1923

THE COLOMBO OBSERVATORY.

REPORT OF THE SUPERINTENDENT OF THE OBSERVATORY.

Staff.—Mr. Harold Jameson, B.Sc., proceeded on vacation leave on May 2, and was away for the rest of the year.

Inevitably the absence of this capable and energetic officer restricted Mr. Evans and myself to routine work to a rather greater degree than in the previous year, and this tendency was emphasized still more during the last three months of the year when, owing to the sudden illness of another officer, I was called upon at the beginning of October to take up duties, at two days' notice, as acting Professor of Physics at University College in addition to my Observatory work.

During Mr. Jameson's absence Mr. P. Felix Fernando, Third Grade Surveyor, has been attached to the Observatory for duties in connection with the upper air work, and has done a good deal of useful observing.

A proposal to strengthen the staff by the appointment of locally recruited junior technical officers, which has been made for several years in succession, has now been agreed to by Government, and applications for these posts were called for at the beginning of the 1923–1924 financial year. The board of selectors have had over 180 applications to consider, from which to fill the three new posts. The new assistants have not yet assumed duties, but it is anticipated they will do so early in 1924.

No change was made during the year in the clerical staff.

Buildings and Compound.—No appreciable additions were made during the year, and the lack of floor space is still a distinct disadvantage. There is, however, a prospect of improvement in this respect early next year, when the departure of the Trigonometrical Branch to Diyatalawa will leave the room it now occupies free for Observatory purposes.

Astronomical Equipment and Work.

Transit Instruments.—The Cooke Transit (4-inch object glass) has been in regular use throughout the year and has given very satisfactory results. In all 664 stars were observed on 106 days, of which 493 stars on 61 days were in the evening, or early part of the night, and the remainder in the early morning. During a good deal of the year at Colombo the evenings are far more overcast than the early mornings, so that the latter group of observations, though less complete than those of the evening ones that were made under good conditions, were often of primary importance for clock rates, since they were made on days when no stars whatever could be seen between dusk and midnight.

A normal evening observation in fine weather has consisted of four stars and at least two pairs of level readings on each face. The collimation has not shown any appreciable variation, except in cases where the object glass has been intentionally removed for cleaning.

The total movement of the level throughout the year has corresponded to a continuous slight settlement of the west end of the pillar, and has twice been corrected by means of the base levelling screws.

The azimuth error has required very little adjustment—the only appreciable alteration was corrected in September after repairs to the roof of the transit room had been carried out, and so provided a certain amount of excuse for the alteration that had occurred. The most interesting fact in this connection is the consistent difference between the azimuth errors in the two positions of the circle, a difference which is almost identical with the differences in observed level due to pivot error, and hence almost certainly due to the same cause. It is readily explained if we consider that the slope in the jaws of the bearings, instead of being evenly distributed between the two sides, is mainly accounted for on one side alone.

The small Gautier instrument continues to be in place as a stand-by, but has not been called upon to an appreciable extent.

The Coudé type Gautier instrument has been dismounted, and for the present is quite out of action, though there is always the chance that in the future, when the increased staff materialize, it may come into use again, not so much as an instrument for the determination of time, but in conjunction with the other transit for the analysis of certain questions of flexure.

Observatory Clocks.—Fournier Sidereal Clock No. 72 (Invar) has continued to be the most reliable clock in the building.

No alteration has been made to its pendulum now for a couple of years, and the fluctuations in its rate are worth consideration. For practical time purposes the most important fact about them is the absence of any sudden changes, but when the last few years' records are examined, a regular annual variation can be seen, giving the most positive rate in the inter-monsoon period, just before the south-west monsoon, and a continuous slight, but regular, decrease in rate during the south-west monsoon reaching a minimum in October and quickening again during the early months of the year.

The clock case is not exhausted, and though the clock is hung on an inside wall, the clock room is not in a specially sunk cellar, hence meteorological variations have full scope, but the smoothed curve of clock rates does not give direct correlation with the pressure, temperature, or humidity curves. With regard to the first a reminder may not be out of place to the effect that in Colombo the pressure is far more even than in the temperate zone, while with regard to the second, it may be noted that though the

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maximum rate occurs a little ahead of the south-west monsoon it does not coincide with the period of maximum temperature. In fact, during what may be called "steady south-west monsoon conditions" the clock appears to be changing rate most rapidly. Several explanations are possible, but at present most of them seem too farfetched to be quoted with confidence.

Fournier Sidereal No. 70 (mercury in steel) has continued to be in use, but is appreciably more erratic than No. 72.

Dent No. 45,082 has been the standard mean time clock, and used for ordinary time ball purposes, for which it has proved quite satisfactory. A comparison between its rate and that of the standard Sidereal clock would clearly be unfair, as the mean time clock is subject to daily adjustment by the solenoid.

The new mean time clock indented for to take the place of the Borrel mean time clock which was condemned last year has not yet arrived.

The electric synchronome clock and its dials have continued to be thoroughly useful, though not possessing quite the same accuracy as the main astronomical clocks. A useful addition to this clock has been a contact by which the hourly marks on the seismograph are controlled by it.

Time Signals.—The arrangements for these were similar to last year. The most important were those that released the harbour time ball at 9 A.M., 1 P.M., and 4 P.M., Ceylon standard time (*i.e.*, 15½, 19½, and 22½ Greenwich mean time) on ordinary days, and at 9 A.M. only on Sundays and public holidays. Ten failures occurred during the year, which works out to about 1 per cent. In one case only the failure might have been avoided at the Observatory, and in one mechanical trouble with the ball itself was reported, but in most of these cases the trouble appears to have been in the electric connections or lines, and I am glad to express my thanks once again to the Telegraph Department for the prompt way in which all telephonic reports of time ball failures were acted upon—the fact that no two failures were consecutive proves that whatever troubles occurred were located and corrected before the next signal was due.

The synchronizing signal to the Central Telegraph Office, Queen's House, and the Surveyor-General's Office (in series) was sent at 7.55 and 15.55 on ordinary days, and in the morning only on Sundays and public holidays. A few isolated cases of failures were reported, but on only one occasion were two failures consecutive.

The clock in the lighthouse at the corner of Queen and Chatham streets received a daily signal in series with the 9 A.M. time ball. The normal amount of setting done by the synchronizer was about 10 seconds. The clock has continued to justify the rather drastic overhauling it received from Mr. McFadyen in 1921 and the attention it has received since from Mr. K. D. Willie.

A daily signal sent to the Wireless Telegraph Station in the early part of the year has been discontinued pending the completion of various improvements there, after which it is anticipated that the wireless time signal recommended by the Port Commission, and referred to in last year's report, will materialize.

The number of people who rang up the Observatory to ask for the correct time has increased enormously during the past few years, and early in 1923 had reached such an amount as to interfere seriously with the normal work of the place. As the bulk of these queries were for the purpose of setting ordinary office clocks, not chronometers, a standard of accuracy up to fractions of a second was not required, and an arrangement has now been made with the Superintendent of Telegraph Traffic, as a result of which such queries are now dealt with by the Telephone Exchange. Queries involving more precise setting for chronometers are of course still sent on to the Observatory.

Meteorological Equipment and Work.

Outstations.—The number of outstations has remained unchanged. A new shed was built at Hakgala, where the old one is appreciably sheltered and its readings consequently not strictly comparable with those at other stations. The readings at Hakgala have recently assumed increased importance owing to the way in which increased temperatures there, and at Nuwara Eliya, have been found to correlate with the advent of bad weather from the eastward, particularly during the north-east monsoon. (This fact is one of peculiar interest when considered in connection with Professor Bjerknes' work on the structure of cyclones in the temperate zone.) Instruments will be read for the present in both the old and new sheds at this station for the purpose of connecting the new shed with the averages from the old one.

All the sheds were inspected by members of the Observatory staff, and the methods of checking, &c., at Colombo have been similar to those employed last year in essentials.

In several cases the services of volunteer observers have been gratefully accepted for other meteorological observations in addition to those of rainfall. The instruments so issued include a sunshine recorder to Mr. Le Feuvre at Balmoral, and anemometers and wind vanes to Messrs. H. S. Popham (Hope) and R. N. Searancke (Beverley). I am also indebted to Mr. A. G. D. Bagot, who has kindly sent me barograph records from Goatfell (Rangalla).

During 1923 seven clerks of the Survey Department and one lighthouse-keeper (for Minicoy) attended the Observatory for instruction in meteorological work.

Thermometer Screens.—An interesting experiment was commenced at Colombo in April by the establishment of a louvred thermometer screen alongside the main meteorological shed. The screen can be roughly described as an enlarged Stevenson screen, and it was set up as the direct result of my reading Mr. Field's paper on the exposure of thermometers in India. Clearly such screens would be less expensive to maintain than the present sheds, but only direct experiments in Ceylon can show whether they will give results in this country that are meteorologically comparable with those from the open sheds.

During the south-west monsoon the differences between readings in the shed and in the screen were in general less than a degree Fahrenheit—the minimum readings at night have given quite small differences (*i.e.*, of the order of 0·1° F.), but the figures for maximum suggest that the screen gives rather more protection from sunlight and so approaches more to "indoor" conditions.

A change in the differences after the collapse of the south-west monsoon was only to be expected, one obvious difference in the case of the screen being that during the morning, and up to the time of maximum, air entering the screen from the west would come between slats that were in shade and so might be expected to be cooler than air entering from the east (or north) between slats on which the sun's rays were falling directly. On this basis it might be expected that the screen would give relatively cooler results in the south-west monsoon than in the north-east, but the observations have shown that the difference " reading in shed minus reading in screen " has always been positive, and more so during the north-east than the south-west.

It may be added that the thermometers in the screen and the shed have been interchanged on the 15th of each month ; any residual error arising from inaccuracy in the instruments' index corrections should thus have been eliminated.

Instruments.—Reference was made in last year's report to the fact that in the new standard barometer, Casella No. 2,592, a group of mercury globules appeared on the inside of the tube above the main column, within a month of the instruments being set up, and also to the fact that these bubbles very soon began to coalesce, and in some cases the larger ones fell back to the main column. During 1923 this process has continued, and there has been a steady decrease in the number of the bubbles throughout the greater part of the year. On December 19, 1923, the number of bubbles visible was four, and as far as I could see, up till then, the decrease had been continuous, unchecked by the appearance of a fresh crop. On the morning of December 20, however, the number had gone up to eleven, so that this appearance of new bubbles occurred at about the same time of year as the original crop. The position of windows is such that direct sunlight could not get to the instrument, and the most striking variation from normal of the night of December 19–20 was its unusual windiness. Temperatures were low at this time, but more so just after the appearance of the globules than before.

All the outstation barometers were re-standardized during the year in terms of No. 2,592, and in the tables for 1923 the new index corrections are adopted from January 1.

Rain Gauge Stations.—The number of these has gone up to 314, as against 305 at the end of 1922, the actual number of new stations being eleven, while two have been struck off. Of the new stations, three are under the Irrigation Department and one under the Agricultural Department, while seven are kept by volunteer observers on estates, namely, Messrs. P. F. Fernando (Dewale and Seeranga), L. B. Moore (Liddesdale), Sirimane (Bogahagoda), S. B. Smith (Blackwood), B. H. S. Stephenson (Oonoogaloya), and R. G. Wilson (Meddegodda).

Once again I am glad to avail myself of this opportunity of thanking observers, both new and old, volunteer and official (which often means volunteer so far as rain gauge returns are concerned), for the help they have given in keeping these statistics.

Upper Air Work.—Considerable strides had been made in 1922, largely on account of the exceptional ability shown by Mr. Jameson, both in actual field work and in evolving labour-saving devices to expedite the calculations.

In the early part of 1923 the procedure of three flights every third day was adhered to, but during the south-west monsoon, when flights were necessarily short, this was modified to two flights a day, on at least five days a week. The total number of flights observed was 437, or rather more than in 1922, but, on the other hand, it must be admitted that observations of cloud drift suffered sadly owing to Mr. Jameson's absence.

The arrangements for filling balloons were improved slightly by fixing a permanent pipe through the wall of one of the outbuildings, so that the present procedure is to have the generator and its attendant fumes outside the building, and to lead the gas through about 6 feet of piping to the drying bottle and balloon which are kept inside. In observing, the tail method has been adhered to, and the proportion of bursts before the balloon has been lost sight of in cloud has been appreciably less than last year.

The institution of a reward of Re. 1 for returned tails has been claimed forty times, or rather less than 10 per cent. of the total flights. Considering the number that must inevitably come down at sea the proportion is not unreasonable, and may be expected to increase as villagers in the districts most concerned get to know of the possibility of earning a rather cheap rupee. The furthest point from which a tail has been returned is Madulsima, where a balloon was picked up on February 10 at a distance of 150 kilometres (over 90 miles) from its point of release.

During the periods for international co-operation, viz., June 12–14 and October 15–20, flights were not only taken at Colombo, but also at Diyatalawa. In both cases Mr. P. Felix Fernando acted as the observer at Diyatalawa, while Mr. G. G. Perera, the meteorological observer at Diyatalawa, assisted as booker.

The computing cards constructed by Mr. Jameson have been used consistently, and have shown that they can give good results in the hands of others besides the original designer.

Storm Warnings.—Extra observations were sent to India from Colombo, Hambantota, and Trincomalee on 19, 5, and 21 occasions, respectively. In addition, there has been an increase in the number of upper air flights, whose results have been wired to India, and in the number of telegrams in which information was volunteered irrespective of inquiries from India on account of suspicious conditions observed round Ceylon.

Publications.—Routine publications were similar to last year, and included daily reports to the " Post Office Daily List " and the local newspapers, and monthly summaries in the *Government Gazette* and " Tropical Agriculturist " (the latter being also given to the newspapers).

The annual report for 1922 appeared a good deal earlier in 1923 than its predecessor did in 1922. Bulletin No. 5, which deals with the " Upper Air Work at Colombo," up to and including the early part of 1923, is now with the Government Printer, while a paper on " Cyclonic Movements over Ceylon " was printed under the ægis of the Ceylon Engineering Association.

Visitors.—The Observatory again benefited during this year by its position at a port of call. Among the scientific visitors that we had the pleasure of seeing in 1923 were Mr. and Mrs. J. Evershed, late of Kodaikanal Observatory ; Mr. A. Walter of the Royal Alfred Observatory, Mauritius ; Mr. Ladislaus Gorcynsky of Warsaw ; and Mr. B. Evans of Hong Kong, all of whom were in transit to or from their respective Observatories, also Mr. W. Watt of the London Meteorological Office, who was engaged in research work on H.M.S. Yarmouth.

Seismograph.—The only noteworthy change in the apparatus was the one already noted under clocks, viz., the use of the synchronome electric clock to calibrate it.

During the year the number of shocks which have been dignified with series numbers as apart from " traces " and " slight tremors " was 85. Shock No. 1,000 was registered on October 1.

Apart from records of such notable disasters as the Japanese one of September 1, one of the most interesting movements recorded was on August 22, when a movement occurred that at first appeared so sudden as to suggest the activity of an insect in the instrument case rather than the normal succession of preliminary tremors, long waves, &c. This was, however, identified as due to a movement at sea near Ceylon, whose effects showed on the weight barographs at both Colombo and Nuwara Eliya (though to different extents owing to the instrument's different orientation), and whose existence was confirmed by a number of dead fish being washed ashore near Mullaittivu.

The following is a list of shocks recorded during the year, and is an abridgement of the fuller lists sent to the Seismological Committee, British Association. In the present list all movements whose amplitudes were less than 0·3 mm. (which far outnumber those that reached that figure) are excluded. A large proportion of these small tremors were, no doubt, due to local effects (*e.g.*, they were noticeably more common on days of heavy rain), but a few cases of genuine movement must have been cut out by this limitation, which is inevitable in a report of this size.

Times are expressed throughout in Greenwich mean time, not in Ceylon time.

A detailed list of shocks recorded by the Milne Seismograph (horizontal pendulum type, set N–S) is appended :—

No.	Date. 1923.	P. H. M.	S. H. M.	L. H. M.	Maximum. H. M.	End. H. M.	Amplitude. MM.	Remarks.
	Jan.							
933	22	6 00	—	—	10 37	—	0·5	—
					11 0	12 15	0·5	—
934	25	16 49·0	—	22 27·5	16 57·5	17 15	0·5	—
935	26	10 44·0	—	10 55·6	10 55·8	11 11·5	1·0	—
936	27	14 17·8	—	14 22·5	14 22·5	14 29	0·5	—
937	28	6 40·5	—	—	6 40·5	6 45	0·4	—
938	28	9 14·0	—	—	9 14·2	9 20	0·4	—
939	28	9 2·3	—	—	9 2·5	9 8	1·0	—
	Feb.							
940	1	19 42·3	—	19 49·0	19 50	—	0·3	—
					20 31	21 00	0·3	—
941	2	0 35	1 52·6	1 57·5	1 58·5	—	0·5	—
					2 03	3 25	0·6	—
942	2	5 20·0	5 31·0	5 53·3	6 03·5	9 01	3·0	—
943	4	4 25·5	—	—	—	4 34	0·3	—
944	4	7 33·0	—	—	7 33·5	7 41	0·3	—
945	4	13 10	—	—	13 44	14 12	0·3	—
946	9	16 14·5	16 19·7	16 21·0	16 22	17 02	1·0	—
	Mar.							
947	1	8 45	—	—	9 43	10 15	0·3	—
948	2	16 57·2	17 03·9	17 17·7	17 20·0	—	3·5	—
949	3	21 57·7	—	22 2·0	22 07	23 5	0·8	—
950	4	—	—	1 4·6	1 5·5	1 43	0·4	Commenced after changing of record at 6 hrs. 18 mts.
951	4	7 21	—	—	8 1	8 50	0·3	—
952	6	9 30·3	—	—	9 {33 / 35}	9 52	(2·5) about	Record faint.
953	8	22 10·5	—	—	22 16	22 24	0·3	—
954	14	(20 48·0)	—	20 54·8	20 56·5	—	0·6	—
955	—	—	—	—	21 14·5	22 27	0·6	—
956	15	5 59·5	—	—	6 33	8 20	0·3	—
957	16	22 9·8	22 17·3	22 34·2	22 35·5	?	2·5	Vibrations not entirely ceased when record was changed for the day at 0·30 on 17th.
958	24	14 45	—	15·6	15 10	17 10	4·0	Sheet much fogged and times possibly uncertain to a few minutes. Also intermittent local tremors; times uncertain.
959	26	13 57·0	—	—	14 7	14 51	0·4	—
960	28	4 17·2	4 36·3	4 58·0	5 1·5	5 44	0·5	—
	April							—
961	13	15 44·3	15 58·8	16 16·5	16 19·5	—	1·2	—
					16 30	18 25	1·5	—
962	19	3 13·6	3 21·7	3 30·0	3 31·0	—	1·1	—
					3 38·6	5·45	1·5	—
963	19	8 5·7	—	—	8 07	—	0·5	Faint tremors still occurring up to 8·57, from which time the light failed.
964	20	10 17·5	—	10 19·7	10 20·2	10 39	0·3	—
965	23	3 32·5	—	3 49·5	3 54·5	—	0·5	End lost in induced vibrations due to artificial movement to test sensitivity at 4·20.
966	24	22 15·0	—	—	22 18	22 38·5	0·3	—
967	27	10 38·2	—	—	11 0	11 24	0·3	—
	May							—
968	4	16 31·4	16 53·3	17 22·0	17 33·0	—	3·6	—
				17 28·1	17 49·3	20 14	2·5	—
969	4	22 47	—	—	23 52	—	0·3	—
	5	—	—	—	—	0 12	—	—
970	12	1 26·0	1 31·3	1 35·4	1 39·7	2 52	1·6	Slight intermittent tremors, probably local.
971	23	22 52·2	23 6·1	23 23·6	23 29·5	—	1·0	Continued to time of changing of record for the day 0·30 and later.
	24	—	—	—	—	1 59	—	
972	28	1 28·7	1 30·2	1 31·4	1 33·5	3 24	9·0	—
973	30	9 1·0	—	9 11·5	9 18	9 50	0·5	—
974	30	18 24·8	—	18 37·0	18 41·5	19 10	0·4	—
975	1	17 35·9	17 44·5	18 5·0	18 7·6	23 30	1·8	—
					20 59·0	—	1·4	—
976	17	3 42·7	—	—	3 43·0	3 51·1	0·4	—

No.	Date. 1923.	P. H. M.	S. H. M.	L. H. M.	Maximum. H. M.	End. H. M.	Amplitude. MM.	Remarks.
	June							
977	17	6 7·4	—	6 10·6	6 11·0	7 20	0·6	—
978	18	—	8 41·7	8 44·7	8 45·5	11 06	0·3	? local tremor.
979	19	23 19·3	—	23 39·5	23 45·0	0 19	(0·3)	—
	20	—	—	—	—	—	Trace	—
	July							
980	1	8 5·6	—	8 11·2	8 12·3	8 37·3	0·4	—
981	2	2 43·5	—	2 59·2	3 02	4 23·5	0·9	—
982	13	11 23·4	11 30·6	11 46·5	11·50	—	1·8	—
					11 53	14 47·5	2·0	—
	Aug.							
983	10	16 3·0	16 7·0	16 10·3	16 15	16 29·5	0·3	—
984	11	0 56·6	1 0·7 / 1 6·0	1 11·0	1 20	2 15	0·8	—
985	12	10 14·6	10 22·1	10 37·3	10 39·5	11 37	0·5	—
986	20	18 26·0	—	18 36·2	18 41	18 58	0·5	—
987	20	19 32·5	—	19 40·2	19 45·5	20 05	0·4	—
987A	22	16 59·2	—	—	17 0·3	17 37	>12·0	Very close.
988	31	2 31·2	—	—	2 36·2	2 48	0·3	—
	Sept.							
989	1	3 8·8	3 13·0	3 18·0	3 19·0	15 15	3·1	Very slight (? local) tremors preceded shock.
				3 24	3 37·8	9 30	7·8	—
					3 39·4	—	10·0	—
					3 41·5	—	8·5	—
					3 51·2	—	9·5	—
					3 53·5	—	7·8	—
					5 46·0	—	2·0	—
					8 19·6	—	0·5	—
990	2	2 57·0	3 5·0	3 18·0	3 22	6 56	3·5	—
					3 27·5	—	5·0	—
					3 31·5	—	8·0	—
					3 33·5	—	4·7	—
					3 38·0	—	4·4	—
					3 41·0	—	3·2	—
991	2	9 37·6	9 46·3	10 7·0	10 8·7	11 29	1·0	—
992	2	22 57·6	23 7·4	23 59·0	—	—	1·0	Vibrations continued up to time of change of record at 0·36 on 3rd.
	3	—	—	—	0 6·3	? —	—	
993	7	23 50	—	—	—	—	0·3	Continuous small tremors, possibly local.
	8	—	—	—	—	7 00		
994	9	—	22 8·7	22 12·6	22 21·3	—	3·5	P uncertain owing to very faint movement from 3·00. Tremors still continuing at 0·31 on the 10th when the film was changed.
					22 25·0	—	5·0	
995	14	14 11·0	—	14 12·4	14 16·3	14 45·0	0·6	—
996	22	20 54·5	20 59·5	21 7·3	21 9·0	—	4·5	Boom still vibrating at time of change of recording sheet at 0·48.
					21 11·5	—	3·7	
997	26	9 15	—	—	10 3·6	—	0·5	—
					10 14·0	11 30	0·5	—
998	27	7 9·7	—	—	7 31	8 7·5	0·3	—
999	28	11 30	—	—	—	—	0·3	Continuous series of small movements. (There was not much rain during this period, but rain preceded it.)
	29	—	—	—	—	5 00		
	Oct.							
1000	1	8 26·0	8 29·3	8 30·4	8 31·7	9 46	1·5	—
1001	7	3 38·6	3 40·9 or	3 45·7 or	3 46·4	—	2·5	—
			3 45·7	4 1·5	4 3·8	7 11	5·5	—
1002	10	7 34·2	—	—	8 4·5	8 59	0·5	—
1003	15	7 44·0	7 56·5	8 20·0	8 32·5	10 45	1·0	—
1004	20	3 30·0	—	—	3 40·5	4 15	0·3	—
	Nov.							
1005	2	21 19·5	21 29·5	21 53·3	21 57·5	—	0·9	Local tremors from 0·30 to 5·30, continuing slight and intermittent to 11·30. Continued up to time of change of record at 0·27.
					22 6·0	—	1·5	
1006	3	16 28·0	16 35·6	16 54·5	16 55·5	19 43	1·1	—
1007	4	0 0 (?)	0 17·0	0 26·5	0 27·0	3 16	0·6	P doubtful owing to change of record at 0·08.
1008	5	21 37·0	21 44·5	22 4·0	22 8	—	2·0	Vibrations continued up to time of change of record at 0·40.
1009	6	19 37·0	—	—	19 55	20 20	0·3	—
1010	17	3 17·2	—	—	3 53	—	0·3	Slight intermittent tremors, probably local, before and after this shock.
1011	18	21 37·6	21 44·5	21 57·0	22 0	22 53·5	0·5	—
1012	21	13 47·5	—	—	13 50	13 55	0·3	—
1013	26	12 34·5	—	—	12 43·3	13 34	0·5	—
	Dec.							
1014	5	22 45·5	22 55·5	23 1·8	23 4·5	—	1·1	—
	6	—	—	—	—	0 26		
1015	11	—	—	—	0 35	6 30	0·3	Vigorous irregular tremors, probably local, but reaching appreciable amplitude of 0·3.
	12	22·45	—	—	1 48			
1016	14	11 55	—	—	12 7·3	12 39	0·4	—
1017	28	22 37·5	—	—	23 14·5 / 23 19·2	23 32	0·4	—

Weather Summary of 1923.—The general summary of the year's weather can best be considered in conjunction with Diagram 5. In this diagram typical stations are arranged in two columns, roughly, with west on the left, and east on the right, while in each column movement downwards corresponds to movement from north to south, or more precisely from north north-west to south south-east.

For each station a firm line shows the average monthly rainfalls, and its position is emphasized by the area below it being tinted blue. A chain line shows the actual rainfall in the several months of 1923, while figures at each angle on both the firm and chain lines give the corresponding number of wet days in the month in question.

The average curves bring out several interesting points with regard to general distribution. Thus, in moving southward down the western (left-hand column) the April pre-monsoon thunderstorms show more strongly at Puttalam than at Mannar, and more at Kurunegala than at Puttalam. At Kurunegala, too, the true monsoonal rain of June shows in a way that it does not further north, though it is not so extensive as the pre-monsoon rain of April. At Kandy, slightly further south, and with the assistance of the hills in obstructing the stream lines of monsoon current, the June average is a trifle above the April one, while at Colombo, still further south, but at the coast, the two effects coalesce to give a rainfall maximum in May (and incidentally much newspaper correspondence in the attempt to find a single formula to cover the effects of two independent causes).

The next stations, Watawala and Hatton, show the full effect of the south-west monsoon against a background of hills, and the April activity is almost lost sight if compared to the much greater rain of June.

Avissawella, though not on the coast, is too far west of the main hills to show this antithesis, and its curves resemble those of Colombo, with the pre-monsoon, and monsoon, rain merging to give a maximum in May. Passing further south, Ratnapura resembles Watawala in having a maximum in June, though the ratio of June to April is not so extreme as at the up-country station.

Further south still the effect of the hills is further reduced at Kalutara and Galle, which show the same type as Colombo and Avissawella, with the maximum in May, but with decreasing quantities.

For the latter part of the year the variations in the left-hand column are not so striking. October shows throughout as a month of heavy rain, commonly attributed to the north-east monsoon, though possibly more accurately attributed to the retreat of the south-west. The most striking points are that at the northern stations, Mannar and Puttalam, with very little but low-country to the eastward, November is wetter than October, whereas the other west side stations all show a fall-off from October to November and from November to December, *i.e.*, they are sheltered from the pure north-east effect in a way that they cannot be sheltered during the less consistent gradient of October.

In the other column the most striking feature is the absence of rain of the pure south-west monsoon type. The only station with an appreciable average for June is Nuwara Eliya, a central station that might well have been included in the left column had space allowed. The April inter-monsoon showers show at all the inland stations, and particularly at the very interesting group of stations at the south-east limit of the hill-country. October shows as a consistently wet month, but with the exception of Nuwara Eliya, which is really a " west side " station, and of Diyatalawa, which is in a cup with higher ground to the east, as well as to the west and south, the stations in this column all have higher rainfall in November than in October, while those that are north-east of the main hills show a further increase in December, *i.e.*, the purer north-east monsoon effect outstrips its own commencement at Rangalla, Batticaloa, Badulla, and Trincomalee in much the same way that the purer south-west effect of June outstrips that in April and May at Watawala and Hatton. Further north and further south, where a steady current from the north-east is uninterrupted by hills, the December average drops below November, *e.g.*, at Jaffna, Koslanda, and Hambantota, while January shows a further fall-off, which is more complete at these stations than at the ones mentioned above as receiving the heaviest monsoon rain in December.

Examining the curves for 1923 in detail, it will be seen that in January rainfall was well above average, particularly on the east side ; in fact, Kalutara is the only exception among the stations given in this diagram. This heavy rainfall was attained by the help of a depression, whose activities are dealt with more fully in the appendix. February is normally a month of low rainfall, but no station, except Trincomalee, reached even its own low average. Colombo just escaped (by a fall of 0·01 inch on the last day) equalling its record (in 1876) of a February with no rain whatever.

March is a month in which the " local thunderstorm " distribution is more to the fore than in the typical monsoon months, and consequently the variations are more erratic. In 1923 the northern stations were all above average, as were these in the extreme south-west (*e.g.*, Galle),while in the remainder the offsets were small, but in both directions.

In April the averages are considerably higher than March, while the type is still dominantly of the local thunderstorm variety. In April, 1923, at the extreme south-west of the Island the rainfall of Galle was several inches above average, and in parts of the low country of the south and west, as typified by Hambantota, Kalutara, Avissawella, and Colombo, 1923 figures were close to the average. Elsewhere there was a marked deficit.

At the end of April and beginning of May the pressure gradient across the Island was steeper than usual at this time of year, and as frequently happens when there is a marked depression in the middle of the Bay of Bengal an unusually dry period occurred in Ceylon. As a natural result very few stations reached their average in May, 1923 ; of those shown in the diagram, Badulla is the only one that did so, and even there the excess was very small. Hence the total from January 1 up to June 1 was below average at most stations in the south-west quadrant of the Island, though above it in the north-eastern areas. However, from early in June a monsoon developed that was of unusual vigour, and from June to September, inclusive, the inland stations that present a direct face to south-west monsoonal activity were all unusually wet. In the diagram Kandy, Watawala, Hatton, Avissawella, Ratnapura, and Nuwara Eliya show this very clearly, while Kurunegala, Colombo, Kalutara, and Galle, though they did not show excess in June, came under the same category from July onwards.

Corresponding to this the stations in the upper half of the right-hand column which are on the lee side of the Island failed to reach even their own low averages, though in the lower half of that column the deficits were less marked, and at the extreme south Hambantota had quite a little rain in both June and July.

In October very few stations were below average, though the excesses were for the most part not very great. In many areas, however, the effects of small excesses were greater than their numerical amounts suggest owing to the cumulative effect of the previous months' heavy rain.

In November it is not uncommon for definite depressions to pass over Ceylon with a corresponding upward tendency on the rainfall averages. This year such a depression did not pass over the Island, though depressional activity was in evidence in the neighbourhood, and was responsible for certain stations, *e.g.*, Trincomalee, Galle, and Hambantota, being well above average, although a trifle more than half the stations in the Island were below.

In December rainfall was consistently in excess, general depressional activity in the neighbourhood of Ceylon being again a fairer description than any attempt to locate a definite storm centre over the Island.

Diagram No. 7 is of a type that has not appeared in these reports before, and brings out several points in connection with the rather vigorous south-west monsoon of 1923. In it the horizontal scale is one of time on the scale of 2 millimetres to the day, and just below the centre two curves of pressure are drawn. One of these (which is in general the upper one), gives the highest pressure recorded each day on the south-west side of the Island, *i.e.*, at Colombo, Galle, or Ratnapura, while the other one gives the lowest pressure on the north-east side—usually at Trincomalee. The vertical difference between these curves is thus a rough measure of the pressure gradient across the Island, which for many purposes is the controlling feature of monsoonal activity.

In the upper part of the diagram a series of curves give the total wind movement per day at various stations, and comparison of the relative amount of movement at different stations is made easy by shading from the zero line up to these curves.

The stations are arranged geographically from north to south, and it will be noticed that, as might be expected, an increase in gradient, as shown by the interval between the pressure curves, usually corresponds with a general increase of wind at all stations (*e.g.*, in the latter part of April). However, if we consider the cross section of Ceylon from north-west to south-east or north north-west to south south-east, *i.e.*, at right angles to the general line of advance of the monsoon wind, it will be seen that Colombo, though at sea level itself and with no direct shielding south-west of it, is in the line of advance that passes through the main hills, but the lines of monsoon advance that pass through Trincomalee and Galle will skirt the shoulders of the main hill-country on opposite sides, while if we move further outwards the lines through Mannar and Hambantota will pass over less in the way of land obstruction, and those through Jaffna and Little Basses Lighthouse through less still. If, then, we consider the monsoonal effect at any point on the surface as due to a main drift, retarded by the frictional effect that the stream line through that particular place undergoes, we might expect that all stations would show response to fluctuations in the main drift—of which the pressure gradient would give some indication—and that a station like Colombo, though on the windward side of the hills, would show considerable retardation due to the hills, but that as we move outwards perpendicularly to the line of main advance, we should get a continuous fall-off in the frictional effect, and a corresponding rise in the surface wind velocity as we get to places, either north or south, which are such that the stream lines of monsoonal advance through them will meet with very little obstruction in the way of hills, &c. This expectation is fully brought out by Diagram 6. The velocities at Jaffna (extreme north) and Little Basses (off the coast, south-east) are easily the highest. and oi these, Little Basses is the higher, which is a natural result when we examine the maps in Diagrams 1 to 4, and see that the course of a south-west or west south-west wind at the Basses is chiefly over the sea, while a stream line through Jaffna has at least the friction of the flat Jaffna peninsula to check it. Dotted curves on the same axis as those of Jaffna and Little Basses give the velocities at Mannar and Hambantota, which under steady south-west monsoon conditions are considerable, but less than those at the former stations.

Moving further inwards to Trincomalee and Galle, it will be seen that the velocitics are markedly below those at Jaffna and Little Basses, and, in general, though by no means always, below those at Mannar and Hambantota, but they are consistently above those at Colombo. If, then, we confine our attention to the main features, we have a striking example of the increase in frictional effect and corresponding decrease in wind velocity as we move from Jaffna to the line of the central hills, and the reverse processes as we move on outwards again towards the south-east, but there are several minor points that will repay closer inspection. The diagram has been extended to include the periods of slack gradient, both before and after the main monsoon gradient, so that the full life-history of the monsoon can be traced, which can best be done in conjunction with rainfall statistics given in the lower part of the diagram for thirteen stations in the south-west quadrant of the Island. These are arranged, roughly, downward and southward, commencing with Nuwara Eliya at 6,000 feet above mean sea level, which may be described as in the centre of the Island, and ending with Galle at sea level in the extreme south-west. Below this a further note is made from the island of Minicoy over 400 miles west of Ceylon.

At the beginning of April it will be seen that the pressure was very uniform and the wind velocities at all stations low. What little wind there was came largely as the result of sea breeze effect. Such slight differences as occur may probably be explained as due to the immediate local surroundings of the instruments. Thus, quite apart from the question of the geographical distribution of stations relative to the general shape of the Island, the Trincomalee instrument on the top of Fort Frederick has a rather more open site as regards immediate environment than the ones at Colombo Observatory, Hambantota, or Mannar, while the sites at Jaffna and Galle are probably intermediate between these.

It is interesting, though not surprising, to note that in the early part of April the Little Basses instrument, with a very open local exposure, but 6 miles from the coast, recorded less than the instrument at Hambantota, which is not so high above ground level, but which, being at the coast, naturally got the full advantage of the sea breeze effect, in which the coast line may be considered as the centre of action.

During the middle of April the gradient was still very slack, though the south-west side was just above the north-east, but from the 22nd onwards there was a steady increase in gradient which shows in all the wind velocity curves, as a more or less continuous rise till May 2–3, and which coincided with the development of a storm in the Bay of Bengal. The rainfall of April is interesting. In the first place, there was a sufficient amount to keep the "Little Monsoon" controversy up to at least its usual strength, but the most interesting thing about it is the way that it was chiefly confined to the coast, and that there was little rain up-country, while such rain as did occur inland was heavier at Carney (on the south-west of the Adam's Peak range) than at the stations higher up and further inland. A particularly noteworthy item is the fact that during April there was no rain at Minicoy, which affords strong proof that the Ceylon rain of that month is due to a different cause from that which is responsible for the monsoon rain of June, &c. Thus, in June a monsoonal current brings moist air to both Minicoy and Ceylon and deposits rain on both, but if we accept the April rain of Ceylon as largely due to the local circulation set up by convection over the Island itself, it follows naturally that the Minicoy rainfall (if any) in that month must depend on the convection over that island, and considering the relative sizes of Minicoy and Ceylon, there is nothing surprising in the idea that in the former case the local convection was insufficient to cause appreciable rain. About May 2–3 the gradient was at its steepest across Ceylon, a fact which shows in all the wind velocities (though by this time the centre of the depression was well into the Bay of Bengal). The next fortnight shows an exceedingly interesting dry period with steadily decreasing gradient and wind.

This early depression and its ensuing fine weather are worth considering in connection with the subsequent monsoon. A very similar case occurred in October, 1920; and in 1920, as in 1923, a very wet monsoon followed. A milder case of the same thing occurred in 1922, and was followed by a monsoon of moderate intensity, while in 1921 there was an almost complete absence of a depression over Ceylon in April, and the ensuing monsoon was exceptionally weak.

Proceeding now with the detailed examination of 1923, it will be seen that both May 17 and 24 have claims to be considered as the "burst," but a still better case exists in favour of June 3 and 4. The period from June 3 to 8 is particularly interesting, and an examination of the chart shows how a steady increase in the pressure gradient (as indicated by the increased vertical distance between the pressure curves) coincided with a movement of the area of most rain from the low-country in the south-west of the Island to the higher altitudes, until on the 10th and 11th the up-country stations were getting over an inch (in some cases many inches), while Galle, Kalutara, and Colombo had dropped back to less than half an inch.

It may be of interest to note that June 11 is quoted from further north as the date of the arrival of the monsoon on the west Indian coast, and June 12 for its arrival at Bombay. For the rest of June a fairly steep gradient persisted with heavy rain up-country, but more moderate rain near the coast.

The increase of rain and wind on June 17 brings out several points, one of the most noteworthy of which arises from the way in which the ordinary distribution of velocity between stations is modified. Colombo and Galle show peaks which do not appear so strongly as might be expected at Jaffna and Little Basses, which can only mean a variation from normal in the direction of the stream lines, an item which did not show very strongly in the Ceylon surface synoptic charts of June 17 or 18, but which showed in the upper air observations at Colombo at a half and one kilometre (1,500 and 3,000 feet), where the wind was a trifle north of west instead of about west south-west, and in a very practical way off the Malabar coast, where the sea was reported "very rough" on the 18th.

The rainfall diagram for the latter part of June calls attention again to the way in which the steeper gradient goes with a greater proportion of the rain being up-country. The gradient on about the 14th was the slackest in the month, and the fall-off in rain at up-country stations was well marked.

A less thorough fall-off occurred on the 25th, and here it is interesting to find that a slight easing up-country finds its counterpart in an increase at Galle on the 25th.

The early part of July was less noteworthy, but on the morning of the 14th, after several days of only very moderate rain, the forecast read "not much change in general type, but liability to rain slightly increased." This (as will be seen from the pressure curves) was in no way dependent on a change in the steepness of the gradient, but was due to a change (not demonstrated in the diagram) in the direction of the upper air movement at half a kilometre, and above, which had gone round from west south-west to south-west, which is usually a wet sign during this monsoon. The ensuing rain of the 14th–15th and next day or two demonstrated the fact that it was due to the arrival of moister air rather than to increased gradient, by the fact that more rain fell in the low-country than in the hills, though a gradual increase in gradient in the next few days took the centre of gravity of the Island's rainfall up to the hills by the 19th.

In the early part of August there was a good deal of monsoon activity at the head of the Bay, and the gradient across Ceylon was above average steepness with heavy rain, particularly up-country, which fell off towards the middle of the month, after which there was a continued decrease in gradient and less rain in general.

On August 30–31 the Little Basses Lighthouse recorded less wind than Hambantota for the first time since May 22, and as a natural result, when the gradient re-established itself, somewhat the same sequence of events had to be gone through as at the beginning of the monsoon, *i.e.*, rain appeared first at Galle, Colombo, and Ratnapura (September 1–8), while it only reached an inch at Carney on the 5th, and at Ambegamuwa and Watawala on the 7th. Similarly a slight increase in gradient from the 19th to the 21st corresponded with a movement of the area of heaviest rainfall from the coast to further up-country.

The sharp change on September 26–27 is a very pretty example of the effect on Ceylon of the formation of a storm in the Bay of Bengal, as part of what may be roughly called the retreat of the monsoon. In the cases in June and July a gradual increase of gradient resulted in the rain appearing first in the low-country and then spreading up-country (or conversely a decrease in gradient allowed rain up-country to spread backwards into the low-country), but in this case, unlike anything since May 24 (except possibly July 9 and 14), there was a sudden transition from a day on which no station recorded half an inch to falls of over an inch in both the low and up-country (and one may add at Minicoy).

Through the early days of October it will be seen that the gradient continued to fall off, and it may be added that on October 8 a wind-reading at 1½ kilometre had an easterly component instead of a westerly one—an event that had not occurred since May 24.

For some purposes the diagram might have ended here, but I have purposely continued it to the end of the month, to show the essentially different type of weather that occurred.

The diagram shows the complete collapse of the gradient from south-west to north-east, the corresponding drop in wind, and the way in which the marks that denote rain constitute more of an irregular mass and less of the vertical grouping of September.

Two items that cannot be shown on this diagram are the fact that from October 12 to 26 the time of rain was more concentrated in the late afternoon, and at night, than formerly, and also that stations such as Trincomalee, which had been on the lee side during the south-west monsoon and suffering from drought, now received rain.

The opening up of the pressure curves from October 26 to 31 differs from that in June, in that it no longer represents a consistent line of maximum steepness. During those days a definite depression existed over the Island of a type not uncommon at this time of year, *i.e.*, cyclonic, though of insufficient wind strength to come into the category of cyclonic storms of which wireless warning is broadcasted.

In this last connection this is another point to be mentioned which has not been shown in the diagram for the south-west monsoon months, but which has already been touched upon under "out-stations," and may be of special interest to those who have been following the work of Professor Bjerknes on cyclonic movements in the temperate zone. The Nuwara Eliya meteorological shed is over 6,000 feet above sea level, and thus in some ways takes the place of an upper air station. On the morning of October 26 the minimum temperatures of all Ceylon stations were below their average for October (though Diyatalawa and Badulla were practically at their averages). By the 27th Nuwara Eliya had risen over 4° and Diyatalawa and Badulla each 1½°, while the other stations were still all below their averages. This is not an isolated instance, but one that to a greater or less degree occurs in every such depression or "bubble depression" that I have investigated in the last ten years, and its practical bearing on forecasting in Ceylon may prove very considerable.

Correlation.—In Appendix B to the 1911 report I called attention to the unsatisfactory state of many of the old statistics, and their consequent uselessnesss for purposes of correlation. Up to that time there seemed to have been very little realization in Ceylon of the fact that the various meteorological elements are essentially related, and should be regarded as a single whole in which the observations of different instruments and different stations admit of being closely interwoven. Such interweaving is the essential basis of forecasting, and was quite impossible with the material available in 1911, and all that could be done then was to settle down to the prosaic business of trying to collect reliable data as the necessary first step before deductions could be built up from those data. To-day the Observatory is in the much happier position of having at least some material with which to build, and the frontispiece of this report is a typical example of correlation being found to exist in a case where the general physical principles caused it to be looked for in the very form in which it was ultimately found.

If air under a low pressure at Nuwara Eliya is taken, under the action of a monsoon gradient, to the sea coast, and compressed till it reaches the sea-level pressure, we should expect it to get hotter under the effect of that compression in the same way that a tyre valve shows the heating effect of compression when the tyre is inflated, and if this is a fair statement of the general idea, it follows that we should expect the heating to be most marked when the pressure gradient was strongest.

The diagram affords a strong argument in favour of the two being closely related. The line from Colombo to Trincomalee approximates to the line of steepest monsoon gradient, so the difference in pressure between these stations is a fair measure of the strength of the monsoon current. Batticaloa is the station that can best be described as in the lee of the main hills, and the way in which a thermometer there has moved parallel with the difference between barometers at Colombo and Trincomalee and kept up the parallelism for several years can hardly be attributed to chance.

The general idea given above is, of course, only a rough one, and has points in common with some of those suggested to explain the Föhn and Chinook winds of the Alps and the Rockies. Possibly the Batticaloa Kachchan is qualified for a place in the geography books alongside the winds named above !

The following periodicals were received in 1923, and while they have been duly acknowledged by letter, I am glad to take this opportunity of thanking the donors collectively —

AFRICA.

(*a*) *Egypt.*

Ministry of Public Works, Physical Department :—
- Climatological Normals dated 1922, with Map showing Meteorological Stations and Annual Rainfall.
- Handbook of Instructions for Meteo. Observers in Egypt, the Sudan, and Palestine.
- Helwan Observatory Bulletins, Nos. 23, 25, 26, 27, and Index to Bulletins Nos. 1–25.
- Meteorological Report, 1918.
- Physical Department Papers, Nos. 8, 9, and 10.

(*b*) *Mauritius.*

Royal Alfred Observatory :—
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(*c*) *Union of South Africa.*

The Irrigation Department :—
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AMERICA (NORTH).

(*a*) *Canada.*

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(*b*) *Jamaica.*

William H. Pickering :—
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- Eratosthenes, III., and A Suggestion Regarding Gravitation, II.
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- A Meteoric Procession of February 9, 1913, Parts I., II., III., and IV.
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(*c*) *Mexico.*

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(*d*) *United States of America.*

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(b) Brazil.

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Monthly Seismological Bulletin, November, 1922, to October, 1923, inclusive.
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(b) Canton, China.

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(c) India.

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(b) New Zealand.

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Colombo, January 31, 1924.

APPENDIX.

Diagram 6 shows the isobars and rainfall distribution over Ceylon during a few days in January, 1923. A slightly shaded area in the centre of the Island denotes the altitude contour of 5,000 feet, and will be found to explain some of the distortion of the isobars that takes place inland. Names of stations are not given on these small maps, but can be identified from Diagrams 1 to 4. The barometers whose readings are used include those given in Tables 9 and 10, and also instruments at Badulla, Kandy, and Kurunegala, which have not been in use long enough to be included in tables of averages. The damage to both life and property at this period was considerable, and attracted a good deal of attention, so that a brief analysis of the meteorological causes at work may fairly be included in an annual report as well as in its more natural place in an Observatory Bulletin.

The period may be summarized by saying that between January 7 and 15 Ceylon experienced an elegant example of a movement, perfectly cyclonic in type, comparatively mild as regards wind velocity (though the observer at Mannar described it as " almost a gale " on the 9th), and involving very heavy, and in some cases disastrous, rain. To this may be added that it showed very clearly two peculiarities of a type that I have observed in a large proportion of Ceylon depressions, and the further analysis of which, I submit, may have a very definite bearing on tropical forecasting.

These points are (1) the utility of the temperature readings of stations such as Nuwara Eliya (6,000 feet above sea level) as a mild form of upper air observations in the front of a depression, and (2) the way in which a tropical depression, once formed, tends to show some of the properties of a simple dynamical whirl, and hence is displaced at right angles to the direction of maximum steepness, and to the left, of a steady gradient whose effect may be superimposed upon it.

With regard to the former, the rise of temperature at this station in front of depressions approaching from the eastward has been noticed too often for the coincidence to be accidental, and it looks as if Ceylon is quite prepared to take a share in the controversies that range round the " warm front " theories of cyclonic movement that have so far been discussed chiefly with regard to regions nearer the Pole.

The second point has a great practical bearing, because the condition postulated is fulfilled whenever a depression escapes from the lee of the Island and comes under the influence of an external (monsoon) gradient in the Bay of Bengal or Gulf of Mannar. The resulting displacement (according to the direction of the external gradient) may either speed the parting or make the depression reverse its direction and retrace its path.

In December or January the general trend of movement of a depression is usually from east to west, and there is apt to be a strong north or north-east wind in the Gulf of Mannar, whose effect on a depression that is leaving the Island in a westerly direction is to reverse that movement. If the rotational velocity of the depression is considerable (as in December, 1913) it may suffer a very slight check and nothing more, whereas in November, 1920, a depression of very slight velocity recrossed the Island entirely. In the case under discussion the movement was of an intermediate strength and showed the phenomenon, but only to a moderate extent.

Turning now to Diagram 6, and examining it day by day, it will be seen that on January 7 there was a fairly normal north-east monsoon distribution. The report and forecast that morning was : " Barometer fallen, and may give strong north or north-east winds. Rain has decreased. It is still likely in the east and south-east, but will probably not be extensive in the west," and it may be explained that the Nuwara Eliya minimum temperature was 46·4°, or slightly below its own average for January, a fact that was largely responsible for the forecast not dwelling on a prospect of widespread heavy rain within the ensuing 24 hours.

The rainfall chart for the 7th to 8th does not show extensive rain, but by the morning of the 8th the pressure had fallen towards the south-east, and the minimum temperature at Nuwara Eliya had risen to 50·4°. That morning's report read : " Barometer lower. Strong wind from north to north-east still likely. Rain likely on east side," which was fairly well fulfilled in the next 24 hours, notably in the distribution of rain, which can be seen in the chart for the 8th–9th. The isobars on the morning of the 9th show the distorting effect of the hills, and it is worth noting that at Hambantota in the south-east the pressure was actually higher than on the previous morning. A still more significant fact, which is not shown by the diagram, is that the Nuwara Eliya minimum had again risen and reached 56·4°, with the result that the report and forecast read : " Barometer slightly lower. There has been appreciable rain on the east side, where it will probably continue, as well as spreading across the Island. Wind liable to be strong, and may vary in direction." The diagram shows that the area in which over an inch of rain fell in the next 24 hours covered more than half the Island, but a further note may be added to the effect that several falls of over 10 inches were recorded, *e.g.*, Hendon 13·35, St. Martin's 12·50, and Meeriatenna 11·42.

The diagram of January 10 might have come out of a text book. The rain had certainly spread westward, and the wind arrows are almost perfect. The hill effect is less marked, but shows in Badulla's higher pressure. The 11th is interesting in showing the further north-westerly movement with Galle pressure above Ratnapura, the west coast having something of the calm centre. The chart for 24 hours from 10th to 11th shows that Galle got a little rain, instead of none, as in the previous 24 hours, but on the whole the rain was certainly not greater than was anticipated. The morning of the 11th still showed the lowest pressure over the Island, though distinctly more to the north-west, and the morning of the 12th showed this movement further developed.

One might be tempted to leave the matter there, as the main storm was obviously west and appeared to be moving further west, but the second point referred to above must be considered, namely, the possible setback after the centre had come out from under the lee of the Island.

In this case the depression had been strong enough for its complete return to be unlikely, but a reasonable expectation was that after about a day of steady improvement we should get a sort of " fighting rearguard " of thunderstorms. The forecast on the morning of the 12th read : " The depression is now to the north-west of the Island and moving away. Weather conditions should improve, but showers still likely," the last phrase being on account of this "rearguard" and the use of the word "showers" rather than "heavy rain" or "thunderstorms" largely on account of the interval that might be expected to elapse before the displacement took full effect.

On the morning of the 13th the pressure was higher than on the 12th, but there was a nearly closed isobar with the pressure inland less than that at the west coast, *i.e.*, the effect of the set back was occurring to a mild extent, and the morning's forecast read : " Barometer risen, and conditions as a whole clearer. Local thunder-storms still possible, but probably not extensive."

The next morning (14th) the pressure was still higher, but still showed a loop inland, not a steady fall-off from east to west, while in the forecast the limitation "probably not extensive" was removed from the "local thunderstorms."

On the night of the 14th the said local thunderstorms were much in evidence, particular attention being called to their effect on a certain tributary of the Deduru-oya and on the railway line between Ganewatta and Maho.

As a further example of how localized the rain was that night, it may be noted that while 3 inches fell in 24 hours at the Observatory, less than half an inch fell at the Fort only three miles away.

One other point may be touched upon in view of a certain type of criticism that is frequently heard. During the period under review several extra meteorological telegrams were sent to India, and at first glance it might seem curious that the wireless weather messages issued from Simla never used a stronger term than " squally " to describe the weather round Ceylon. Yet a very little consideration will show that there was no disagreement. The wireless messages are intended as warnings for ships, and in them wind and state of sea are of primary importance, while the presence or absence of floods over the land are simply irrelevent. A movement of cyclonic type must always be kept under observation by a meteorological service, because it may develop and become dangerous in more ways than one. The fact that it is comparatively harmless from one point of view is no guarantee of its complete good behaviour, and in this case (where most of the rainfall was not orographical) it is probable that the very absence of strong wind tended to concentrate the rain and increase its capacity for damage in the areas most concerned.

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