

Silica	63·26
Alumina	21·87
Ferric oxide	0·22
Lime	0·21
Potash	3·09
Soda	10·25
Loss on ignition	0·78
	99·68

On adjusting to 100, neglecting the loss on ignition, due probably

[1] Determined by Mr. L. Fletcher, F.R.S.

to small quantities of secondary minerals, and calculating the molecular ratios, we obtain :—

SiO_2	1·066	
Al_2O_3	0·215	0·216 R_2O_3.
Fe_2O_3	0·001	
CaO	0·004	
K_2O	0·033	0·200 RO.
Na_2O	0·167	

The ratio of K_2O : Na_2O= 1 : 5, and of Al_2O_3 to the other bases, a little in excess of 1 : 1 on account of the small quantities of muscovite and kaolin, which are of secondary orgin. As a magma for the solution of alumina and subsequent separation of corundum this rock conforms perfectly to Morozewicz's law (see p. 39) : soda predominates amongst the alkalies, which makes it a good solvent for alumina, whilst the protoxides, being already satisfied with alumina, any excess would separate in the free condition. Minute quantities of BeO and ZnO have used up a corresponding quantitity of Al_2O_3 in the form of accessory chrysoberyl and automolite respectively. These have been excluded from the analysis.

The felspar-rock has been referred to by Middlemiss as a coarse-grained, pink granite (*Rec. Geol. Surv., Ind.*, XXIX, 47 and 48) ; but quartz is generally absent and when present is in extremely small quantities ; it can only be regarded as an accidental and local accessory, being altogether difficult to find. In the fields around, however, large quantities of quartz fragments are found, probably derived from the more acid pegmatites and quartz veins which also occur in this neighbourhood.

Not more than a couple of miles or so from the western end of the row of elæolite-syenite hillocks occur large quantities of graphic granite cutting through a mica-gneiss or schist ; it is from one of the drusy veins in this rock that the aqua-marines were obtained by Heath early in the century, and some of the colourless quartz was recently, and possibly still is, carried to Trichinopoly and Tanjore for the manufacture of the so-called "Vallum

diamonds." The occurrence of beryl in the acid pegmatites, and of chrysoberyl in the felspar-rock near by, suggests a genetic relationship. Masses of quartz occur also near the eastern foot of Sivamalai; but whether these or any of the quartz masses found in the neighbourhood are genetically connected with the elæolite-syenite and its associates is not certain. Almost every igneous eruption (even peridotite) seems to be accompanied by quartz veins, probably as an end-product of the segregative consolidation.

IV.—ORIGIN OF THE CORUNDUM.

The corundum occurs in the felspar-rock as a normal, primary constituent, the crystals being idiomorphic in outline and embedded in the felspathic material without a recognisable "court" or peripheral alteration. The crystals are sometimes greenish-grey, sometimes blue and variegated, showing a tendency to the development of a tabular habit, which Lagorio considered to be characteristic of pyrogenetic corundum, and which is the habit of crystals obtained by the crystallization of artificial slags.

The villagers generally select the foot of each small hillock of elæolite-syenite for their prospecting operations, which indicates that the corundum is most abundant near the junction of the felspar-rock and the elæolite-syenite. But as the ground around is cultivated and the rocks entirely hidden, it may be also that the felspar-rock itself is limited to the immediate neighbourhood of the elæolite-syenite lenses. Where the two rocks are seen in actual contact there is no chilling on either side, and nothing to show secondary contact effects; it is highly likely in fact that their intimate association is the result of a common origin.

This view is rendered all the more plausible by the fact that similar associations of elæolite-syenite with a corundiferous syenite were discovered independently, and, curiously enough almost simultaneously, in other parts of the world, namely, in Ontario and in the Ural mountains. Taken in conjunction with the facts obtainable from Sivamalai, these occurrences appear to suggest a simple explanation for the fact that the corundum is limited to the felspar-rock and is not found in the aluminous elæolite-syenite.

Descriptions of the Canadian occurrences had not been published when I first announced, early in 1898,[1] the occurrence at Sivamalai,

[1] Economic Geology of India, 2nd Ed., Part I, Corundum, 1898, pp. 11 and 37.

but having heard privately of the discovery, I postponed this discussion of the relations between the corundiferous rock and the elæolite-syenite until the Canadian occurrence had been fully described. Following Dr. A. P. Coleman's discovery in 1890 of elæolite-syenite amongst the boulders of the drift in Central Ontario,[1] Prof. F. D. Adams in 1893 discovered a large area of the same kind of rock in the county of Hastings, Eastern Ontario.[2] Corundum was found in this region by Mr. W. F. Ferrier in 1896,[3] and in the following year Prof. W. G. Miller's examination of the ground revealed the fact that the mineral occurred in association with the elæolite-syenite.[4] Other occurrences of the same rock series were examined by Dr. A. P. Coleman in 1898.[5]

Like the elæolite-syenites of Sivamalai, those of Ontario are included with the gneissic rocks classified usually as Laurentian,[6] being foliated in conformity with the gneisses around and traversed, as in the case at Sivamalai, by coarse-grained contemporaneous veins.

Comparison of the descriptions herein given with those by the Canadian geologists will show that, besides certain resemblances in the characters of the two occurrences of elæolite-syenites and corundiferous rocks, there are important differences. The most important of these is the occurrence of corundum in the elæolite-syenite, as well as in the associated syenite, of Ontario, whilst at Sivamalai, so far as we know, the corundum never actually occurs in the elæolite-bearing rock. Prof. Miller has remarked, however, that in Ontario

[1] Coleman: *Trans. Roy. Soc. Canada*, VIII (1890), Sect. III, p. 14.

[2] Adams: *Amer. Journ. Sci.* (3), XLVIII (1894), 10.

[3] *Ann. Report of the Geol. Surv. Canada for 1896*, IX, p. 116A.

[4] Miller: *Report of the Bureau of Mines, Ontario*, VII, part 3, p. 207, and further occurrences in 1898. (*Ibid*, Vol. VIII, part 2, p. 205.)

[5] Coleman: *Journal of Geology*, VII (1899), 437, and Report of the Bureau of Mines, Ontario, VIII, part 2, p. 250.

[6] See Adams and Barlow in *Summary Report, Geol. Surv. of Canada for 1897*, pp. 47A, 48A and 52A.

the corundum is most abundant in the rock which contains little or no elæolite.[1] Both occurrences, therefore, point to the conclusion that the conditions favouring the formation of elæolite and corundum are in some sense complementary, and what appears to be the true explanation is suggested by the work of Morozewicz.[2]

The formation of corundum [under experimental conditions], according to Morozewicz, is not dependent on the basicity of the magma, but on the ratio of the alumina to the sum of the other bases, and one can consequently predict the saturation point in pure alumino-silicate magmas. For instance, in pure anorthite magmas the minimum limit is about 36·5 per cent. Al_2O_3, in nepheline about 32—33 per cent., in labradorite 27—30 per cent., and in an albite-magma about 19·5 per cent.

Now, I find on analysis of the felspar-rock in which the corundum occurs near Sivamalai that it (the felspar) corresponds very nearly to the general formula of albite or orthoclase ($R_2O.\ Al_2O_3.\ 6SiO_2$), being in fact a mixture of albite and orthoclase. As this felspar-mixture makes up the principal mass of the rock, and the accessories contain still larger proportions of alumina, it satisfies as a magma the conditions laid down by Morozewicz, and would become saturated by a smaller quantity of alumina than the magma containing elæolite. From this consideration alone one would expect to find less corundum in the elæolite-syenite than in the felspar-rock if both had similar opportunities of saturation with alumina.

But there is still another feature in connection with the elæolite-syenite which militates against the separation of corundum. Morozewicz points out that in supersaturated alumino-silicate magmas, with the general formula RO. mAl_2O_3. $nSiO_2$ ($R = K_2$, Na_2 or Ca ; $n = 2-13$), the whole excess of alumina ($m-1$) separates in the

[1] Dr. Coleman also says the largest crystals of corundum occur in the ordinary syenites.

[2] J. Morozewicz: Exprimentelle Untersuchungen über die Bildung der Minerale im Magma, *Tschermak's min. und petr. Mittheil.*, XVII[1], 1898, 1—240.

form of corundum if at the same time there is no considerable quantity of magnesia and iron present, whilst spinel (or spinel and corundum) is formed if there is more than 0·5 per cent. of MgO and FeO contained in the magma. Reference to the analysis on page 34 will show that these conditions with regard to magnesia and ferrous oxide are exceeded in the case of the prevalent form of elæolite-syenite at Sivamalai, and that corundum would not have separated from it unless the percentage of alumina had been sufficiently increased to satisfy all the bases. The presence of considerable quantities of ferromagnesian minerals in the elæolite-syenite and the remarkable absence of these compounds from the associated corundiferous rock would thus alone account for the separation of free alumina in the latter case, and its absence from the elæolite-bearing rock.[1]

The corundum is very unevenly distributed through the coarse-grained felspar-rock and the material collected is insufficient to obtain an analysis representative of the whole rock. We are not able, therefore, to state the amount of alumina in the magma from which this rock crystallized, but it was probably not much greater than that contained by the elæolite-syenite, and the mineralogical difference between the two rocks would thus be due to the higher proportion of other bases contained in the elæolite-syenite. So far as

[1] It is not unlikely that the law of Morozewicz referred to above does not represent the *whole* truth; for magnetite sometimes occurs locally in the corundiferous rock in quantities sufficiently large to represent more than 0·5 per cent. of FeO. It is possible that when Fe_2O_3 is also present, magnetite may form instead of hercynite ($FeO.Al_2O_3$). I have frequently found these two minerals together, with the magnetite included by the hercynite, indicating that $FeO.Fe_2O_3$ forms before $FeO.Al_2O_3$, and it is possible, therefore, that when there is enough Fe_2O_3 to unite with the FeO, the alumina must (*a*) unite with some other available protoxide to form a spinelloid, (*b*) form other alumino-silicates, or, if still in excess, (*c*) separate as corundum. Nevertheless, it is only locally that magnetite is abundant in the corundiferous felspar-rock. An *average* analysis would show less than 0·5 per cent. FeO.

our observations go at Sivamalai then the distribution of the corundum is in agreement with the results indicated by Morozewicz's experiments. But we want many more instances of the kind before we can state that in Nature corundum can be formed *only* in magmas which satisfy the conditions experimentally indicated by Morozewicz. The details hitherto published concerning the Ontario occurrence are insufficient as a test of Morozewicz's law. The greater abundance of the corundum in the ordinary syenite, as mentioned by Miller and by Coleman, are in agreement, so far as they go; but we want to know also the molecular ratio of the alumina to the other bases in each case, and whether magnesia and ferrous oxide are present in available quantities in excess to form spinel. In the case of the felspar-rock near Sivamalai a certain amount of the alumina has been used to form accessory zinc-spinel (automolite) and chrysoberyl ($BeO.Al_2O_3$).

One reason for raising the question of the universal applicability of Morozewicz's law is the occurrence of corundum with peridotites in North Carolina, where, according to Dr. J. H. Pratt, the conditions point to the corundum having separated as an early-formed constituent from the peridotite magma.[1] Dr. Pratt states that Morozewicz has shown that molten magmas having a composition approximately that of basic magnesian rocks readily dissolve alumina, which separates out on cooling as corundum.[2] I am unable to see that any of the magmas from which Morozewicz obtained corundum bear any chemical resemblance to basic magnesian rocks. On the contrary, Morozewicz has pointed out that the formation of corundum is independent of the basicity, whilst, when magnesia is present, corundum is formed only when there is more than enough

[1] J. H. Pratt: On the origin of the Corundum associated with the Peridotite in North Carolina. *Amer. Journ. Sci.* (4), VI, 1898, 49—65.

[2] *Op. cit.*, p. 60, and in a further communication, "On the separation of Alumina from molten magmas, and the formation of Corundum." *Ibid.* (4), VIII, 1899, 230.

alumina present to use up the magnesia as spinel.[1] Morozewicz is repeatedly explicit on these two points, and I consequently do not see in what sense his experiments can offer any support to Dr. Pratt's conclusions as to the origin of the corundum associated with the peridotites in North Carolina. At the same time, I am quite conscious of the fact that in Nature the physical conditions may so far depart from those under which laboratory experiments are conducted that it may be *possible* for corundum to separate as a primary constituent in a dunite magma. Where, however, the conditions of a natural occurrence so markedly differ from those which are considered to be essential in a laboratory experiment, it is necessary to be all the more careful to be quite sure that the natural conditions have been correctly interpreted. Dr. Pratt's description of the occurrences in North Carolina, if I have not misunderstood it, is suggestive as much of the formation of corundum by contact action as by the separation of free alumina through differentiation of a molten magma, and in view of Morozewicz's work the latter conclusion requires more than ordinary criticism. There was a time when we doubted the occurrence of corundum as a primary constituent of igneous rocks. Let us be careful now not to commit the converse error, and regard it *only* as a pyrogenetic primary mineral: it is a rare mineral indeed that can be formed by one only of the ways in which we imperfectly classify the processes of Nature.

Corundum-syenite in the Urals.

Morozewicz has given a description of an occurrence in the Urals of corundum in felspar-rock very similar to the instance at Sivamalai. Like the latter, also, the rock occurs both in the pegmatitic and the ordinary form of medium texture. The pegmatite ("corundum-pegmatite") is composed of blue corundum, microperthitic orthoclase, some secondary muscovite and accessory rutile, apatite, zircon and a black, highly

[1] See *Zeitschr. f. Kryst.*, XXIV, 1895, 281—285, and *op. cit.*, pp. 34, 56 and 72.

lustrous mineral undetermined. The "corundum-syenite" forms stocks of a medium-grained, granular structure and pink colour composed of corundum, orthoclase and microperthite, biotite and some secondary muscovite. The rocks gave the following results on chemical analysis:—

	I.	I*a*.	II.	II*a*.	III.
Corundum . .	35·40	—	18·55	—	—
SiO_2 . . .	40·06	62·71	52·34	64·65	63·68
Al_2O_3 . . .	13·65	21·37	16·05	19·83	20·60
Fe_2O_3 . . .	0·35	0·55	0·45	0·56	0·55
CaO . . .	0·30	0·47	0·20	0·25	0·36
MgO . . .	0·15	0·23	0·16	0·19	0·21
K_2O . . .	5·20	8·14	6·58	8·14	8·14
Na_2O . . .	3·71	5·81	4·77	5·89	5·85
Water . . .	0·46	0·72	0·40	0·49	0·61
	99·28	100·00	99·50	100·00	100·00

I.—Corundum-(syenite)-pegmatite.

II.—Corundum-syenite of Nikolskaja Ssopka.

III.—Average of the two analyses adjusted to 100 after deducting the corundum.

Deducting the corundum from I and II and calculating the remainder to 100, we obtain the figures given in columns I*a* and II*a*, respectively, of which the average, III, agrees very nearly with the composition of the felspar-rock containing corundum near Sivamalai. Morozewicz calls attention to the fact that the molecular value for soda exceeds that for potash, which is an important circumstance, as he finds that, although alumina is readily soluble in molten soda-alumino-silicate, it is insoluble in potash-alumino-silicate, whilst the introduction of soda into the latter rapidly increases its solubility which is of course an essential preliminary to its subsequent separation in crystal form. The same remark applies to the corundiferous felspar-rock near Sivamalai, in which the soda also exceeds the potash in quantity and in molecular proportion, the ratio being $Na_2O : K_2O = 5 : 1$ (see p. 35).

There is still a further circumstance to complete the parallel between the occurrence in the Urals and that near Sivamalai: the same eruptive zone in the Urals also includes elæolite-syenite (miascite), which Morozewicz regards as genetically related to the corundiferous syenites.

In these three instances, the corundum has apparently separated out as a primary, original constituent from a magma supersaturated with alumina, the alkaline nature (with a predominance of soda) having permitted the previous solution of large quantities of alumina. There are no circumstances connected with these occurrences to indicate formation by secondary or by contact action, and no facts to suggest that the alumina has been locally picked up at the time of intrusion. That magmas rich in alkalies and rich in alumina have existed may be postulated without necessarily compelling an explanation as to how such magmas were formed. It is important, however, not to confuse crystallizations from a definite aluminous magma with mere local concentrations of that compound due to contact action and local absorption of aluminous rocks. The corundiferous rocks near Sivamalai do not break through any unusually aluminous rocks, the associated gneisses being of the ordinary intermediate to acid kind with probably never more than 15 per cent. of alumina. The same thing appears to be true of the Canadian occurrence, and as the elæolite-syenite and corundiferous rocks of Ontario occupy a belt some 75 miles long and about 5 miles wide, the peculiar character of the rocks could hardly be the result of an accidental and local contact.

V.—SUMMARY.

Locality and form of the elæolite-syenites.

Elæolite-syenite forms the main mass of the large hill of Sivamalai (11°3′ ; 77°36′) in the Coimbatore district, as well as of the row of six or seven small hillocks stretching away in the west-north-west direction. The rocks present a well-marked foliation, generally in conformity to that of the gneisses around, in which their outcrops present the appearance of lenticular masses. The foliated structures, however, must have been impressed before complete consolidation, as the rocks show no signs of subsequent crushing.

Augite-syenite.

The elæolite-syenites are accompanied by augite-syenites containing olivine, agreeing in this feature with the laurvikite described by Brögger from the famous Christiania district of Norway. The other constituents of the augite-syenites are, in approximate order of abundance, microperthitic felspar, green non-pleochroic augite, opaque black iron-ores, zircon, hornblende, hypersthene, apatite and biotite.

Corundum-syenite.

These rocks are accompanied by others made up principally of felspar (albite and orthoclase), containing large quantities of well crystallized, generally tabular, corundum, which is extracted by the villagers near the junction of the felspar-rock with the elæolite-syenite. As accessories in this rock we find chrysoberyl, garnet (near rhodolite), blue apatite, magnetite, zircon, muscovite, biotite, and automolite.

The association in this area is remarkably similar to that of Eastern Ontario described by Adams, Barlow, Coleman and Miller, and to that of the Urals described by Morozewicz.

Chief types of elæolite-syenite.

The elæolite-syenite presents five well-marked forms at Sivamalai.

(*a*) An even-grained, foliated, grey variety, which is the prevalent form and contains graphite, biotite and magnetite as the

dark-coloured constituents. The felspar is chiefly microperthite. The constituents of the rock exist in the following approximate proportions :—

	Per cent.
Elæolite	34
Microperthite	56
Magnetite	3·6
Other constituents, biotite, plagioclase, graphite, etc.	6·4
	100·0

Calcite is present in small quantities and considered to be a primary constituent.

(*b*) Coarse-grained "contemporaneous" veins cutting through the ordinary variety, and consisting largely of elæolite and microperthite with flakes of graphite, biotite and sometimes autoliths of the fine-grained ordinary form.

(*c*) A granulitic form devoid of graphite, but containing a larger proportion of opaque, black iron-ores with biotite. The felspars are microcline and plagioclase.

(*d*) A glomero-plasmatic, gneissose variety containing brown hornblende and calcite, but without graphite and magnetite. The calcite in this and the more basic variety (*e*) is considered to be primary in origin.

(*e*) Basic, black lenses, or sometimes dyke-like bands, with brown barkevikitic hornblende, calcite, purple augite, sphene and graphite. The occurrence of sphene with purple augite in this form is more in accordance with the commoner occurrences of elæolite-syenite, but it is quite an exceptional feature at Sivamalai.

Age and origin.

No definite evidence is obtainable as to the age of these rocks, but on account of the foliation which they present it is likely that they are geologically very ancient, as there is no evidence of foliation, folding, or any marked earth-movement in South India since lower palæozoic times ; the

rocks, in fact, have previously been regarded, on account of their foliation, as normal members of the Archæan crystalline schists. Their chemical, mineralogical and structural peculiarities are, however, in agreement with the general type of elæolite-syenite of undoubtedly eruptive origin.

Presence of graphite.

But besides their general agreement in average composition and petrological characters, the family of elæolite-syenites have a curious way of presenting some new and strange feature peculiar to each occurrence discovered. In this case the presence of graphite so evenly distributed through the rock appears to be a feature quite new to the elæolite-syenites, and for that matter, new to normal eruptive rocks generally. The presence of graphite in certain members of the crystalline schists is sometimes quoted as part of the evidence pointing to their sedimentary origin ; but when it is so accompanied by nearly 15 per cent. of alkalies in a rock whose structures so perfectly imitate those of unequivocal eruptive elæolite-syenites, the graphite must be considered to be as much an igneous mineral as the elæolite itself. The graphite in these rocks shows the phenomenon of "sprouting" regarded by Moissan as characteristic of graphite crystallized from fusion.

Freshness of South Indian rocks.

The remarkable freshness of the elæolite, as well as of all the other constituents of these rocks, is not inconsistent with their probably great age. Indeed, the preservation from hydration of such a delicate mineral as elæolite is only in agreement with the remarkable freshness of the equally susceptible olivine, which has been found unaltered in other very ancient rocks in South India. An explanation of this freedom from hydration has been offered by the Author elsewhere (*Rec. Geol. Surv. Ind.*, XXX, 40; *Report Brit. Assoc.*, 1898, 868; *Geol. Mag.*, VI, 1899, 540).

The whole of these rocks are regarded as genetic relatives, formed by the differentiation of a highly aluminous and alkaline magma. The petrologically different types belong to one petrographical

province, which, so far as we know, is of Archæan age. The products of differentiation recognised within this petrographical province may be chemically divided as follows:—

Differentiation of the petrographical province.

(*a*) a highly alkaline division comparatively rich in ferromagnesian silicates, giving rise to the various forms of elæolite-syenites;

(*b*) a division supersaturated with alumina and poor in the ferromagnesian protoxides, forming the corundiferous felspar-rocks with chrysoberyl;

(*c*) a division approximately intermediate between (*a*) and (*b*) including the laurvikites, and

(*d*) the siliceous end-products, probably forming the associated acid pegmatites carrying aqua-marine (beryl) and quartz-veins.

The elæolite-bearing members of this province are in many ways peculiar; but new rock names do not at present appear to be necessary. If new exposures are found elsewhere in the same region, and show a probability of relationship to those near Sivamalai, the question of correlating isolated exposures may be simplified by using distinctive names for the different types. For the present, however, the whole series of types may be known as the *Sivamalai series*, so named from the most prominent mass amongst the exposures.

The corundum occurring as a constituent of the felspar-rock is regarded as a primary constituent, being amongst the earliest of the minerals to separate from a magma which was supersaturated with alumina and very poor in the ferromagnesian protoxides. The rock agrees very closely with that which Morozewicz has described under the name corundum-syenite from the Urals, and which, he points out, conforms to the laws established experimentally by him as to the conditions essential for the solution of alumina in alumino-silicate magmas, and the sub-

Origin of the corundum.

sequent separation of corundum on their crystallization. The protoxides of glucinum and zinc, present in small quantities in the magma, have united with a portion of the excess of alumina, and formed the accessory constituents chrysoberyl and automolite respectively. According to Morozewicz's law the elæolite-syenite would require a larger quantity of alumina to produce saturation than is the case with an albite-orthoclase rock. Consequently, with very little difference in the percentage of alumina, the latter contains much corundum, whilst the former is devoid of the mineral.

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MEMOIRS

OF

THE GEOLOGICAL SURVEY OF INDIA.

Report on the Geological Congress of Paris, 1900, *by* W. T. Blanford, LL.D., F.R.S., F.G.S., late *Superintendent, Geological Survey of India.*

Under instructions received from the Secretary of State for India, and by the request of the Director of the Geological Survey of India, I have attended the International Geological Congress recently held in Paris. I will endeavour, as briefly as possible, to show what has been the work of this Congress, and to compare the proceedings with those of the earlier Congresses (Bologna 1881, Berlin 1885, and London 1888) in which I took part.

In accordance with the original plan, as announced in January 1899, the Eighth Geological Congress, held in Paris, under the presidency of Professor Albert Gaudry, the distinguished palæontologist, commenced on the 16th of August 1900. Meetings were also held on the 17th, 18th, 21st, 23rd, 25th, and 27th August; the last, which was a formal meeting to close the business of the Congress, I did not attend, but I was present at most of the others. The object of prolonging to 12 days the duration of the Congress, which, on previous occasions, has been limited to a week, was to afford opportunities to the members, on the intervening days, when no meetings took place,

for visits to the Great International Exhibition and to the museums of Paris, and for excursions in the neighbourhood.

In the first place, it is merely just to acknowledge the heartiness of the reception given by the French geologists to their foreign colleagues, and the great efforts made by the Committee of Organization to entertain those who attended the Congress. Amongst other entertainments to which the members of the Congress were invited were a garden party given by the President of the French Republic at the Elysée, a reception by the Municipal Council of Paris at the Hotel de Ville, and a banquet given by the Committee of Organization at the Hotel du Palais d'Orsay. There were also evening receptions by the Geological Society of France, by the President of the Congress, and by Prince Roland Bonaparte. The greatest courtesy and attention was shown to the members by the officers of the Congress, and especially by the President, Professor Gaudry, and the General Secretary, Professor Barrois.

The meetings of the Geological Congress and of the other Congresses, brought together on the occasion of the Centennial Exhibition, were held in a large building specially designed for the purpose within the Exhibition grounds, and containing several spacious meeting rooms, which, although admirably adapted for the purpose for which they were planned in many respects, were unfortunately defective in acoustic properties, so as to render it difficult for anyone to hear clearly what was said.

The principal work of the Congress was done at meetings of the Council held on most of the days already mentioned and at General Meetings on the 16th, 25th, and 27th. To this work I will refer afterwards. For the purpose of reading communications from various geologists, the Congress was divided into four sections:—

I. General and Structural Geology.
II. Stratigraphy and Palæontology.
III. Mineralogy and Petrography.
IV. Applied Geology.

The majority of the papers read at these sections differed in no respect, either in subject or scope, from the papers usually read before scientific societies. A few, however, were of more general interest. But owing to the number of papers presented and the comparatively small amount of time available, very little if any discussion was possible, and except in those instances in which printed copies of the papers were provided, so that the facts brought forward could be studied at leisure, it is questionable whether any useful scientific result was obtained by the presentation of the various memoirs.

The reports presented to the Congress by Committees appointed by previous Congresses were of greater importance. Printed reports were furnished by the different Committees on (1) Nomenclature of rocks (Prof. Lacroix), (2) Stratigraphical nomenclature (Prof. Renevier), (3) Glaciers (Prof. Richter), and (4) The foundation of an international Journal of Petrography (Prof. Becke). The Committee for the most important undertaking in connection with past Geological Congresses, that of the Geological map of Europe, presented a report of which printed copies were not available. It is to be feared that the lamented death of M. Hauchecorne, by whom the map was originally planned, and to whose energy its preparation has been largely due, will still further delay the progress of the work which has already been 19 years in hand. Copies of the other reports are sent herewith. All are of interest, but none shows any very important result. Perhaps the most valuable is that on the nomenclature of rocks, giving an account of various propositions by different petrologists for reducing the number of terms applied to the crystalline rocks, and for introducing a systematic nomenclature. The report on stratigraphical classification contains a *rechauffé* of various propositions discussed and in some instances rejected as impracticable or unnecessary at earlier Congresses (*e.g.*, our old acquaintance the désinences homophones) together with one proposal, which is of rather more modern date, but which is in some respects one of the most objectionable hitherto made,—this is to use, instead of upper, middle and lower, the prefixes Eo or Palæo, Meso and Neo

applied to the names of systems (or Periods) for the series (or Epochs) into which the systems are divided. Thus instead of upper, middle, and lower Cretaceous or Tertiary (Tertiary is regarded, perhaps rightly, as a system of the Cenozoic group) we are to talk and write of Palæo-cretaceous, Meso-cretaceous and Neo-cretaceous, Palæotertiary, Mesotertiary, and Neotertiary, or, if we adopt the désinences homophones beloved of Professor Renevier, we may find ourselves committed to terms like Neo-cretacic and Meso-tertiaric. It is to be expected that a sense of humour will restrain geologists in general from venturing upon these very barbarous compounds.

The Committee on glaciers report the progress made in the study of their subject, and this is considerable, especially with regard to the secular variation of the ice-flows. The report of the Committee on the foundation of a Journal of Petrography supplies a scheme for the proposed publication.

Three new International Committees were appointed, two on the proposal of Sir A. Geikie and one to deal with a subject brought forward by MM. Oehlert and Kilian. Of the first two one is intended to introduce greater uniformity into the study of the coasts in the Northern hemisphere, the other for co-operation in geological investigation, in order that observations, for instance, on earthquakes or on the progress of subærial denudation, should be systematic, and that experiments should be similarly conducted, so that the results may be easily compared. The importance of this study, to which Sir A. Geikie has repeatedly called attention, cannot be questioned. A communication from Mr. T. G. Chamberlin of Chicago, with a similar proposal, was also taken into consideration. The third Committee was charged with the arrangements for publishing, by means of photography, repetitions of the earlier figures, now often very difficult of access, of various fossil types, and also of photographs of the types themselves, when practicable.

The above I believe is a general account of the work of the Congress, as distinguished from its amusements. Amongst the latter may be classed the various excursions to localities of geological

interest in France, before, during, and after the actual Congress meeting in Paris. These excursions have assumed a great importance during the last three or four Congresses, and both in the United States and in Russia have enabled members to visit places of great interest, but which are, in general, very difficult of access. In the present case no less than 20 different excursions had been arranged, several of them taking place at the same time, but occupying in the aggregate almost the whole of August and September, whilst an additional excursion has been arranged for the early days of October.

In comparing the last Congress with the earlier meetings at which I was present, it is impossible not to observe that a great change has taken place in the whole proceeding. Both at Bologna and at Berlin the chief business of the Congress was to endeavour to establish uniformity in geological nomenclature, and to arrange a scheme of stratigraphical classification and of colouration for the geological map of Europe. For these purposes Committees were appointed, which met yearly in the intervals between the different Congresses, and the greater part of the Congress meeting itself was taken up with discussions in the Council and in General Meetings on the schemes proposed. A few miscellaneous papers were read, but very little time was given to them, and such excursions as took place were short and simply intended to occupy a few days after the meeting of the Congress was over. The last Congress at Paris, on the other hand, consisted chiefly of meetings for reading papers, and of excursions. Indeed it may almost be said that the excursions, instead of playing a subordinate part, have now become the principal feature of the Congress, whilst the actual work of the Congress, the discussion of really important and international geological questions, bids fair, if the present tendency be not checked, to bear much the same proportion to the excursions and other diversions, as did Falstaff's "one half pennyworth of bread to this intolerable deal of sack" in his bill. In short, in later Congresses there appears to have been less work and more play. How far the admission of ladies as

members (none were present at the earliest Congresses) has contributed to this tendency, it is difficult to say.

That geological excursions to places of interest and often to localities that have become of classical importance in the history of the science, are of the greatest possible value to working geologists, no one will dispute for a moment. The excursions also supplement admirably what, in agreement with many others, I have always regarded as the most important result of geological Congresses, the opportunity afforded to the geologists of different countries, and even of different continents, to become acquainted with each other and to discuss geological questions. But, except indirectly and in the manner specified, it is impossible to regard these pleasant amusements as contributing in any way to the progress of geological science.

Lastly, I must express a doubt whether it was of advantage to the work of the Congress and to geological science for the meeting to be held in conjunction with the Great Centennial Exhibition of Paris, with its innumerable distractions of all kinds. The number of members of the Congress who were in Paris during the greater part or the whole of the term was considerable, but the attendance at the scientific meetings was not large; I think it was, if anything, smaller than at other Congresses that I have attended.

The next Congress is to be held in Vienna in 1903, Prof. Suess being nominated as President of the Committee of Organization and Dr. Tietze, Secretary General. In view of the friendly relations that have so long subsisted between Austrian and Indian geologists, the meeting in Vienna will probably offer great attractions to all engaged on the Geological Survey of India.