THE COLOMBO OBSERVATORY. 1931

REPORT OF THE SUPERINTENDENT OF THE OBSERVATORY.

TABLE OF CONTENTS.

ADMINISTRATION.

Staff.—On November 18 Mr. A. J. Bamford, the Superintendent, sailed for England on three months' retirement leave. Mr. H. Jameson, Assistant Astronomer, became Acting Superintendent, and Mr. D. T. E. Dassanayake, Senior Technical Assistant, became Acting Assistant Astronomer.

Mr. Bamford arrived in Ceylon in November, 1908, as assistant to Mr. H. O. Barnard, who combined the duties of Assistant Surveyor-General and Superintendent of the newly formed Colombo Observatory. Mr. Bamford was the first full-time scientific officer of the Observatory, and, on Mr. Barnard's retirement, in January, 1913, became Superintendent.

Mr. Bamford carried out many investigations, mainly on the meteorology of Ceylon, the results of which have been published in local or European scientific journals. In addition to his ordinary duties, he acted on several occasions as Professor or Lecturer in Physics at the University College, Colombo. During the war he served with the Armoured Cars in German East Africa, and was afterwards engaged on sound ranging and army survey work in Palestine and Arabia. He received the Military Cross, and was twice mentioned in despatches, being demobilized with the rank of Captain. Throughout his residence in Ceylon, he took a keen interest in the Ceylon Planters' Rifle Corps; joining as a rifleman on his first arrival, he retired, on his departure from the Island, with the rank of Major.

Mr. Bamford retired from Government Service under that provision of the Ceylon (State Council) Order in Council, 1931, which gives to certain members of the Public Services the option of retiring on pension at any time during their subsequent service.

Buildings.—There were no extensions made to the buildings during the year.

TIME WORK.

The astronomical activities of the Observatory were mainly limited to time work.

The Cooke micrometer transit (4-inch object glass) and Borrel chronograph were in occasional use, but the clocks were rated by regular observations of the Bordeaux and Rugby vernier time signals.

Both the sidereal clocks, Fournier 70 and 72, continued to show satisfactory rates. A new cord was supplied to 72 on July 2.

The Cooke mean-time clock was used chiefly for sending out the wireless time signals. For this purpose it is adjusted daily by a solenoid, after comparison with the sidereals. The action of the solenoid had been very irregular for some time, so on August 4 it was rewound, and has since proved quite satisfactory.

Dent mean-time clock No. 45082 was mainly used for the time ball work. On November 3 it gave trouble, and was dismounted. It was found that the pendulum rod was fouling the solenoid coil, probably owing to warping of the wooden case. This matter was put right, and the clock was set going again on November 6.

The Synchronome master clocks continued to be in use for calibrating the seismograph, and for dials in various parts of the building.

Time Ball and Synchronization.—The time ball at the Flagstaff Station was dropped as before at 09.00, 13.00, and 16.00, Ceylon Standard Time (0330, 0730, 1030, G.M.T.), on ordinary week days, and at 09.00 only on Sundays and public holidays, until the end of May. Owing to the increase in wireless time signals during the past few years, the Port Commission considered that so many time ball signals were unnecessary, and from June 1, the ball was dropped only once a day, at 09.00.

There were 592 successful signals out of a possible 597. The reason for one failure was the disconnection of the battery at the Observatory by a workman, who was overhauling it. Another was caused by the officer on duty inadvertently leaving a switch in the wrong position. Two of the remainder were due to trouble on the line, while the cause of the fifth could not be determined, though, as the current sent out from the Observatory was perfectly normal, the fault was presumably neither at the Observatory nor on the line.

The working of the time ball involves co-operation between four departments, Survey (Observatory), Telegraph, Harbour Engineer's, and Master Attendant's, and my thanks are due to those officers of the other departments concerned who have co-operated in this work.

Synchronizing signals were sent daily to the Central Telegraph Office, whence a further distribution of time signals was made all over the Island. These were sent from the Observatory at 07.55 and 15.55 on ordinary week days, at 07.55 only on public holidays that are not post office holidays, and at 08.54 on Sundays and post office holidays. A test measurement was in all cases made immediately after the setting signal, and this enabled the Observatory staff to verify that the setting signal had done its work satisfactorily, and if necessary to report any defect by telephone. Details of this test signal were given in last year's report.

The clock in the lighthouse at the corner of Chatham street and Queen street was synchronized daily at 09.00, its relay being in series with the time ball circuit. At certain hours the strike of this clock is included in the broadcasting programme as a time signal.

The broadcast of the strikes of this clock is checked daily at the Observatory, and the error noted. The great majority of these checks gave errors of less than 5 seconds. The clock stopped on four occasions during the year. On one occasion workmen were engaged in repairs in the Clock Tower, and the stoppage was probably due to their activities. On the other three occasions the cause of the stoppage could not be determined.

J. N. 21824 (7/32)

Issue of Wireless Time Signals.—These were sent out twice daily, in the old International or "Onogo" Code, from the Welikada Wireless Station. The morning signal is from 11.27–11.30, Ceylon Standard Time (0557–0600, G.M.T.), on 130 kc/s (2300 metres), C.W., and the evening one from 22.27–22.30 (1657–1700, G.M.T.) on 500 kc/s (600 metres), I.C.W. There is no curtailment on Sundays or public holidays.

In the case of a failure or erroneous signal, the words "time signal failed" are sent out in Morse immediately afterwards.

Details of the apparatus and procedure are given in preceding reports.

In 1931 there were 725 successful signals out of a possible 730 Two failures were caused by premature release of the drum, presumably due to stray currents on the line, and three to faults developing in the apparatus at the Wireless Station during the signal.

As in the case of the time ball work, the wireless signals involve close co-operation with the Telegraph Department, and I am glad to take this opportunity of expressing my thanks to all concerned for the way in which they have been maintained.

Meteorological Equipment and Work.

The 16 main climatological stations were maintained during the year, as were 3 of the 4 new stations established for aeronautical meteorology. The station at Negombo was, however, discontinued in September, as unusual erosion on the beach threatened the destruction of the instruments. The improvement in the records from these stations, shown in 1930, was maintianed during this year.

At the 16 main climatological stations, observations were taken daily at $9\frac{1}{2}$ hours and $15\frac{1}{2}$ hours. Until May 1, observations were taken at 7 hours at Colombo, Trincomalee, Hambantota, and Nuwara Eliya, for transmission to India, while observations were taken at 19 hours at Hambantota and Trincomalee, for use, in conjunction with values derived from Colombo autograms, in preparing the evening weather report. From May 1, the time of the morning observations for India was changed from 7 hours to 8 hours, and observations were also taken at 17 hours, at Trincomalee and Hambantota, for India. These 17 hours' observations are now used for the evening weather report from Colombo, and the 19 hours' observations have been discontinued.

Mention may also be made of the climatological station maintained by the Rubber Research Institute at Culloden, Neboda, and of that started at St. Coombe's Talawakele, in January, by the Tea Research Institute. The records from these stations are sent regularly to the Observatory. A pluviograph is maintained at Labugama Reservoir by the Colombo Municipality, while the Observatory maintains another at Watawala, and a recording anemometer at Haputale, in addition to some pluviographs and recording anemometers at the main stations. There is a Robinson anemometer at the Little Basses lighthouse, which is maintained and read twice daily by the Lighthouse Service.

The pin diagrams and other systems of checking at Colombo were continued without any marked change in methods.

Six clerks of the Survey Office, and one from Mannar Kachcheri, were given a course of training in meteorological work, and passed as observers or relieving observers.

Wireless Weather Reports.—The chief daily weather report and forecast was prepared each morning in time to be broadcasted *en clair* at noon. It subsequently appeared in the "Post Office Daily List" and in the local newspapers.

The chief material for this report was provided by the morning telegrams from 14 climatological outstations, the Colombo observations, including the morning pilot balloon flight, and such ships' messages as were available. Other sources of information were the telegram from Pamban, and the figures from stations in Ceylon that are not fully equipped climatological stations, but from which the morning measurement of rainfall is wired. These stations now number 15.

Weather reports, prepared avowedly with a view to shipping, were sent out in Morse immediately after the time signals at $11\frac{1}{2}$ hours and $22\frac{1}{2}$ hours. These messages deal with the immediate neighbourhood of Ceylon in more detail than can be expected in the Indian messages, which avowedly have to summarize the outstanding features over big areas. By kind permission of the Director-General of Observatories, copies of the Indian messages are received at Colombo, and use is made of any relevant parts, but the main sources of information for the reports from Colombo are the Ceylon readings (both surface and upper air) and wireless messages received direct from ships.

A new departure during the year was the issue of a Fleet Synoptic Message from Matara Naval Wireless Station, daily at $13\frac{1}{2}$ hours on a wave-length of 150 kc/s (2000 metres). This was started on December 11. It was originally intended, as a result of the "Conference on the Meteorological Requirements of the Royal Navy," held at Colombo in March, 1930 (see last year's report), that a Fleet Synoptic Message should be issued daily, giving observations for the Bay of Bengal, the Arabian Sea, and the neighbourhood of Ceylon, prepared at Calcutta, Poona, and Colombo, repectively. This scheme broke down over questions of finance, and it was decided to proceed with a modified synoptic message from Colombo only, giving such observations as were available here, mainly from Ceylon and the neighbourhood. This message consists of observations from Colombo, Hambantota, Trincomalee, Nuwara Eliya, and the Indian station Pamban, any ship's observations received, a summary of the morning pilot balloon flight at Colombo, and a weather inference and forecast. It covers too small an area to be altogether satisfactory, but is mainly intended as an experiment, until the original scheme can be proceeded with.

The number of ships from which weather telegrams were received during the year was 319, which is a considerable increase over the number for the preceding year (244). I am glad to take this opportunity of expressing my thanks to the various Captains and other officers concerned.

The greatest number of telegrams received from any one vessel was 94, from the ss. Badarpur. H.M.S. Vindictive sent 65, and others from which over 30 were received were H.M.S. Folkestone, the ss. Aungban, Streefkerk, Jalapalaka, Marnix van St. Aldegonde, and Derfflinger.

The total number of ships' telegrams received was 2,235, an increase of 60 per cent. over the number for last year.

Acknowledgements have been sent in all cases, but not all of these have reached the addressee —some have been returned after redirection had failed to keep up with the movements of the ship.

Rain Gauges and Volunteer Observers.—Rainfall figures appear in this report from 390 stations. These include the stations that report daily, at which the observers receive an allowance, but the great majority of them are maintained voluntarily, and I am glad to take this opportunity of thanking all who have co-operated in this work.

The new stations started during the year include three under the Irrigation Department, one each under the Public Works Department, Railway, and Department of Agriculture, and two on estates, Pilacholai (Mr. J. R. C. Backhouse) and Dikmukalana (Mr. A. M. Cheyne).

While it is not possible to mention all the voluntary helpers individually, I wish to put in a special word of thanks to some of those who have done a great deal more than supply monthly summaries of their daily rainfall figures. Among these is Mr. R. G. Coombe of Poonagalla, who has contributed barograms weekly. In this connection I must express my deep regret at the death during the year of Mr. J. A. Coombe of Poonagalla, who had given us barograms, temperature and rainfall readings, and weather notes for several years past. Others who have helped considerably are Mr. E. E. Megget (Detanagalla), Mr. Ross Wyllie (Oakwell), Mr. Pearson (Horakelle), with sunshine charts ; Mr. A. C. Tutein-Nolthenius (West Haputale) with anemometer figures and charts ; Messrs. H. A. B. Webb and C. K. Graves (Hope) with anemometer figures ; Mr. G. Huntley (Vincit) and Messrs. H. F. Dalton, R. K. Lowry, and J. A. Mudge (Theydon Bois), with climatological notes, Mr. G. Van Rooyen (Bandarawela) and Mr. C. Erskine (Ben Hope) with telegrams and post cards concerning heavy rain.

Daily figures have been received from three estate gauges, and published in the daily reports, in addition to those from observers in Government service. In this connection I am indebted to the various Superintendents concerned, namely, Mr. H. A. McLaren (Geekiyanakanda), Mr. S. B. Dias (Upper St. Martin's), and Messrs. M. P. Fraser, W. S. Roper, and Rawdon Payne (Panilkande).

I also wish to make a special acknowledgement of the help given by a number of gentlemen in or near the Kelani Valley, who were kind enough to dispatch telegrams regarding heavy rain, in connection with the question of flood warnings. Among the senders of such telegrams, I may mention Mr. R. A. Shaw (Ingoya), Mr. H. C. Rowbotham (Yataderiya), and Mr. J. A. Tate (Dunedin).

Here again, it is impossible to thank everyone by name, and in mentioning the above, I emphasize that the list is not exhaustive, and that I wish to express my thanks to all who have co-operated in this work.

Co-operation with Indian Meteorological Department.—Telegrams from Colombo, Trincomalee, Hambantota, and Nuwara Eliya are sent to India at 8 A.M. as a matter of routine, while extra storm warning telegrams are also sent from the three coast stations at various times, when asked for by the Indian Meteorological Department. The numbers of storm-warning telegrams sent in 1931 to Poona were :—Colombo, 37 ; Trincomalee, 13 ; Hambantota, 16 ; Nuwara Eliya, 13 ; and to Calcutta :—Colombo, 49 ; Trincomalee, 100 ; Hambantota, 95.

The results of the morning pilot balloon flight were telegraphed to Poona throughout the year, and to Calcutta at certain seasons. In addition, afternoon flights were wired when required, and telegrams were also sent whenever the general appearance of the morning synoptic chart showed anything worthy of such treatment.

The weather messages received from shipping were also forwarded to India, by wire if required, or if anything unusual was noted in them.

By the courtesy of the Director-General of Observatories, India, copies of all broadcasts sent by him to the Navy Wireless Station at Matara were also delivered to the Colombo Observatory. In addition, copies of the daily morning telegram from Pamban were also sent here during the north-east monsoon and inter-monsoon periods, and proved of considerable value, owing to the way in which strong wind often blows down the Gulf of Mannar, and so produces distinctly rougher weather between Colombo and Cape Comorin than is indicated by the shore readings at Colombo alone.

Upper Air Work.—Rubber pilot balloons were in use throughout the year, the tail method of observation being used. The balloons maintained the standard of quality of those received in 1930. This, although a marked improvement on the standard of 1929, still leaves something to be desired, and, towards the close of the year, the experiment was started of sending out each monthly consignment of balloons from England in two parts, half by ordinary post, and half by special stowage (in cold storage aboard ship), and comparing their behaviour afterwards. These tests seem to indicate that the method of transit has no marked effect on the subsequent behaviour of the balloons, and that deterioration in transit cannot therefore be invoked as the cause of the poor quality of so many of the balloons received during the past few years.

The total number of flights was 585, or 55 more than last year. The normal procedure of two flights a day on working days was carried out during the year, though for special reasons (*e.g.*, on international days) more might be sent up.

Requests, in English, Sinhalese, and Tamil, that the finder would return the tail, were attached during the south-west monsoon. Sixty-two tails were returned, which represents over 23 per cent. of the number of tails to which the request was attached. This proportion is distinctly higher than last year.

The total number of flights in which the balloon was followed to a height of at least 5 kilometres was 138. Of these, 64 were followed to at least 7 kilometres, including 17 followed to at least 10 kilometres. The highest observed altitude was 15.3 kilometres, in February. Nearly all these high flights were in the first four months of the year. The numbers of high flights in the last three months of 1931 were very much below average, partly owing to defective balloons, and partly to the unusual weather conditions of December.

Vertical Temperature Gradient.—The four thermographs at the Welikada Wireless Station have been in continuous operation during the year, except from January 19 to February 17, when the wireless mast on which three of them are hoisted was being overhauled.

Special Investigations.—

(*a*) Temperature of Rainfall.—These measurements were discontinued towards the end of the year.

(*b*) Rain Gauge Comparison Experiments.—These were continued during the year.

(*c*) Refraction Experiments.—Observations of the apparent altitude of the top of one of the wireless masts, by means of a converted Coudé transit telescope, were continued till August. These observations were used, together with the thermograms at various heights above the ground at Welikada, by Mr. Bamford, for an analysis of the structure of the atmosphere near the surface of the earth.

Seasonal Correlation.—The indications as to the strength of the monsoon rains, given by pre-monsoon local thunderstorms, were not very definite this year. The rainfall of March was generally deficient, while, on the other hand, thunderstorm activity was exceedingly well marked in April, and the rainfall over the greater part of the Island was above average. Pre-monsoon temperatures were distinctly above average, an indication which pointed to excess of monsoon rainfall (see Appendix, Observatory Report, 1927, page 9). The testimony was too conflicting for a forecast to be ventured, but the balance of evidence was slightly in favour of the excess that actually occurred (see plate 4).

Publications.

The present report is on the same lines as its predecessors, and gives among other information rainfall figures from 390 stations. The latter part of it includes the tables that also appear in the Ceylon Blue Book. The chief change this year is the inclusion of a new table (Table XIX.), giving statistics of drought, according to the standard definitions adopted in "British Rainfall," for certain selected stations. Another change is the use of the short-period screen temperature observations, instead of the longer series of observations corrected to screen values, for temperature averages. Temperature variations are so small in Ceylon that very few years will give fairly satisfactory means.

Routine publications have been similar to those of last year, and included daily reports in the "Post Office Daily List" and newspapers, and monthly summaries in the *Government Gazette* and Tropical Agriculturist.

It must be remembered that a good many observations are made here which are not published in the report and Blue Book, owing to exigencies of space and the expense of printing. Among these may be mentioned measurements of amount of cloud, surface and underground temperatures, evaporation, &c. Information on these points can be obtained on application to the Observatory.

Other publications include.—"Colombo Observatory" by Mr. Bamford, in the 25th anniversary number of the Transactions of the Engineering Association of Ceylon; "The South-west Monsoon Drought of 1929 over Ceylon," by Mr. Jameson, in the Meteorological Magazine, and "Temperature Observations on Adam's Peak, Ceylon," by Mr. Jameson, in the Quarterly Journal of the Royal Meteorological Society. Mr. Bamford also read a paper on "The Adaptation of Standard Types of Measuring Instruments for use in Ceylon" at the annual meeting of the Engineering Association in August.

As in previous years, publications have been received from a number of observatories and other organizations. While their receipt has been acknowledged individually by letter, I am glad to take this opportunity of thanking the donors collectively.

Seismograph.

The Milne Shaw seismograph was in use throughout the year. The boom point was changed on December 4, but, except for this, only minor adjustments were required. There were a few stoppages on account of trouble with the clocks, but none of these were protracted.

The coupling was maintained at the 250 magnification throughout, and measurements of period, damping ratio, and sensitivity were made at least once a month.

The free period slowly decreased from 12.1 seconds in January to 11.5 seconds in June, when it was adjusted to 12 again, and remained near that value till the boom point was changed, upon which it decreased to 11.7 seconds.

Measurements of the damping ratio varied from 1 in 16 to 1 in 22. It was occasionally adjusted to a mean value of 1 in 20.

The sensitivity was usually a little over 60 mm. per second of arc, the extreme values, until December 4, being 57 and 68. However, when the boom point was changed, it dropped to 49.

The list below, of 113 earthquakes, is restricted to definite shocks, and contains no reference to a large number of small traces that were also recorded. The regular diurnal movement of the pillar is still a definite feature of the records.

All times are in Greenwich Mean Time.

No.	Date 1931.	P	S	L	Maximum.	End.	Amplitude.	Remarks.
	January	H M S	H M S	H M S	H M S	H M	MM	
1508..	2	.. 0 0 34..	—	—	.. 0 19 24..	1 03½..	0.6..	—
1509..	2	..10 09 08..Elusive	..10 56 13..		11 26 05..	13 13½..	1.6..	—
1510..	12	..20 56 18..	—	—	..21 26 13..	22 10 ..	0.5..	—
1511..	15	.. 2 10 39..Elusive	.. 2 41 25..		3 17 05..	6 05½..	20.0..	—
1512..	15	..21 11 29..	—	—	..21 35 02..	22 37 ..	0.7..	—
1513..	15-16	..22 53 37..23 02 17..	23 14 27..		23 26 27..	0 43½..	1.3..	—
1514..	16	..20 24 50..	—	—	..20 55 57..	21 39½..	1.0..	—
1515..	17	.. 3 10 04..	—	—	.. 4 21 55..	5 25½..	1.4..	—
1516..	18	..13 18 02..	—	—	..13 28 20..	14 12½..	0.9..	—
1517..	19	..12 32 51..12 39 56..	12 48 56..		12 54 06..	13 35 ..	1.7..	—
1518..	20	eP 9 34 05.. 9 43 49..	9 45 44..		9 48 37..	10 48 ..	1.0..	—
		iP 9 39 53						
1519..	20	..15 30 46..15 34 26..	15 36 23..		15 39 30..	16 19½..	1.2..	—
1520..	20–21	..23 55 47..	—	—	.. 0 09 53..	1 19½..	0.9..	—
1521..	24	..17 43 —..	—	—	..17 58 —..	19 06 ..	1.0..	Times are given approximately to the nearest minutes, as the time marking device had failed
1522..	27	..20 14 34..20 19 09..	20 25 39..		20 26 37..	23 51½..	50.7..	—
1523..	29	..21 34 44..21 43 18..	21 51 10..		21 58 20..	lost ..	3.1..	—
	February							
1524..	2–3	..23 04 34..23 14 27..	23 37 09..		23 44 49..	02 53½..	22.5..	—
1525..	8	..02 01 38..02 11 36..	02 31 53..		02 37 32..	03 34 ..	0.6..	—
1526..	10	..01 28 20..01 32 40..	01 39 05..		01 43 20..	02 47 ..	1.9..	—
1527..	10	..06 40 02..06 44 20..	06 52 02..		06 53 00..	10 40½..	26.7..	—
1528..	11	..17 45 04..	—	—	..18 00 19..	18 28 ..	0.5..	—
1529..	12	..05 49 34..05 54 14..	05 57 19..		05 59 25..	07 42½..	6.5..	—
1530..	13	.. — ..	—	—	..02 08 47..	02 21 17..	05 23 ..	12.0.. P and S lost owing to the light spot having been off the sheet. Even at the the maximum phase the trace is not fully on the sheet
1531..	13	..22 22 18..	—	—	..22 26 18..	23 04½..	0.5..	P probably earlier
1532..	14	..14 04 25..14 08 35..	14 11 50..		14 14 15..	16 25 ..	11.2..	—
1533..	16	..19 17 56..	—	—	..19 35 03..	20 09½..	0.9..	—
1534..	18	..19 28 53..	—	—	..19 42 02..	20 06 ..	0.5..	—
1535..	19	..17 46 03..17 50 14..	17 51 18..		17 54 48..	21 12 ..	8.5..	—
1536..	20	..05 43 04..05 50 52..	05 58 37..		05 58 56..	07 38½..	4.0..	—
1537..	22	..21 36 06..	—	—	..21 56 33..	22 39 ..	0.5..	—

No.	Date 1931.	P	S	L	Maximum.	End.	Amplitude.	Remarks.
		H M S	H M S	H M S	H M S	H M	MM	
	February							
1538..	24	..17 39 28..	— ..	—	..17 53 35..	18 27 ..	0.7..	—
1539..	27	..09 46 06..	09 52 51..	10 01 51..	10 06 11..	11 50½..	3.0..	—
	March							
1540..	2	..02 31 41..	02 42 09..	02 49 06..	03 11 39..	04 59½..	1.3..	—
1541..	5	..17 58 55..	— ..	18 03 17..	18 05 31..	19 30 ..	2.6..	—
1542..	7	.. — ..	— ..	—	..00 55 33..	02 48 ..	0.5..	P is probably lost in the interval for changing sheet
1543..	7	..10 13 04..	— ..	—	..10 23 25..	11 45½..	1.1..	—
1544..	8	..02 00 33	.02 08 48..	02 24 00..	02 28 58..	04 24½..	2.7..	—
1545..	9	..03 59 32..	04 08 12..	04 16 17..	04 29 17..	07 56½..	21.0..	—
1546..	11	..06 14 55..	06 18 42..	06 25 49..	06 26 24..	06 50½..	0.8..	—
1547..	11	..12 37 11..	12 45 43..	12 57 36..	13 04 18..	14 22 ..	1.5..	—
1548..	12	..10 51 04..	11 00 06..	—	..11 21 04..	12 13 ..	0.8..	—
1549..	18	..08 21 48	Indeterminate	09 02 48..	09 25 33..	11 19 ..	4.7..	—
1550..	18	..20 22 02..	20 28 57..	20 36 47..	20 41 15..	23 14½..	2.4..	—
1551..	19	..06 32 49..	06 38 59..	06 45 07..	06 49 34..	lost ..	3.5..	—
1552..	28	..12 47 35..	12 54 57..	13 03 41..	13 12 55..	15 59½..	5.5..	—
	April							
1553..	3	..21 54 18..	— ..	—	..22 21 25..	22 59 ..	0.6..	—
1554..	3–4	..23 39 18..	23 41 43..	23 48 30..	23 50 33..	01 10 ..	0.7..	—
1555..	6	..07 01 31..	07 11 11..	07 37 04..	07 38 13..	09 55½..	1.1..	—
1556..	9–10	..23 15 23..	—	..23 36 18..	23 50 30..	00 37½..	0.7..	—
1557..	12	..02 16 18..	—	..02 46 48..	02 52 08..	04 01½..	1.2..	—
1558..	16	..12 05 03..	— ..	—	..12 21 18..	12 57 ..	0.4..	—
1559..	24	..17 34 04..	17 43 48..	18 08 48..	18 10 58..	20 51½..	1.6..	—
1560..	27	..16 58 36..	17 05 38..	17 13 48..	17 21 06..	19 00½..	2.2..	—
	May							
1561..	6	..15 34 13..	— ..	—	..16 02 03..	16 30 ..	0.9..	—
1562..	13	..07 48 —..	— ..	—	..08 05 —..	09 30 ..	0.8..	Times are to the nearest minutes only, as the time marking device had failed
1563..	20	..02 35 51..	02 46 56..	03 09 58..	03 19 43..	06 11 ..	5.5..	—
1564..	20	..22 13 36..	— ..	—	..23 15 06..	00 03½..	0.7..	—
1565..	24	..lost	.. — ..	—	..00 42 08..	01 20½..	0.8..	P probably lost in the interval of changing sheets
	June							
1566..	4	.. 9 59 05..	10 06 35..	10 17 20..	10 21 58..	11 01½..	0.4..	—
1567..	9	..16 23 49..	— ..	—	..17 15 22..	18 27½..	1.0..	—
1568..	18	..13 03 49..	13 08 13..	13 11 29..	13 13 26..	14 01 ..	1.8..	—
1569..	23	.. 6 18 25..	— ..	—	.. 6 55 42..	8 01½..	0.5..	—
	July							
1570..	12	..16 53 33..	17 00 04..	17 09 15..	17 14 18..	18 22 ..	3.5..	—
1571..	15	..15 47 38..	—	..16 07 05..	16 16 22..	17 01½..	1.1..	—
1572..	18	..11 35 49..	11 45 49..	12 02 17..	12 12 25..	13 37 ..	0.6..	—
1573..	21	..03 49 51..	03 59 43..	—	Not pronounced	05 15 ..	0.5..	—
1574..	23	..14 32 15..	14 41 28..	—	.. do.	..15 50½..	0.5..	—
1575..	28–29	..23 31 20..	— ..	—	..23 39 02..	00 06 ..	0.5..	—
	August							
1576..	7	..02 22 10..	Between 02 29 58 and 02 30 28	..02 35 08..	02 46 48..	05 40 ..	6.5..	S had taken place during the hour mark which is of 30 secs duration
1577..	8	..01 02 49..	— ..	—	..01 11 34..	01 58 ..	0.9..	—
1578..	8	..04 11 01..	— ..	—	..04 19 41..	05 06½..	0.9..	—
1579..	10–11	..21 26 25..	21 33 —..	21 39½—..	Between 21 40 — and 21 47 —	02 01½..	>130..	Times of the phases except P are given to the nearest half minute as the trace is faint owing to fast movement of the light spot
1580..	13	..22 36 32..	— ..	—	..23 09 53..	23 53 ..	0.6..	—
1581..	16	..12 10 19..	— ..	—	..12 57 35..	14 00 ..	0.8..	—
1582..	18	..14 28 35..	14 35 02..	14 44 50..	14 47 10..	17 48 ..	21.9..	—
1583..	24–25	..21 40 58..	21 45 48..	21 49 48..	21 53 03..	01 27 ..	61.0..	—
1584..	25	..03 16 25..	— ..	—	..03 23 43..	03 47 ..	1.9..	—
1585..	25	..19 02 56..	— ..	—	..19 10 13..	19 39 ..	0.7..	—
1586..	26	..19 39 48..	— ..	—	..19 48 18..	20 23 ..	0.7..	—
1587..	27	..15 32 50..	15 37 35..	15 45 40..	15 48 20..	19 41½..	70.5..	—
1588..	28	..00 47 50..	00 52 20..	00 58 20..	00 59 35..	01 30 ..	1.4..	—
1589..	28	..19 49 19..	— ..	—	..19 59 04..	20 27½..	0.7..	—
	September							
1590..	6	..14 43 29..	14 46 07..	14 48 04..	14 48 19..	15 16½..	1.0..	—
1591..	8	..19 27 48..	— ..	—	..19 54 40..	20 21½..	0.4..	—
1592..	9	..20 48 49..	20 57 19..	21 03 04..	21 11 21..	lost ..	1.4..	—
1593..	21	..02 28 59..	02 38 44..	02 49 49..	03 00 24..	05 12 ..	2.0..	—
1594..	21	..10 33 19..	10 39 39..	10 48 47..	10 51 49..	12 58 ..	3.4..	—
1595..	25	..06 05 21..	06 10 —..	06 17 —..	06 19 —..	10 05½..	77..	Times of phases S, L, and M are given to the nearest half minute as the trace is faint owing to the fast movement of the light spot. Amplitude given approximately to the nearest mm.
1596..	26	..20 23 33..	— ..	—	..21 44 08..	22 43½..	0.6..	—

No.	Date 1931.	P			S			L			Maximum.			End.		Amplitude.	Remarks.
		H	M	S	H	M	S	H	M	S	H	M	S	H	M	MM	
	September																
1597..	28	..17	24	19..	17	28	41..	17	31	01..	17	35	17..	18	29½..	1.0..	—
1598..	29	..05	21	51..	05	29	46..	05	38	31..	05	44	33..	06	11½..	0.6..	—
1599..	30	..11	18	30..	11	24	57..	11	31	52..	11	35	05..	12	17 ..	0.9..	—
	October																
1600..	3	..10	40	37..	—		..	—			..10	51	56..	11	12½..	1.0..	—
1601..	3–4	..19	25	50..	19	36	20..	19	54	08..	20	08	32..	03	19 ..	14.0..	—
1602..	5	..04	54	31..	04	58	54..	05	00	59..	05	04	24..	05	55½..	0.4..	—
1603..	5–6	..22	37	25..	22	42	10..	—			..22	49	25..	00	10 ..	2.3..	Change of phase from S to L not well defined
1604..	9	..06	08	15..	—		..	—			$M_1$06	14	57..	07	26 ..	1.6..	—
											$M_2$06	18	02..	—		1.6	—
1605..	10	..	—		..00	42	21..	00	54	42..	01	03	49..	06	13 ..	8.5..	P lost in the interval for changing sheet and it must have begun certainly after 00 31 19
1606..	10	..16	56	19..	17	05	24..	17	18	34..	17	26	34..	18	30 ..	1.4..	—
1607..	18	..00	39	00..	—		..	—			..01	34	08..	02	50½..	0.7..	—
1608..	18	..04	43	20..	—		..	—			..05	05	38..	06	06 ..	0.7..	—
1609..	28	..05	41	59..	05	49	19..	05	56	11..	06	00	37..	07	10 ..	1.0..	—
	November																
1610..	1	..19	02	19..	—		..	—			..19	27	19..	20	09½..	0.7..	—
1611..	2	..00	53	56..	—		..	—			..02	06	54..	03	21½..	0.9..	—
1612..	2	..10	12	27..	10	20	08..	10	29	58	$M_1$10	36	55..	14	13½..	23.2..	—
											$M_2$10	39	10..	—		23.2 .	—
1613..	2	..17	14	05..	17	22	55..	17	37	50..	17	48	20..	19	43½..	1.1..	—
1614..	5	..12	33	24..	12	37	32..	12	42	22..	12	45	38..	14	01½..	4.0..	—
1615..	20	..14	28	57..	14	39	15..	14	50	20..	15	05	45..	17	02½..	2.0..	—
	December																
1616..	11	..14	27	58..	—		..	—			..14	31	41..	14	50 ..	0.5..	—
1617..	18	..09	54	49..	09	59	29..	10	01	13..	10	07	33..	12	39½..	4.5..	—
1618..	25	..03	16	43..	—		..	—			..03	42	51..	04	35½..	0.5..	—
1619..	29	..16	44	05..	—		..	—			..16	55	42..	18	01 ..	0.5..	—
1620..	31	..00	29	19..	—		..	—			..lost			..02	33½..	—	..Maximum lost in the interval for changing sheets

Weather Summary, 1931.

January.—The rainfall this month was on the whole above average, though small deficits were frequent on the western side. Excess of rainfall was most marked in the east and the extreme south of the Island, and on the eastern side of the hills. The heaviest rain occurred near the middle of the month, when a large number of falls of over 5 inches in a day were reported, while very little rain fell anywhere during the last week.

February.—The rainfall was mainly in deficit, a large majority of the rain-gauge stations north of a line between Puttalam and Trincomalee reporting no rain at all during the month. A few places, however, on the north-eastern slopes of the hills, and on the east coast south of Batticaloa, showed distinct excess. Both day and night temperatures were generally distinctly above normal.

March.—At the great majority of stations the rainfall of March was deficient, the effect being more marked as it came after a dry February. Such rain as did occur fell chiefly between the 5th and 14th, and was largely of the local thunderstorm type. A large number of stations in the north of the Island reported no rain at all during the month. Temperatures continued almost everywhere above average.

April.—Thunderstorm activity was very well marked in April. The accompanying rain was above average over the greater part of the Island, though deficits predominated near the west coast. Excess of rain was particularly well marked along the southern limits of the main hill country, the chief contribution to this being a heavy storm on the 14th, when Haputale rain-gauge stations recorded over 9 inches, and other stations in these districts reported falls almost as heavy.

The highest total for the month was 35·4 inches at West Haputale. This figure is a record for any one month at that station, while at most places in the neighbourhood, the month's total is the highest April total on record. In the case of Diyatalawa, where figures for 31 years are available, it is 67 per cent. in excess of the next wettest April.

A squall at Colombo on the 27th reached a velocity of 69 miles per hour at the Pilot Station. In the Fort, however, the velocity was much less, while at the Observatory it was under 30 miles per hour.

May.—The rainfall of May was generally below average, deficits being most marked on the western side of the hills. The chief areas in which the average was passed were in the north-east and the extreme south-west of the Island, and a few districts south of Batticaloa. In the first half of the month such rain as occurred was largely of the thunderstorm type. The third week there was comparatively little rain, but in the last week it was fairly general over the south-west quarter of the Island. On the west coast there was less monsoonal activity than usual during the greater part of the month, but some vigorous squalls from the 26th onwards.

June.—The pressure gradient was steeper than usual in June, and rainfall was above average at most of the stations in the south-west of the Island. Excess of rain was most marked on the western slopes of the hills. The highest total was at Theydon Bois (56·67 inches), while several other stations recorded over 50 inches. Nearly all stations in the north and east of the Island were in deficit, a large number of these stations, particularly in the north, reporting no rain at all.

A very interesting feature of the month was the typically monsoon distribution of the rain. Despite the large totals, no station reported over 5 inches in a day. A natural concomitant of the steep gradient was strong wind, which manifested itself on the west coast in a series of squalls, while particularly heavy wind was reported from up-country, especially about the 6th and 20th.

July.—Rainfall was well above average in the low-country to the west and south-west of the hills. On their western slopes, however, it was considerably in deficit. Elsewhere in the Island offsets from average were generally small, deficits on the whole predominating. Many stations in the north-west of the Island, in the Jaffna peninsula, and on the north-eastern slopes of the hills, reported no rain at all during the month.

August.—The rainfall of August was above average over the whole of the south-west quarter of the Island. It was particularly heavy on the western slopes of the hills, where all the stations were at least 10 inches above average, and some over 30 inches above. The rainfall totals for this month were the heaviest August totals on record for a large majority of the rain-gauge stations in the south-western areas of Ceylon. The highest total was at Watawala, 61·55 inches, but several stations recorded over 50 inches.

The rain was essentially of monsoon type and continuous throughout the month, many stations reporting rain on every day. Only one fall of as much as 6 inches in a day, and only ten of over 5 inches, were reported.

Deficits were amost universal over the rest of the Island, most of the stations in the north reporting no rain at all.

September.—The rainfall of September was below average over almost the whole Island. Deficits, though general, were usually not numerically great. Only a few stations in the north failed to record any rain at all ; in several areas, however (*e.g.*, Mannar), the cumulative effect of several months in deficit became marked.

October.—The rainfall was again below average over the greater part of the Island. Deficits were most marked in the low-country to the west of the hills, where several stations were over 15 inches below normal.

The only appreciable area in which the rainfall was above average was included in the districts lying between Mannar and Dambulla.

The deficit was most marked in the first half of the month. In the latter part two depressions in the Bay came near enough to affect both the velocity and direction of the wind. Their effect on the rainfall, though recognizable, was not intense, the bulk of the rain during the month being of the thunderstorm type.

November.—The rainfall this month was generally above normal, most markedly so in the Uva plateau and some neighbouring districts, where excesses up to 28 inches were reported. In and near the hill-country, and in the north-west corner of the Island excesses up to 10 inches were fairly common, but elsewhere they were generally much smaller, while occasional districts reported deficits particularly near the north-east coast, the extreme south, and near Kurunegala and Puttalam.

The highest monthly total was at Hakgala, 39·56 inches. Local thunderstorms were well developed throughout the month, and account for most of the rainfall, though some heavy rain in the north and east of the Island was probably better classified as monsoonal, due to the coming in of the incipient north-east monsoon.

December.—The rainfall of December was almost everywhere above normal. The excess was most marked in the north, where many stations were over 15 inches above average, and nearly all over 10, and on the northern and eastern flanks of the hills, where excesses between 10 and 20 inches were also found. The highest monthly totals reported were 41·66 inches at Dooroomadella, and 40·96 inches at Delft, while several stations reported over 30 inches.

The Island came under the influence of two depressions during the month, both of which formed to the south-east of Ceylon, and crossed the Island. The first passed over on the 9th giving heavy rain between the 7th and 10th. The second crossed the north of the Island on the 22nd to 23rd, developing into a storm with unusually strong winds, which did considerable damage, particularly at Trincomalee and Mannar. It also caused very heavy rainfall in the north of the Island, daily rainfalls of 14·20 inches at Jaffna Farm School, 12·97 inches at Talaimannar, and 11·12 inches at Jaffna Observatory being reported.

Local thunderstorms were also well developed during the month.

Year.—At practically all stations the totals for the year were above average, but, on the whole, not markedly so.

H. JAMESON, M.Sc., F.Inst.P.,
Superintendent.

Colombo, June 14, 1932.

Return of Rainfall in Ceylon during 1931, and the Means during different Periods.

Station and Abbreviation used on Maps.	Height above mean Sea Level.	Year.	Jan.		Feb.		March.		April.		May.		June.		July.		August.		Sept.		Oct.		Nov.		Dec		Total for the Year.		Greatest Quantity registered in any 24 hours.	
			Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	In hes.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Dates.
	Feet.																													
Alagalla (Al.) ..	1,062	1931 ..	7·15	8	0·30	1	6·14	6	21·21	18	7·55	11	14·53	24	7·36	19	18·94	26	5·67	14	11·70	9	13·46	17	12·33	17	126·34	170	4·05	Dec. 13 to 14.
		means during 21 years ..	6·02	9	2·02	2	6·00	7	9·50	12	9·38	10	11·37	17	7·43	12	6·01	10	8·07	11	15·69	16	12·76	15	9·17	10	103·42	130	9·82	June 24 to 25, 1911.
Allai Tank ..	20	1931 ..	20·97	4	2·40	5	0·00	0	3·35	5	0·92	4	0·00	0	2·70	6	0·00	0	0·40	4	4·32	6	13·04	19	17·35	22	65·45	85	4·80	Jan. 17 to 18.
		means during 56 years ..	8·92	9	2·48	3	2·27	3	2·02	4	2·93	4	1·33	1	1·75	2	4·16	4	4·45	5	8·97	11	15·75	15	18·10	15	73·13	77	9·11	Nov. 17 to 18, 1906.
Alutnuwara ..	300	1931 ..	25·51	18	4·59	7	2·99	2	11·74	10	2·00	2	0·00	0	0·00	0	0·00	0	2·62	2	8·56	7	19·93	13	27·37	17	105·31	78	4·50	April 23 to 24.
		means during 32 years ..	15·79	14	5·18	7	5·15	7	5·18	9	2·85	5	0·56	2	1·17	2	1·94	3	2·86	5	11·78	15	14·04	16	16·78	17	83·28	103	9·92	Jan. 17 to 18, 1913.
Ambalantota ..	15	1931 ..	5·74	9	0·38	2	0·45	1	9·20	13	1·54	8	5·33	19	1·18	8	4·78	14	1·71	8	2·49	6	5·76	18	9·09	15	47·65	121	3·88	April 23 to 24.
		means during 10 years ..	3·92	6	1·35	3	4·44	7	3·66	6	4·22	7	3·09	9	2·11	5	1·20	6	3·38	8	4·48	9	8·42	13	5·83	9	46·11	87	5·27	Nov. 4 to 5, 1929.
Ambanpitiya (Am.) ..	663	1931 ..	5·97	6	0·80	4	6·10	7	15·28	19	6·19	15	16·20	27	9·68	26	16·70	27	6·31	20	7·10	12	17·58	20	11·61	15	119·52	198	2·90	April 5 to 6.
		means during 60 years ..	3·49	6	2·61	4	6·81	10	10·79	15	10·71	15	12·88	20	8·23	17	6·70	16	8·58	16	17·46	21	13·78	17	7·27	11	109·33	168	16·65	Aug. 7 to 8, 1886.
Ambepussa ..	—	1931 ..	8·69	9	0·62	4	6·79	6	7·95	19	6·57	17	13·20	28	11·72	26	13·14	27	4·52	19	10·28	15	14·30	21	8·47	17	106·25	208	4·72	Jan. 17 to 18.
		means during 4 years ..	6·97	9	2·48	5	7·01	8	15·17	19	11·77	18	10·33	24	7·18	19	5·66	17	6·36	19	18·47	22	15·79	23	6·02	12	113·20	193	5·87	May 6 to 7, 1930.
Amparai Tank ..	90	1931 ..	19·27	17	7·25	9	1·21	6	4·04	8	7·31	8	0·18	1	1·91	5	2·12	4	2·20	6	4·03	11	16·62	20	19·40	22	85·54	117	5·10	Jan. 14 to 15.
		means during 56 years ..	14·50	12	4·79	5	3·41	5	3·21	6	3·87	5	2·08	3	1·87	3	2·87	5	4·16	6	8·63	12	12·50	14	17·87	15	79·77	92	19·20	Dec. 7 to 8, 1881.
Andankulam Tank, Trincomalee	40	1931 ..	20·29	11	2·01	3	0·73	2	3·16	5	2·37	3	0·00	0	5·08	6	0·15	1	2·07	4	7·20	9	14·29	18	18·83	23	76·18	85	6·03	Jan. 17 to 18.
		means during 41 years ..	8·69	10	1·89	3	1·72	3	1·90	4	2·55	3	0·83	1	1·94	3	3·24	5	3·73	6	7·52	11	15·26	16	15·60	15	64·88	80	13·30	Nov. 18 to 19, 1904.
Angoda Lunatic Asylum	—	1931 ..	5·73	7	3·26	4	1·79	8	6·47	12	23·04	20	10·36	25	14·29	17	11·99	20	6·30	18	7·14	9	10·89	16	9·02	16	110·28	172	9·69	May 3 to 4.
		means during 2 years ..	—	—	—	—	—	—	9·80	13	26·81	22	13·14	24	7·53	13	7·61	15	6·67	19	21·12	18	13·57	16	4·73	9	—	—	9·69	May 3 to 4, 1931.
Annfield Estate, Dikoya (An.)	4,300	1931 ..	4·74	11	1·15	6	7·67	12	11·06	20	4·28	12	21·72	28	5·75	26	28·75	31	12·56	22	6·94	14	15·16	24	8·94	21	128·72	227	3·06	Sept. 21 to 22.
		means during 44 years ..	4·01	10	2·20	6	6·30	12	9·37	18	8·90	17	16·34	25	15·04	26	11·63	23	10·76	21	12·60	22	9·71	18	6·11	13	112·95	210	8·79	Oct. 4 to 5, 1913.
Anningkanda Estate, Deniyaya	1,550	1931 ..	11·06	17	4·30	9	7·91	15	16·88	26	11·01	24	24·94	27	6·83	25	16·90	28	9·92	22	7·66	18	23·13	28	21·80	23	162·34	262	3·80	May 25 to 26.
		means during 54 years ..	8·94	14	7·24	10	10·81	16	12·82	18	12·62	18	13·24	22	9·03	18	7·96	17	10·87	17	15·99	21	17·53	21	13·66	19	140·70	211	7·56	Oct. 27 to 28, 1906.
Anuradhapura — Survey Office	295	1931 ..	8·32	13	0·00	0	1·39	3	10·35	12	5·05	7	0·22	2	0·05	1	0·10	2	1·72	4	13·26	11	11·98	22	18·35	21	70·79	98	3·00	Oct. 21 to 22.
		means during 62 years ..	4·02	9	1·53	4	2·94	7	6·82	13	3·45	7	1·24	4	1·27	3	1·66	4	3·16	6	9·66	16	10·70	18	8·67	16	55·11	105	9·32	Dec. 20 to 21, 1891.
Anuradhapura — Experiment Station	295	1931 ..	8·55	11	0·00	0	1·06	1	8·82	14	6·25	5	0.00	0	0·00	0	0·00	0	1·53	4	11·40	8	12·16	20	20·29	14	70·06	77	4·18	Oct. 22 to 23.
		means during 8–9 years ..	6·77	9	1·32	3	4·74	7	5·75	10	4·18	6	0·17	1	0·95	1	0·82	2	5·13	5	8·38	12	11·03	15	8·48	11	57·72	82	7·56	Dec. 27 to 28, 1928.