1928



# THE COLOMBO OBSERVATORY.

## REPORT OF THE SUPERINTENDENT OF THE OBSERVATORY.

*Staff.*—Mr. H. Jameson, M.Sc., Assistant Astronomer, was on leave from March 28 to October 27. During his absence Mr. D. T. E. Dassanayake, B.Sc., Senior Technical Assistant, acted as Assistant Astronomer.

In the clerical staff there were three changes. One member was transferred to the Head Office of the Department and two left to take up appointments under the Public Analyst and Director of Medical and Sanitary Services respectively. Their places were filled by transfers from Head Office.

Overseer D. Gregory Perera retired on June 14, after 36 years in the Department, of which the last 17 were spent in the Observatory.

*Buildings.*—The new workshop and laboratory were completed and taken into regular use from June.

Considerable difficulty has been experienced from overcrowding of the main building. One of the iron sheds has now had a ceiling inserted and has been converted into a record room, pending the building of a more permanent library.

### Astronomical Equipment and Work.

The main instruments have been unchanged. The Cooke transit (4-inch object glass with travelling micrometer) and the Borrel chronograph have continued to be in use for clock stars. The number of star transits observed was 1,016, which is less than in the previous year, when extra observations were being made for longitude comparisons. These comparisons have been maintained, but it has been found necessary to restrict the amount of time spent on them.

Fournier sidereal clock No. 72 has been the chief ratekeeper. It was stopped for cleaning on October 18, when a new cord was inserted. Dent No. 45,082 was rehung on June 12, after new parts had been obtained, and the movement of Fournier No. 70 returned to its normal duties as a sidereal clock after a very creditable period of action as a mean time clock in conjunction with the pendulum of Dent.

The Cooke mean time clock continued to work satisfactorily in sending out the wireless signals.

The synchronome master clock continued to work well in controlling the office dials and calibrating the seismograph.

The chronometers left at the Observatory again included those of H.M.S. Cyclamen and H.M.S. Lupin.

*Time Ball and Synchronization.*—The Time Ball at the Master Attendant's Office was dropped, as before, at 9 A.M., 1 P.M., and 4 P.M. Ceylon standard time (3.30, 7.30, and 10.30 Greenwich mean time) on ordinary week days, and at 9 A.M. only on Sundays and public holidays. During the year there were 945 successful signals and 9 failures, or less than one per cent. None of the failures were due to causes over which the Observatory had any control, and eight of them appear to have been due to trouble on the line (5 disconnections and 3 reversals).

Synchronizing signals were sent at 7.55 A.M. and 3.55 P.M. on ordinary week days to the Central Telegraph Office, and a signal was sent at 8.54 A.M. on Sundays and Post Office holidays. During the greater part of the year these signals also actuated the relays at Queen's House, the Post Office, and the Survey Office, but from November 7 a change was made, and only the relay at the Central Telegraph Office was worked directly on the Observatory line, signals to the other master clocks being transmitted from the Central Telegraph Office. This was essentially matter of distribution and did not affect the work here. A more important addition, from the Observatory point of view, was the insertion of a contact on the Surveyor-General's Office master clock in April which short circuited its relay when that clock indicated the exact hour. As the relays are of polar type, a current in the reverse direction to that used for the setting signals does not effect them, and hence if a continuous current is sent in this reverse direction for a period commencing a few seconds before the hour it does not alter the setting, but it does show the instant at which the clock indicates the hour by a slightly increased amperage, owing to the relay being cut out of the circuit.

A similar device was subsequently added to the master clock at the Central Telegraph Office, and from June 16 onwards each setting signal was followed, a few minutes later, by a test signal which showed how accurate the setting had been. The particular value of these tests lies in the fact that synchronization by means of heart-shaped cams on the master clocks is only efficient if the error of the clock prior to the setting signal can be corrected by not more than one revolution of the main count wheel. If the initial error is greater than this, a partial correction may be made but an error left uncorrected corresponding to one or more complete revolutions of the wheel, but with nothing to call attention to its existence. The new contact provides the necessary information on this point.

From October 1 the maintenance of the control clocks at the Surveyor-General's Office, which now number twenty, was handed over to the Telegraph Department.

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The clock in the lighthouse has been synchronized by the same current that operates the 9 A.M. time ball. The bells of this clock are over a hundred years old, and have acquired an unexpected importance of late, owing to the strike being broadcasted twice daily as part of the general broadcasting programme. Incidentally this allows a check on its behaviour to be kept at the Observatory. Plenty of people who work in its vicinity are probably unaware of the fact that it does strike, but when the striking gear was out of action for a couple of days in March for repairs, queries were received not only from Ceylon but from Southern India.

All the time-signalling work is a matter of interactivity between the Observatory and the Telegraph Department,—and in the case of the time ball and lighthouse clock with the Master Attendant's and Harbour Engineer's Departments as well, and I gratefully acknowledge the way in which all concerned have co-operated in keeping the proportion of failures so low.

*Issue of Wireless Time Signals.*—These have been sent out twice daily throughout the year on the International code. The morning signal is from 11.27–11.30 Ceylon standard time (5.57–6.00 Greenwich mean time) on 2,300 metres C.W., and the evening one at 22.27–22.30 (16.57–17.00 Greenwich mean time) on 600 metres, I C.W.

The contacts for the actual dots and dashes of the wireless signal are made by metal pieces sunk in the rim of an ebonite drum at the Welikada Wireless Station. This drum is released at 11.27.00 or 22.27.00 by a signal from the Observatory, and during the three minutes it is in action is kept in beat with second by second signals from the Observatory mean time clock.

A chronograph at the Wireless Station records both the impulses from the Observatory and the movements of the drum. This chronograph, though very useful, does not meet every contingency (*e.g.*, it would give no immediate warning if the drum dropped a second and went on exactly one second slow) and as a further safeguard, every outgoing signal is listened to on the receiving set at the Observatory by the officer who is responsible for sending the impulse that starts the signal. This officer is in direct telephonic communication with the Wireless Station, and the decision as to whether a signal may be passed as correct or not rests with him.

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

In 1928 there were 722 successful signals out of a possible 732. It will be noticed that there is no curtailment of this service on Sundays or holidays. On one occasion no attempt was made to send the signal owing to the Wireless Station being urgently engaged otherwise. Of the 9 failures 1 was due to an error at the Observatory, and 2 appear to have been due to power failures. The other 6 were due to trouble with the drum at Welikada, either because of erratic drive by the motor there, or failure of the signals transmitted from the Observatory to actuate it. This latter cause of trouble appears to have been greatly reduced by the installation of a Kamm relay with condenser at the Observatory, by Mr. Kingston on March 27. This gives a rather longer contact than the ordinary G. P. O. relay, formerly in use, and while the trouble referred to was essentially due to variations in the line from the Observatory to the Wireless Station, or in the earth connections, the new relay has made the system less sensitive to such troubles.

In the case of these signals, as in the case of the visual ones, a successful result can only be obtained by co-operation between the staffs of the Observatory and Telegraph Department, and I again wish to thank Mr. Harper, Mr. Kingston, and all others concerned for their help in this matter.

*Longitude Determinations.*—The Bordeaux and Rugby vernier time signals were listened to as a matter of routine. The former, which come through at 1.31 to 1.36 P.M., Ceylon standard time, are less interfered with by local atmospheric disturbances than the latter, which are nearly two hours later, and more affected by afternoon thunderstorms.

The Bordeaux signal was compared with the Observatory clocks on 348 occasions. The 18 occasions on which a satisfactory comparison was not made include 6 on which no attempt was made to listen for it on account of thunderstorms or other reasons, and 12 on which the attempt was unsuccessful, which includes any cases in which no signal was transmitted.

The comparisons between clock errors as determined by these signals and by star transits have continued to be of considerable interest. With the help of this year's observations it has been possible both to attribute some of the variations in 1926–27 to instrumental causes, and to feel more sure that certain other variations are non-instrumental, and hence can be used with more confidence than before in the search for meteorological correlations.

Detailed discussion on this subject would be out of place here, but the paper on it that appeared in Part 2, Vol. 1. of Section E of the Ceylon Journal of Science has been followed by a second paper in Part 3 of that Journal.

## Meteorological Equipment and Work.

Climatological stations were maintained at the same sixteen outstations as in 1927. The transfer of thermometers from sheds to screens of the enlarged Stevenson type has been continued, but is not yet complete, duplicate readings being made in all cases before the demolishment of the old sheds.

Self-recording anemometers of the locally made type described in the Quarterly Journal of the Royal Meteorological Society (Volume XL. page 213) were set up at Chilaw and Tabbowa, pending the arrival of the new Dines anemometers and other apparatus indented for as one of the results of the visit of the members of the Airship Mission in 1927. All this apparatus was received before the end of 1928, but too late for the erection of the anemometer masts to be carried out this year.

Direct readings were taken at all stations at 9.30 A.M. and 3.30 P.M., Ceylon standard time, and the former wired to Colombo. Observations were taken at 7 A.M., at Colombo, Trincomalee, and Hambantota, in order to co-operate with the work of the Indian Meteorological Department, and observations were taken at 7 P.M., at these three stations, in connection with the evening wireless weather signals sent out from Colombo.

No alteration was made in the general methods of checking the outstation work at the Observatory, *e.g.*, pin diagrams, &c. Seventeen potential outstation observers underwent courses of instruction at the Observatory. These included eleven Survey Department clerks, one Kachcheri clerk, four lighthouse-keepers, and one member of the Agricultural Department.

The chief daily weather report and forecast was prepared as before from the 9.30 A.M. readings, and broadcasted *en clair* at noon, *i.e.*, two and a half hours after the readings on which it was based. It subsequently appeared in the " Post Office Daily List " and in the local newspapers.

One addition was made to the list of stations whose rainfall figures are telegraphed daily and appear in the " Post Office Daily List," viz., Balangoda.

Weather reports prepared avowedly with a view to shipping, and hence omitting any discussion of rainfall over the Island, were sent out in Morse immediately after the time signals at 11.30 A.M. and 10.30 P.M.

These reports deal with conditions round Ceylon in considerably more detail than those issued by the Indian Meteorological Department for the Arabian Sea and Bay of Bengal as a whole, but in compiling them use is made of these messages as well as of the observations at Ceylon stations (including pilot balloons), of those at Pamban, and on various ships whose officers are kind enough to send in their reports by wireless.

The importance of both the pilot balloon observations and the wireless messages from ships has increased considerably in the last few years, and with regard to the latter I am very glad to take this opportunity of expressing my thanks to the Captains and other officers concerned who have co-operated in this work. The ships from which such messages were received in 1928 include ss. Achilles, Adrastus, Akbar, Algic, Alipore, Amboise, Amur Maru, H.M.S. Argus, ss. Arracan, Artemisia, Atlanta City, Auditor, Aungban, Awa Maru, Azayleridean, Badarpur, Bahadur, Barala, Begum, Bellerophon, Berlin, H.M.S. Berwick, ss. Bovenkerk, British Sailor, Callandia, Canara, H.M.S. Carlisle, Castor, ss. Cathay, Chenab, Cheshire, Chyebassa, City of Calcutta, City of Canterbury, City of Halifax, City of Roubaix, Comorin, H.M.S. Concord, Cornflower, Curlew, ss. Dacre Castle, Deucalion, Diomed, Dogra, H.M.S. Effingham, ss. Elpenor, H.M.S. Enterprise, ss. Ferndale, Fulda, Gambada, Gandara, Garadana, Garbeta, Gharinda, Glaciere, Glenamoy, Gloucestershire, Golconda, Gretafield, Haruna Maru, Hatkhola, Havildar, H.M.S. Hawkins, ss. Hector, Herefordshire, H.M.S. Hermes, ss. Hobsons Bay, Hohenfels, H.M.S. Hollyhocks, ss. Holywell, Homefield, Jaladuta, Jalajyoti, Jalapalka, Jalaputra, Jalarashmi, Jalaveera, Janpieterszooncoen, Kalyan, Kantara, Karagola, Karmala, Kedoe, Kemmendine, H.M.S. Keppel, ss. Khosrou, Khyber, Kitanomaru, Kohinur, Leicestershire, H.M.S. Lupin, ss. Macharda, Magdapur, Magapur, Mahout, Mahratta, Mahronda, Maidan, Malancha, Malaya, Mandala, Mandasor, Mangalore, Mashobra, Manora, Masimpur, Masiripar, Medan, Media, Medon, Meerkerk, Memnon, Mentor, Merkera, Mirzapore, Moldavia, Mongolia, Mooltan, Morvada, Mulbera, Murmahal, Nagpore, Naldera, Nairnbank, Nankin, Nawab, Nellore, Nerbuda, Nirpura, Nizam, Novara, Novard, Nurjehan, Nurmahal, Nwevada, Orford, Ormara, H.M.S. Ormonde, ss. Orsova, Orvieto, Osterley, H.M.S. Otway, ss. Ozarda, Padua, Paeua, Pasha, Peleus, H.M.S. Pero Alenquer, ss. Perseus, Peshawur, Pessus, Philoctetes, Port Hardy, President Garfield, President Harrison, President Wilson, Princess Juliana, Pundit, Purpura, Quiloa, Radja, Rajula, Remo, Risaldar, Rotti, Salawati, Saleir, Shiya, Shuja, Singkep, Singu, Stanley, Steel Scientist, Sunik, Toba, Tydeus, H.M.S. Vindictive, ss. Wangaratta, Warialda, Warla, Yorkshire.

The question of " fair wear and tear " with regard to rain gauges in Ceylon contains several items that I do not think have been referred to in any of the discussions on the design and protection of rain gauges that appear from time to time in the Meteorological Magazine. An example of such an item is shown in the lower part of the frontispiece, which depicts a rain gauge from one of the Irrigation Department's stations in the Eastern Province, after an elephant had trodden on it.

The number of rain gauges whose figures appear in this report is 356, the additions since last year including seven under the Agricultural Department, one each under the Irrigation and Medical Departments and two estate gauges, Iddemekelle (Mr. F. O. N. Phillips) and Oopar (Mr. W. R. Westland).

Two stations have been discontinued, Haldummulla and Pottuvil Dispensary, but both were in action during the greater part of this year, and their figures are included up to the date of their discontinuation.

I am very glad of another opportunity of thanking the observers, both old and new, volunteer and official (and " official " observers are mostly " volunteer " so far as their rain gauge work is concerned) for all that they have done in keeping up these records.

In addition to the volunteer observers who report rainfall alone there are many who do not confine their assistance to this item, and supplement such information in various ways. In the limits of this report I regret I cannot mention by name everyone who comes under this category, but I wish to express my special indebtedness to Mr. J. A. Coombe of Poonagalla, to Mr. E. E. Megget and his assistants at Detanagalla, Mr. A. C. Tutein Nolthenius (West Haputale), and Mr. H. Jones (Hope estate).

*Co-operation with Indian Meteorological Department.*—In addition to the daily 7 A.M. telegrams from Colombo, Hambantota, and Trincomalee, extra telegrams were sent from these stations at various times when asked for by the Indian Meteorological Department. The numbers sent in 1928 were, Colombo 22, Hambantota 33, Trincomalee 26. These figures are decidedly less than in 1927, a fact that is the natural concomitant of the statement in the weather summary that Ceylon was less affected than usual by cyclonic movements in this year.

Telegrams were sent to India giving the results of pilot balloon flights, and a certain number of the wireless telegrams received from ships were passed on by land line, while in addition extra telegrams were sent whenever the 9.30 A.M. synoptic chart for Ceylon showed anything worthy of such special treatment.

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 Observatory. In addition, copies of the daily morning telegram from Pamban were also sent here and proved of considerable value, as the readings at Mannar town and Talaimannar alone are not typical of conditions in the Gulf of Mannar.



*Upper Air Work.*—The number of pilot balloons observed was 583, of which 578 were at Colombo and 5 at Diyatalawa. This represents a further slight increase over the numbers in the previous year.

As in previous years the tail method was used, so that vertical as well as horizontal movements could be measured.

The number of tails returned was 51, which represents 23 per cent. of the cases in which a request for its return was attached to the tail. Last year the percentage was 17, but the increase is more apparent than real, since the number of cases in which the request was attached was decidedly less, being limited to those seasons when the likelihood of the balloon coming down over the land rather than over the sea was greatest.

The results of the year's observations are shown in plate VIII.

*Special Investigations.*—In addition to the routine observations, of which some indication is given in the subsequent tables, a number of others were taken whose figures do not appear in this report, but from which information is available for use when required, and which may be published as opportunity occurs. Under this category may be mentioned the readings of the sunshine recorders at six stations and the evaporation tank and underground thermometers at Colombo. The temperature readings and averages at 9.30 A.M. and 3.30 P.M. might also be included under this head, also much of the upper air work, of which only the briefest summary appears in the diagram at the end of this report.

In addition to the above, several special observations were being made during the year, of which no detailed results are given in this report. These include the following :—

(*a*) *Rainfall Temperature Measurements.*—These were first referred to in the 1926 Report, which included photographs of the apparatus devised by Mr. Jameson and since used by him.

(*b*) *Rain Gauge Receiver Experiments.*—These were continued along the lines indicated in a communication to the Meteorological Magazine. (Vol. 57, page 240, October, 1922.)

(*c*) *Percolation Gauges.*—These were not soil percolation gauges, but attempts to measure the capacity of various trees for receiving rain. Gauges were placed under various trees and the amount of rain recorded in them under different conditions noted. These experiments were discontinued in October on the completion of two complete years' records.

(*d*) A series of measurements were made by theodolite in November of the apparent angular altitude of the top of a mast at the Wireless Station. This was really a measurement of variation in refraction, and its purpose was two-fold. In the first place the possibility of airships coming to Ceylon has created a demand for information on the question of changes of density near the surface, while the points raised in connection with possible refraction effects on clock stars have put an additional interest into all questions of refraction here.

To expedite this observation a telescope is being mounted permanently in such a way that variations in the apparent altitude of the masts can be read directly with a micrometer and level.

(*e*) The question of the temperature gradient within a few hundred feet of the ground has received some attention during the year, and thanks to the kind assistance of the Telegraph Department, it is hoped that records up to the height of 260 feet will soon be available from thermographs hoisted on the masts of the Wireless Telegraph Station at Welikada.

One of the most interesting experiments made during the year in this connection is shown in the frontispiece and represents a thermograph hoisted on a collapsible mast in the Observatory compound. The mast in question is one that can be erected by successive sections from the ground and was originally intended for use as a portable triangulation mast when surveying over low jungle.

In view of what has been said above about the Wireless Station, it is not anticipated that the experiment of erecting it in the Observatory compound will develop into a regular practice, but at least the possibility of such use has been demonstrated.

One incidental point in connection with it is perhaps worthy of comment, namely, that it was not only surveying apparatus that was put to a meteorological use, but the astronomical equipment had to help too. The mast is certainly not strong enough for a man to climb to its summit, but when the thermograph was there, I was able to satisfy myself that it was working satisfactorily by direct observation through the equatorial !

(*f*) *Personal Equation.*—An analysis of the differences in personal equation between various members of the staff in their eye-and-ear estimates of vernier wireless coincidences, and in clock comparisons, has given some rather interesting results, while comparisons have also been taken of the personal equations of a number of other gentlemen who had occasion to be interested in the subject for various reasons, notably on account of their acting as timekeepers at sports.

*Seasonal Correlation.*—In the frontispiece to the 1927 Report curves were given showing the rainfall in the south-west monsoon at each of two groups of stations on the west of the Island, and it was pointed out that an appreciable degree of agreement existed between them and theoretical curves built up from periodicities of 3·7 and 4·65 or 4·67 years.

Apart from the simple periodicity curves, attention was called to the fact that exceptionally well developed thunderstorms in the inter-monsoon period of March and April (especially April) tended to be followed by a south-west monsoon of deficient rainfall and also that an exceptionally cold February had preceded a monsoon of deficient rainfall sufficiently often to suggest that the connection was more than one of coincidence alone, while night temperatures appear to be more important than those by day.

For 1928 the periodicity curve suggested rather less rain than had fallen in 1927. The February temperatures were on the whole low, and particularly so at night, which made their significance rather greater than appears from the offsets of the means in Table II., while in addition the April thunderstorms were above average in vigour.

All three items thus reinforced each other in suggesting the likelihood of a deficient monsoon, and plate IV. shows that the forecast was amply fulfilled. In that plate it will be seen that deficits of at least ten inches for the period May–September, 1928, inclusive, were common throughout the greater part of the south-west quarter of the Island, but if looked at critically the deficit was even more marked than is indicated by that plate alone, since the monsoon was so weak that it allowed some depressional activity on July 6–7, which is most unusual in that month, and but for which the deficits in that period would have been decidedly greater.

*Publications.*—The present Report is on the same lines as its predecessors, and gives among other things the rain gauge figures from 356 stations. The latter part of it includes the tables that also appear in the Ceylon Blue Book.

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 Agriculturalist.

A new Manual of Instructions for the guidance of outstation meteorological observers was published during the year, and also the second part of Volume I., Section E, of the Ceylon Journal of Science, which contained six papers, three by Mr. Jameson and three by myself. The former dealt with the maximum total rainfall in n consecutive days, the use of quill pens for self-registering instruments, and the diurnal variation in the barometric gradient over Ceylon, while the latter were on the variation of clock star observations with wind, on longitude determinations at Colombo, with special reference to the distortion of time observations by meteorological causes, and on the exposure of thermometers in Ceylon.

The material for the third part, which will complete Volume I. of the new series, was sent to the printers during 1928, but is still in the press. This contains some notes on the climate of western Ceylon, including the summary of the last seven years pilot balloon flights, further discussion of several of the subjects dealt with in the previous issue, and also a paper on the rather interesting interaction between the monsoon and a mild depression in July, which has already formed the subject of a brief note in the Quarterly Journal of the Royal Meteorological Society.

A paper by Mr. Jameson on "The Mean Maximum Rain falling in a Time $t$" was read before Royal Meteorological Society in London in November, and a note by him on the same subject has appeared in *Nature.*

A paper on the floods in the Kelani Valley River was read by me before the Ceylon Engineering Association in August, and contained a series of coefficients connecting rainfall with river height which could be used in forecasting.

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. The list is as follows :—

INTERNATIONAL.

League of Nations, Health Section, Eastern Bureau, Singapore :—
- Weekly Fascicules, 1927, December 17th–1928, December 15th.
- Annual Report of the Advisory Council, 1927.

Commission Internationale de Longitudes par T. S. F. :—
- "Heures siderales locales des signaux rythmés enregistré à l'Observatoire de Zi-Ka-Wei," Octobre–Novembre, 1926.
- "Heures siderales locales des signaux rythmés enregistré à l'Observatoire de Paris," Octobre–Novembre, 1926.

International Meteorological Organization :—
- Commission pour l'Etude des Nuages, 1926.
- Commission pour étudier la Création d'un Bureau Météorologique International, 1926.
- Commission for the Exploration of Upper Air :—
- Report of the meeting in Leipzig, August 29 to September 13, 1927.

AFRICA.

*Egypt.*

Helwan Observatory :—
- Bulletin No. 33.
- Meteorological Report, 1922.

Ministry of Agriculture :—
- A study of Butterfly Migration in South India and Ceylon, by C. B. Williams, M.A.

*Mauritius.*

Royal Alfred Observatory :—
- Annual Reports, 1926 and 1927.
- Monthly Magnetical and Meteorological Observations, July, 1926, to December, 1927.

*Union of South Africa.*

Royal Observatory, Cape of Good Hope :—
- Wireless Time Signals, October to November, 1926.

AMERICA (NORTH).

*Canada.*

Ottawa Dominion Observatory :—
- International Longitude Signals, October–November, 1926.

Toronto Observatory :—
- Meteorological and Magnetical Observations, 1926.

*Jamaica.*

William H. Pickering, Esq., Mandeville :—
- The Orbit cf Uranus.
- The Three Outer Planets beyond Neptune.
- Report on Mars, No. 41.

*Mexico.*

Geological Institute :—
- Catalogo de Los Temblores, 1926 and 1927.

*United States of America.*

U. S. Department of Agriculture :—

Weather Review, 1927, September–December ; 1928, January–August.
Index to Volume 55.
Review, 1928.
Supplement No. 31.

New York Meteorological Observatory :—

Monthly Reports, 1927, September–December ; 1928, January–June, August–September.
Report and Annual Tables for 1927.

U. S. Coast and Geodetic Survey :—

First Order Levelling in Oregon, by H. G. Avers.

Jesuit Seismological Association, Central Station :—

Preliminary Bulletins, Earthquakes of 1927, November 21 to 1928, November 1.

Seismological Station of St. Louis :—

Bulletins, 1927, November–1928, July.

Regis College, Denver :—

Records 3 and 4, 1927, and 1–7, 1928.

Gonzaga Seismological Station :—

Bulletins, 1927, February, and 1928, March September.

Lick Observatory :—

Bulletins Nos. 392–405.
Registration of Earthquakes at Berkeley and Lick Observatory, 1927, April 1 to 1928, March 31.

Carnegie Institute of Washington :—

Annual Report (Terrestial Magnetism), 1926–27.
Weighting by Mean Differences, by H. W. Fisk.
On the Revision and Correction of Fourier Analysis Computations, by C. C. Ennis.
Computation of Fourier Terms, by C. R. Duvall.
The Purpose and Progress of Ocean Surveys, by J. P. Ault.
List of Publications of the Department of Terrestial Magnetism, 1904–1927.

U. S. Naval Observatory :—

World Longitude Signals, October–November 1926.

Smithsonian Institute :—

World Weather Records.

AMERICA (SOUTH).

*Bolivia.*

La Paz Observatory :—

Seismological Bulletins, 1927, November–December, 1928, January–June.

Sucre Observatory :—

Seismological Bulletins, 1927, May–October; 1928, January–May, August–December.

*Brazil.*

Directoria de Meteorologia, Rio de Janeiro :—

Boletim Meteorologico, 1922.
Boletim Mensal, 1927, October–1928, September.
"A Aviacao e a Meteorologia no Brasil," and "A Previsao Do Tempo, Baseuda Em Observacoes Locaes," by Dr. J. de Sampaio Ferraz.

Observatorio Nacional Rio de Janeiro :—

Annuario, 1928.
Boletim Magnetico, 1926.
Medidas micrometricas de Estrellas Duplas, by Domingo Fernandes de Costo.
Calculo do Nascer e Do Occaso da Lua.

*Chile.*

Observatorio Del Salto, Santiago :—

Boletin Mensal, 1927, November–1928, September.

*Venezuela.*

Del Servicio Meteorologico :—

La Lluvia En Venezuela, 1925–1926, by Ernesto Sifontes.

ASIA.

*China.*

Royal Observatory, Hong Kong :—

Annual Report, 1927.
Monthly Meteorological Bulletins, November, 1927–October, 1928.
Monthly Seismological Bulletins, November, 1927–October, 1928.
International Loginitude Wireless me Signals, October–November, 1926.

*India.*

Indian Meteorological Department :—

Annual Summary for 1925, 1926.
Monthly Rainfall of India, 1926.
Memoirs, Volume XXV., Parts I. and II.
Administration Report, 1927–28.
Daily and Monthly Weather Reports.
Scientific Notes Vol. I., Nos. 1–3.

Kodaikanal Observatory :—

Bulletins, 82, 83, 84.
Report, 1927.

Director of Agriculture, Bengal :—

Daily Rainfall, 1927, November–December; 1928, January–October.
Report, 1927.

Mysore University :—

Journal, 1928.

Survey of India, Geodetic Branch :—

Time of Reception of Wireless Signals from Bordeaux and Saigon.

*Indo-China.*

Central Observatory, Phu-lien :—

Bulletin Pluviometrique, 1926.
Note sur le climat de l'Indochine, by P. Carton.

*Japan.*

Astronomical Observatory, Tokyo :—

Wireless Time Signals, October–November, 1926.

*Java.*

Batavia Observatory :—

Seismological Bulletins, October–December, 1927 ; January–June, 1928.
Regenwaarnemingen in Nederlandsch–Indie, 1926, 1927.
The Climate of the Netherland Indies, by Dr. C. Braak.
Sea Surface Temperatures on some Steamer Routes in the Malay Archipelago, by Dr. H. P. Berlage (Jr.).

*Philippine Islands.*

Central Observatory, Manila :—

Meteorological Bulletins, May–December, 1926 ; January–August, 1927.
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## Weather Summary, 1928.

There were several rather interesting features in the weather of 1928. These included exceedingly well developed local thunderstorms in the inter-monsoon periods both before and after the south-west monsoon, and a decidedly deficient rainfall during that monsoon.

There was an unusual absence of depressional activity, and the main exception to this was itself the most interesting feature of the weather of the year, namely, the appearance of a mild depression in July (a month in which depressions are unusual) and its interaction with the monsoon to produce heavy rain in the Puttalam-Mundel-Ragama area, which is usually a comparatively dry one in that month.

The totals for the year, resulting from these various causes, were, on the whole, not widely different from normal. A very rough summary may be made by saying that deficits were more common on the east side and centre and excesses on the west.

The following is a summary by months :—

In January the number of stations that received above average rainfall was about equal to those that failed to do so, the former being on the whole more on the west side than the east. By a curious coincidence the Nitre Cave district, whose January average is high, provided both the highest total for this month (St. Martin's 31·9) and the biggest deficits below average.

In February very few stations recorded as much as ten inches, but as the averages are low considerably more than half of them were above their average. A striking feature of the month was the lowness of the minimum temperatures, a point that has been noticed before as apt to be associated with deficient rain in the following monsoon.

In March rainfall was, on the whole, deficient and the resultant drought was more marked than the figures alone suggest, since such rain as had fallen in February had mostly been in the first half of that month.

In April the local thunderstorms of the monsoon period were very well developed and suggested the likelihood of deficient rain in the ensuing monsoon. Their immediate effect was to put the April totals above average over the greater part of the Island, and particularly so south of a line from Marichchukkaddi to Kalmunai.

In May the rainfall was consistently deficient. Most of the stations in the Jaffna Peninsula recorded nothing, but the biggest numerical deficits were in the south-west quarter of the Island, where the average rain of May is higher.

In June deficits again predominated. They were not quite so large numerically as in May, but their cumulative effect in succession to that month probably made them more noticeable. North of a line from Puttalam to Batticaloa and east of one from Mullaittivu to Hambantota the majority of stations recorded no rain.

July was an exceptionally interesting month. Normal monsoonal activity was again below average, but its very weakness allowed rain of a type unusual in July, due to the interaction of a mild depression with it. As a result the rainfall map for the month is quite unique and resembles the October average distribution more than the July one. Many of the stations in the south-west of the Island were appreciably below average, but elsewhere there was marked excess, particularly in the North-Western Province and the southern parts of Uva, and the Eastern Province.

A particular feature was the rainfall of over 10 inches in one day on the 7th, along a comparatively narrow strip extending from Puttalam to Henaratgoda. This appears to have been due to the interaction of a mild depression, whose northern quadrant directly opposed the monsoon round the northern boundary of the hills.

If the monsoon had developed more normally the depression would probably not have been allowed to form. It appears not only to have formed, but to have used the hills as cover from which it attacked the mildly advancing monsoon currents, to the great inconvenience of people in the Puttalam District. (The storm in question has been discussed in greater length in the Quarterly Journal of the Royal Meteorological Society and the Ceylon Journal of Science, Section E, Volume I., Part III.)

In August the rainfall in the south-west quarter of the Island was up to average with a little to spare, and in addition there was rain along the north-east coast, where the 2-inch contour extended from Point Pedro to Tirrukovil (south of Kalmunai) and the 5-inch one from between Mullaittivu and Kanukkeni to south of Allai tank. Between the two main wet areas in the south-west and north-east of the Island deficits were nearly universal, and stations that reported no rain were common.

In September practically the whole Island had deficient rainfall, and stations with none were common in the North-Western Province and North-Central Province. Rain was particularly deficient up to the 23rd, after which date a mild attempt at recovery occurred. Notwithstanding this, deficits of 10 inches were not uncommon in the totals for the whole month.

At the beginning of October the south-west wind persisted and was responsible for the alterations of the ships' moorings in Colombo Harbour being later than usual. During the month as a whole, rain was widespread, and chiefly of the local thunderstorm type, but markedly more in evidence on the west side than the east, though the east coast got a little more than some of the eastern inland stations.

In November local thunderstorms typical of the inter-monsoon period were still in evidence and the resulting rainfall heavy and widespread, though the absence of a definite depression was noteworthy, and the excess of the number of days on which rain fell above the average of this amount was even more marked than the excess of amount of rain. Stations that failed to reach their average in both these items were not numerous, and were to be found chiefly in the central parts of the Island.

The rainfall of December was, on the whole, decidedly below average. There was a fair amount of rain during the first ten days, but after that very little fell (except possibly on the 19th) till X'mas. There was rather more during the last week, but not enough to bring the totals for the month up to average, in the majority of cases.

## Seismograph.

The new Milne Shaw instrument that was set up in 1927 was in use throughout 1928. There were no prolonged interruptions, though there were several short ones, chiefly in April, on account of trouble with the driving clocks. The mirror connection was that required to give a magnification of 250, and the various constants were determined monthly, and at times more frequently when occasion demanded. The sensitivity was found to vary from 48 to 73 millimetres per second of arc tilt, and the damping ratio from 1 in 17 to 1 in 26, except for one determination in February when it was 1 in 10.

The period was adjusted to twelve seconds, but determinations of its amount before each readjustment showed that this did not remain constant but was apt to change by as much as a second in either direction.

The average speed of the film was 8 millimetres per minute, and time marks were put on at half minute intervals by putting the shutter in series with the Synchronome master clock.

Earthquakes are not felt very frequently in Ceylon by the general public. The shocks of February 7 and March 9 this year were, however, exceptions to this rule, though fortunately neither were severe enough to do appreciable damage.

The ss. Mooltan, Taormina, and Olga Siemers in the neighbourhood of 87° E, 2° S, reported vigorous submarine shocks, and appear to have been rather nearer the focus. Alternative readings for the time of maximum on February 7 are 0 hr. 18 min. 25 sec. and 0 hr. 20 min. 30 sec. It is hard to be precise in such cases as the width of the swing made the trace very faint.

In the case of March 9 there were slight thickenings from 10.30 to 11.30 which would probably not have been commented on but for what occurred later. The movement at 18 hr. 8 min. 30 sec. was a sharp displacement to the west, after which the trace became undecipherable, presumably because the spot of light was moving too fast.

The three maxima given are simply the turning points of swings which became visible when the direction of movement was slowest. The first two were to the east and the last one to the west. It is quite possible that wider movements occurred but were either too rapid to leave a trace or passed beyond the edge of the paper. From 18.24 to 18.38 with deflections of from 35 to 53 mm. the period appears to have been 18.2 seconds. After 18.55 the trace became sufficiently compact for it to be possible to estimate the position of its centre line which was about 10 mm. further east than it was before the shock commenced. The period had then decreased to about 13 seconds, *i.e.*, nearly the natural period of the pendulum. It will be noticed that the movements the next day suggested a focus in the neighbourhood of that on February 7.

| No. | Date. 1928. | P. H. M. S. | S. H. M. S. | L. H. M. S. | Maximum. H. M. S. | End. H. M. S. | Amplitude. M.M. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| | January | | | | | | | |
| 1226 .. | 4 | .. 21 36 31.. | 21 46 11.. | 22 2 1.. | 22 7 6.. | 23 30 | .. 1·1.. | — |
| 1227(*a*) | 6 | .. 19 40 5iP | 19 45 54Si | — .. | 19 56 .. | 23 20 | .. 14·0.. | — |
| | | | 19 46 31Se | | 20 2 | | 15·0 | |
| 1228 .. | 10 | .. 2 29 33.. | 2 39 49.. | 2 45 49.. | 2 54 34.. | 4 30 | .. 1·3.. | — |
| 1229 .. | 12 | .. 13 26 19.. | — .. | — .. | 14 27 49.. | 15 37 | .. 0·6.. | — |
| 1230 .. | 26–27 | .. 21 56 1.. | — .. | 21 59 41.. | 22 2 21.. | 0 30 | .. 11·8.. | — |
| 1231 .. | 30 | .. 3 23 17.. | Lost .. | 3 36 4.. | 3 37 9.. | 5 27 | .. 2·1.. | — |
| | February | | | | | | | |
| 1232 .. | 3 | .. 13 50 .. | — .. | — .. | 14 27 30.. | 15 30 | .. 1·0.. | — |
| 1233 .. | 6 | .. 4 0 34.. | 4 7 34.. | 4 19 19.. | 4 21 29.. | 5 30 | .. 1·6.. | — |
| 1234 .. | 7 | .. 0 4 40.. | — .. | 0 6 52.. | 0 7 42.. | 3 54 | .. 47·0.. | Initial movement towards the west |
| 1235 .. | 13 | .. 16 35 .. | — .. | — .. | 17 6 .. | 18 10 | .. 1·1.. | — |
| 1236 .. | 21 | .. 20 1 22.. | 20 13 2.. | 20 35 22.. | 20 38 37.. | 22 30 | .. 3·2.. | — |
| 1237 .. | 26 | .. 1 41 22.. | 2 9 32.. | 2 13 2.. | 2 15 27.. | 4 20 | .. 2·7.. | — |

(*a*) First two waves period about 7 seconds. Then very short period till S. Period composite from S to M becoming more regular after M, at 20h. 10m. about 16·1 secs. Crests of curve read as shown, but absolute maximum probably greater than 15 mm., situated between 19h. 56m. and 20h. 2m., as trace is too thin to read between these limits.

| No. | Date. 1928. | P. H. M. S. | S. H. M. S. | L. H. M. S. | Maximum. H. M. S. | End. H. M. S. | Amplitude. MM. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 1238 | February 29-March 1 | 22 10 21.. | 22 20 6.. | 22 32 11.. | 22 45 6 | 0 30 | .. 1·1 .. | — |
| 1239 | March 7–8 | .. 22 56 22.. | 22 59 2.. | 23 4 22.. | 23 7 37.. | 0 15 | .. 1·2.. | — |
| 1240 | 9 | .. 18 8 30.. | — .. | — .. | 18 16 30.. | | .. 48 .. | — |
| | | | | | 18 17 30.. | 24 0 | .. 53 .. | See note above. |
| | | | | | 18 20 45.. | | .. 101 .. | — |
| 1241 | 10 | .. 3 23 18Pi | — .. | — .. | 3 27 58.. | 5 35 | .. 7·5.. | — |
| 1242 | — | .. 5 58 48Pi | — .. | — .. | 6 3 28.. | — | .. 3·4.. | — |
| 1243 | — | .. 10 24 49.. | — .. | — .. | 10 29 29.. | — | .. 1·0.. | — |
| 1244 | — | .. 15 55 5.. | — .. | — .. | 16 0 15.. | 16 55 | .. 1·2.. | — |
| 1245 | 13 | .. 1 39 53Pe | — .. | — .. | 1 47 33.. | — | .. 4·0.. | — |
| | | 1 42 53Pi | — .. | — | | | | |
| 1246 | 13 | .. 18 43 37.. | 18 52 52.. | 19 8 40.. | 19 12 7.. | — | .. 1·5.. | — |
| 1247 | 17 | .. 14 32 20.. | 14 40 35.. | 14 47 8.. | 14 51 5.. | 16 7 | .. 0·6.. | — |
| 1248 | 18 | .. 3 11 29.. | 3 27 49.. | 3 49 29.. | 3 59 49.. | 5 22 | .. 0·9.. | — |
| 1249 | | .. 12 9 7.. | — .. | — .. | 12 57 7.. | 14 23 | .. 0·9.. | — |
| 1250 | 19 | .. 10 7 50.. | — .. | — .. | 10 16 35.. | 11 30(about) | 1·2.. | — |
| 1251 | 22 | .. 4 37 3.. | — .. | — .. | 5 53 43.. | 10 (about). | 17·0.. | — |
| 1252 | 26 | .. 5 34 48.. | 5 41 18.. | 5 51 48.. | 5 57 8.. | — | .. 1·5.. | — |
| 1253 | | .. — .. | 6 58 18.. | 7 6 33.. | 7 11 33.. | 7 51 18.. | 0·7.. | Preliminary lost in the previous shock |
| 1254 | | .. 8 14 18.. | 8 21 48.. | 8 29 33.. | 8 34 33.. | 9 14 18.. | 0·8.. | — |
| 1255 | | .. 9 58 4.. | 10 2 49.. | 10 10 49.. | 10 15 14.. | — | .. 0·6.. | — |
| 1256 | 27 April | .. 19 23 .. | 19 26 .. | 19 29 .. | 19 31 .. | — | .. 1·4.. | — |
| 1257 | 14 May | .. 9 10 .. | 9 18 .. | 9 33 .. | 9 39 .. | — | .. 3·3.. | — |
| 1258 | 14 | .. 22 34 50$P_1$ | 23 0 50$S_1$ | 23 30 10$L_1$ | 23 47 50–55 | — | .. 26 .. | Mean position of trace is displaced toward east from $S_2$ about 1 MM |
| | | 22 39 5$P_2$ | 23 16 10$S_2$ | 23 38 50$L_2$ | | | | |
| | | | | 23 42 35$L_3$ | | | | |
| 1259 | 19 | .. 3 31 46.. | 3 34 30.. | 3 35 43.. | 3 38 38.. | — | .. 1·6.. | — |
| 1260 | 27 | .. 9 57 19Pe | 10 9 44.. | 10 28 4$L_1$ | 10 32 19.. | 14 30(about) | 5·6.. | — |
| | | 10 1 4Pi | — .. | 10 29 24$L_2$ | — .. | — .. | — .. | — |
| 1261 | 29 June | .. 12 33 31.. | — .. | — .. | 12 37 49.. | 12 58 19.. | 1·5.. | — |
| 1262 | 1 | .. 13 31 37.. | — .. | — .. | 13 52 7.. | 14 29 19.. | 1·0.. | — |
| 1263 | 15 | .. 6 20 18Pe | 6 26 38.. | 6 38 3.. | 6 39 3.. | — | .. 15·5.. | — |
| | | 6 22 8Pi | | | | | | |
| 1264 | — | .. 17 24 10Pe | 17 30 15.. | 17 41 0.. | Not pronounced | 18 4 50.. | 4·0.. | Maximum possibly 17·49 |
| | | 17 25 50Pi | | | | | | |
| 1265 | 17 | .. 3 39 33.. | 3 58 28.. | 4 18 58$L_1$ | 4 45 48.. | — | .. 15·0.. | — |
| | | | | 4 39 8$L_2$ | | | | |
| 1266 | 21 | .. 10 50 1.. | Elusive .. | 11 36 14.. | 11 40 4.. | 13 38 | .. 2·9.. | — |
| 1267 | — | .. 16 42 31.. | Elusive .. | 17 26 1.. | 17 32 16.. | 18 14 21.. | 6·0.. | — |
| 1268 | 29 July | .. 23 4 10.. | 23 13 33.. | 23 31 2.. | 23 41 0.. | — | .. 2·3.. | — |
| 1269(*b*) | 9 | .. 21 35 46.. | 21 46 9.. | 22 5(about) | Not pronounced | — | .. 0·5.. | — |
| 1270 | 18 | .. 19 25 10.. | Elusive .. | 20 19 20.. | 20 33 32.. | — | .. 2·3.. | — |
| 1271 | 27 | .. 15 26 39.. | — .. | — .. | 15 33 31.. | — | .. 0·6.. | — |
| 1272 | 31 | .. — .. | — .. | 0 54 .. | 0 59 .. | — | .. 0·7.. | P and S lost in changing film, and P after 0h. 36m. on the 31st |
| 1273 | August 4 | .. 18 46 21.. | Elusive .. | 19 41 26.. | 19 55 26$M_1$ | — | .. 3·5.. | P probably earlier—masked in microseisms |
| | | | | | 20 3 21$M_2$ | | 4·0 | |
| | | | | | 20 4 51$M_3$ | | 4·1 | |
| 1274 | 10 | .. 15 43 30.. | 15 46 10.. | 15 51 8.. | 15 51 38.. | — | .. 0·9.. | — |
| 1275(*c*) | 12 | .. 8 17 12.. | 8 24 2.. | Not pronounced .. | | — | .. — .. | — |
| 1276(*d*) | 24 | .. 21 56 16.. | 22 6 21.. | Not pronounced .. | | — | .. — .. | — |
| 1277 | 30 | .. 4 51 28.. | — .. | — .. | 4 54 33.. | 5 9 | .. 1·8.. | — |
| 1278 | September 1 | .. 6 14 18.. | 6 18 48.. | 6 21 18.. | 6 23 38.. | — | .. 19·5.. | — |
| 1279 | 13 | .. 3 34 47.. | 3 41 32.. | 3 50 57.. | 3 52 47$M_1$ | 5 2 | .. 1·5.. | — |
| | | | | | 3 57 17$M_2$ | | 1·8 | |
| 1280 | 18 | .. 17 35 21.. | — .. | — .. | 18 13 15.. | 19 14 | .. 1·5.. | — |
| 1281 | 18 | .. 19 58 36.. | 20 5 31.. | 20 9 36.. | 20 10 46$M_1$ | 21 22 | .. 2·5.. | — |
| | | | | | 20 13 19$M_2$ | | 2·2 | |
| 1282 | 22 | .. 7 44 17.. | 7 54 47.. | 8 0 42.. | 8 1 12.. | 10 49 | .. 2·5.. | — |
| 1283 | October 4 | .. 18 30 51.. | 18 37 16.. | 18 44 36.. | 18 45 36.. | — | .. 2·1.. | — |
| 1284 | 9 | .. A shock was recorded on the morning of October 9 and lasted till 6h. 30m. The commencement was lost owing to the spot of light being deflected off the sheet. A maximum occurred about 4h. 38m., but a more pronounced one may have occurred earlier. | | | | | | |
| 1285 | 13 | .. 15 25 20.. | 15 32 5.. | 15 39 50.. | 15 46 5.. | — | .. 0·6.. | — |
| 1286 | 15 | .. 14 25 1.. | 14 29 41.. | 14 33 41.. | 14 36 19.. | 17 13 | .. 35·5.. | — |
| 1287 | 19 | .. 10 35 59.. | 10 52 19.. | 11 12 34.. | 11 27 34.. | 13 24 | .. 2·1.. | — |
| 1288 | November 6 | .. 4 18 7.. | 4 29 19.. | 4 48 49.. | 5 0 24.. | 7 36 | .. 2·1.. | — |
| 1289 | 11 | .. 22 49 20.. | 22 56 0.. | 23 3 10.. | 23 3 35.. | — | .. 1·5.. | — |

(*b*) The beginning of S is the real maximum, and yet it is not read as such, owing to the irregularity in period of the waves both preceding and following.

(*c*) P permanently displaced the trace to west by 1 mm. and S by another 1 mm. to west. The amplitude is so small that it does not show the phases L and M clearly.

(*d*) Probably spurious. The amplitude is so small that it does not show the phases L and M.

| No. | Date. 1928. | P. H. M. S. | S. H. M. S. | L. H. M. S. | Maximum. H. M. S. | End. H. M. S. | Amplitude. M.M. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| | November | | | | | | | |
| 1290(*e*) | 14 | 4 43 49.. | 4 44 29 | 4 48 9.. | — .. | 6 5 | 2·5.. | — |
| 1291 | 20 | 20 54 52.. | Elusive .. | 21 35 52.. | 21 52 47.. | 23 5 | 1·4.. | — |
| 1292 | 22 | 8 43 30.. | 8 55 28.. | 9 8 23.. | 9 25 36.. | — | 0·8.. | — |
| 1293 | 28 | 10 51 20.. | 10 53 15.. | 11 4 30.. | 11 11 50.. | 13 53 | 19·5.. | — |
| 1294 | 29 | 18 17 21.. | — .. | — .. | 19 4 6.. | 20 30 | 0·5.. | — |
| | December | | | | | | | |
| 1295 | 1 | 4 25 38.. | 4 47 18.. | 5 11 3.. | 5 33 3.. | 8 27 | 14·5.. | — |
| 1296(*f*) | 2 | 4 39 49.. | 5 1 34.. | 5 31 29.. | 5 38 39.. | 7 33 | 2·0.. | — |
| 1297 | 7 | 9 23 32.. | 9 31 15.. | 9 42 50.. | 9 50 42.. | — | 1·8.. | Trace displaced at S to East by 4 M.M. |
| 1298 | 9 | 5 16 55.. | 5 27 36.. | 5 36 48.. | 5 37 18.. | — | 0·8.. | — |
| 1299 | 10 | 4 38 0.. | 4 41 48.. | 4 43 13.. | 4 45 6.. | — | 0·7.. | — |
| 1300 | 12 | 20 38 16.. | 20 48 22.. | 21 14 7.. | 21 19 32.. | 23 1 | 0·9.. | — |
| 1301 | 14 | 0 33 38.. | 0 37 48.. | 0 41 53.. | 0 43 33.. | — | 1·4.. | — |
| 1302 | 19 | 11 45 20.. | 11 52 10.. | 12 5 45.. | 12 7 35.. | — | 25·5.. | — |
| 1303(*g*) | 28 | 14 27 44.. | 14 34 14.. | 14 41 9.. | 14 48 59.. | — | 3·7.. | — |

(*e*) Time of maximum wave could not be given, for the trace is very irregular as though superimposed.
(*f*) From the middle of phase L to M trace gradually displaced to East by over 2 mm.
(*g*) Trace gradually displaced to East between P and S by about 1·5 mm. and sharply at S by another 2 mm.

Colombo, February 9, 1929.

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## Return of Raintall in Ceylon during 1928, 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. | Inches. | Days. | Inches. | Days. | Inches. | Days. | Inches. | Days. | Inches. | Dates. |
| | Feet. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Alagalla (Al.) .. | 1,062 | 1928 .. | 3·95 | 12 | 4·37 | 7 | 6·32 | 5 | 13·60 | 20 | 1·46 | 3 | 9·76 | 17 | 14·62 | 10 | 7·91 | 14 | 5·54 | 7 | 22·47 | 28 | 12·82 | 21 | 6·45 | 13 | 109·27 | 157 | 8·20 | July 8 to 9 |
| | | means during 17–18 years | 6·04 | 9 | 1·91 | 2 | 6·11 | 7 | 8·79 | 11 | 9·25 | 10 | 11·59 | 17 | 7·77 | 12 | 5·49 | 9 | 8·20 | 10 | 16·04 | 16 | 12·81 | 14 | 9·59 | 9 | 103·60 | 127 | 9·82 | June 24 to 25, 1911. |
| Allai Tank .. | 20 | 1928 .. | 8·37 | 14 | 5·51 | 6 | 1·67 | 3 | 1·88 | 6 | 1·34 | 4 | 0·00 | 0 | 4·85 | 5 | 6·34 | 6 | 1·71 | 4 | 6·58 | 11 | 28·80 | 23 | 10·94 | 18 | 77·99 | 100 | 3·85 | Nov. 10 to 11. |
| | | means during 53 years .. | 8·62 | 9 | 2·47 | 3 | 2·29 | 3 | 1·91 | 4 | 2·78 | 4 | 1·40 | 1 | 1·75 | 2 | 4·20 | 4 | 4·61 | 5 | 8·88 | 11 | 15·93 | 15 | 18·45 | 15 | 73·31 | 76 | 9·11 | Nov. 17 to 18, 1906. |
| Alutnuwara .. | 300 | 1928 .. | 16·27 | 20 | 5·56 | 9 | 5·33 | 6 | 11·14 | 17 | 2·28 | 6 | 0·00 | 0 | 3·26 | 3 | 0·00 | 0 | 2·35 | 3 | 3·74 | 10 | 22·61 | 28 | 12·66 | 17 | 85·20 | 119 | 3·74 | Nov. 1 to 2. |
| | | means during 29 years .. | 15·79 | 15 | 4·99 | 7 | 5·30 | 7 | 4·79 | 9 | 2·65 | 5 | 0·59 | 2 | 1·28 | 3 | 2·04 | 3 | 2·75 | 5 | 11·90 | 15 | 14·04 | 16 | 16·68 | 17 | 82·82 | 103 | 9·92 | Jan. 17 to 18, 1913. |
| Ambalantota .. | 15 | 1928 .. | 3·03 | 6 | 0·98 | 3 | 1·50 | 2 | 4·27 | 7 | 3·05 | 7 | 1·65 | 4 | 3·62 | 4 | 1·07 | 6 | 0·31 | 1 | 4·60 | 13 | 11·04 | 16 | 5·36 | 9 | 40·48 | 78 | 2·68 | July 6 to 7. |
| | | means during 7 years .. | 4·37 | 6 | 1·49 | 3 | 4·83 | 8 | 2·11 | 4 | 3·56 | 6 | 3·11 | 7 | 2·61 | 6 | 0·96 | 5 | 3·22 | 7 | 4·85 | 9 | 6·90 | 12 | 4·94 | 9 | 42·94 | 81 | 5·20 | Nov. 14 to 15, 1923. |
| Ambanpitiya (Am.) .. | 663 | 1928 .. | 5·07 | 7 | 6·27 | 7 | 2·91 | 5 | 22·88 | 19 | 2·81 | 17 | 13·70 | 24 | 12·67 | 17 | 10·22 | 28 | 2·99 | 17 | 24·35 | 31 | 13·54 | 24 | 10·38 | 12 | 127·79 | 208 | 5·60 | July 7 to 8. |
| | | means during 57 years .. | 3·38 | 6 | 2·68 | 4 | 6·78 | 10 | 10·47 | 15 | 10·72 | 16 | 12·80 | 20 | 8·37 | 17 | 6·62 | 16 | 8·54 | 16 | 17·45 | 21 | 13·75 | 17 | 7·40 | 11 | 108·95 | 167 | 16·65 | Aug. 7 to 8, 1886. |
| Ambepussa .. | — | 1928 .. | 7·50 | 6 | 3·60 | 7 | 3·62 | 5 | 15·66 | 16 | 3·35 | 13 | 7·96 | 21 | 11·96 | 16 | 5·29 | 25 | 1·93 | 14 | 25·01 | 27 | 15·00 | 28 | 10·70 | 12 | 111·58 | 190 | 5·30 | July 7 to 8. |
| | | means during 1–2 years | — | — | — | — | — | — | — | — | 9·78 | 19 | 8·38 | 24 | 6·86 | 14 | 2·86 | 15 | 5·88 | 16 | 19·80 | 24 | 11·68 | 22 | 6·44 | 8 | — | — | 5·30 | July 7 to 8, 1928. |
| Amparai Tank .. | 90 | 1928 .. | 13·43 | 16 | 3·57 | 11 | 2·53 | 4 | 4·04 | 12 | 1·70 | 7 | 0·00 | 0 | 3·79 | 6 | 2·48 | 5 | 0·84 | 5 | 4·16 | 12 | 17·95 | 24 | 7·65 | 13 | 62·14 | 115 | 3·66 | Jan. 4 to 5. |
| | | means during 53 years .. | 14·81 | 12 | 4·82 | 5 | 3·45 | 5 | 3·16 | 6 | 3·68 | 5 | 2·13 | 3 | 1·91 | 3 | 2·90 | 5 | 4·29 | 6 | 8·77 | 12 | 12·44 | 13 | 18·02 | 15 | 80·38 | 91 | 19·20 | Dec. 7 to 8, 1881. |
| Andankulam Tank, Trincomalee | 40 | 1928 .. | 7·03 | 9 | 5·13 | 5 | 0·43 | 1 | 2·34 | 4 | 1·55 | 1 | 0·47 | 1 | 2·08 | 5 | 5·35 | 8 | 0·88 | 2 | 9·22 | 10 | 23·21 | 23 | 8·15 | 13 | 65·84 | 82 | 3·80 | Oct. 13 to 14, & Nov. 10 to 11. |
| | | means during 38 years .. | 7·81 | 10 | 1·66 | 3 | 1·70 | 3 | 1·50 | 4 | 2·07 | 3 | 0·85 | 1 | 1·58 | 3 | 2·93 | 5 | 3·34 | 6 | 6·72 | 11 | 14·07 | 16 | 14·96 | 15 | 59·20 | 79 | 9·70 | Dec. 27 to 28, 1921. |
| Annfield Estate, Dikoya (An.) | 4,300 | 1928 .. | 3·25 | 11 | 3·25 | 6 | 2·32 | 6 | 11·42 | 16 | 4·99 | 13 | 14·51 | 25 | 14·10 | 19 | 14·38 | 24 | 5·08 | 15 | 14·51 | 28 | 15·88 | 26 | 5·36 | 11 | 109·05 | 200 | 2·61 | July 10 to 11. |
| | | means during 41 years .. | 3·99 | 10 | 2·25 | 6 | 6·25 | 12 | 9·26 | 17 | 8·81 | 17 | 16·30 | 25 | 15·50 | 26 | 11·42 | 23 | 10·66 | 21 | 12·72 | 22 | 9·62 | 18 | 6·13 | 13 | 112·98 | 211 | 8·79 | Oct. 4 to 5, 1913. |
| Anningkanda Estate, Deniyaya | 1,550 | 1928 .. | 5·32 | 15 | 2·40 | 8 | 14·65 | 18 | 9·74 | 17 | 6·34 | 23 | 6·67 | 24 | 9·15 | 17 | 10·91 | 26 | 4·17 | 19 | 20·15 | 30 | 21·25 | 29 | 18·28 | 21 | 129·03 | 247 | 5·25 | Dec. 29 to 30. |
| | | means during 51 years .. | 8·86 | 14 | 7·27 | 10 | 10·66 | 15 | 12·80 | 18 | 12·65 | 17 | 13·15 | 21 | 9·29 | 18 | 7·94 | 17 | 10·85 | 17 | 16·13 | 21 | 17·45 | 21 | 13·58 | 19 | 140·64 | 209 | 7·98 | Oct. 27 to 28, 1906. |
| Anuradhapura — Survey Office | 295 | 1928 .. | 6·21 | 10 | 1·99 | 8 | 3·08 | 6 | 4·78 | 12 | 3·20 | 2 | 0·00 | 0 | 4·72 | 5 | 0·13 | 1 | 0·12 | 1 | 5·75 | 12 | 17·73 | 25 | 6·69 | 14 | 54·40 | 96 | 3·88 | Nov. 14 to 15. |
| | | means during 59 years .. | 4·02 | 9 | 1·55 | 4 | 2·86 | 7 | 6·67 | 13 | 3·35 | 7 | 1·28 | 4 | 1·33 | 3 | 1·72 | 4 | 2·99 | 6 | 9·55 | 16 | 10 71 | 18 | 8·66 | 16 | 54·70 | 105 | 9·32 | May 20 to 21, 1891. |
| Anuradhapura — Experiment Station | 295 | 1928 .. | 3·83 | 5 | 3·53 | 5 | 0·69 | 2 | 4·58 | 11 | 0·97 | 2 | 0·00 | 0 | 5·07 | 5 | 0·00 | 0 | 0·00 | 0 | 5·98 | 10 | 15 22 | 23 | 10·96 | 11 | 50·83 | 74 | 7·56 | Dec. 27 to 28. |
| | | means during 5–6 years.. | 8·03 | 9 | 1·33 | 3 | 4·01 | 7 | 4·75 | 8 | 3·29 | 6 | 0·14 | 1 | 1·43 | 2 | 0·92 | 2 | 4·93 | 5 | 7·51 | 12 | 11·27 | 5 | 8·21 | 12 | 55·82 | 81 | 7·56 | Dec. 27 to 28, 1928. |
| Arachchi Amuna (A. A.) . | 135 | 1928 .. | 2·52 | 8 | 2·05 | 7 | 3·28 | 8 | 7·32 | 14 | 4·29 | 11 | 4·53 | 17 | 5·18 | 11 | 8·63 | 19 | 0·80 | 3 | 9·94 | 24 | 10·84 | 20 | 11·08 | 19 | 70·46 | 161 | 3·78 | Dec. 26 to 27. |
| | | means during 12 years .. | 4·08 | 10 | 2·40 | 6 | 7·63 | 11 | 5·26 | 10 | 5·93 | 12 | 5·58 | 16 | 4·68 | 14 | 4·04 | 13 | 5·45 | 13 | 6·29 | 14 | 9·71 | 16 | 9·55 | 15 | 70·60 | 149 | 7·40 | Dec. 6 to 7, 1919. |
| Aranayaka (Ar.) .. | 1,000 | 1928 .. | 7·05 | 10 | 4·49 | 6 | 2·09 | 7 | 12·29 | 13 | 2·48 | 5 | 11·25 | 20 | 13·25 | 15 | 7·06 | 19 | 2·45 | 11 | 16·74 | 26 | 15·12 | 24 | 6·54 | 11 | 100·81 | 167 | 4·67 | July 7 to 8. |
| | | means during 23 years .. | 4·32 | 8 | 1·95 | 3 | 6·33 | 10 | 7·42 | 12 | 7·13 | 11 | 13·64 | 20 | 11·19 | 18 | 8·07 | 16 | 8·40 | 13 | 14·17 | 19 | 11·22 | 17 | 7·32 | 11 | 101·16 | 158 | 9·30 | Oct. 4 to 5, 1913. |