

HONGKONG.

REPORT OF THE DIRECTOR OF THE OBSERVATORY FOR 1889.

Presented to the Legislative Council, by Command of His Excellency the Officer Administering the Government.

HONGKONG OBSERVATORY,
24th April, 1890.

SIR,—My fifth volume of observations and researches was published early in spring last year and I have the honour to submit herewith my sixth volume in manuscript as ordered by His Excellency the Governor. It consists in addition to this, the annual departmental report, of the usual annual synopsis of meteorological and magnetic means and extremes. Then follow the usual twelve monthly reports for 1889, as ordered by the Secretary of State, on 120 pages. Appendix A. contains hourly readings of tides for 1887 and 1888 as well as the mean sea level obtained therefrom.

2. Curves from the automatic tide-gauge for 1889 are available and will be read off whenever assistants can be spared for such work.

3. Owing to the necessity of having meteorological observations made hourly from 7a. till 10p. inclusive and work connected with weather intelligence, storm-warnings, and tidal observations, which have been by degrees added by me with the approval of the Governor to the work ordered by the Secretary of State, and none of which latter may be discontinued, the staff is so hard worked that I ventured last summer to call His Excellency's attention to the necessity for appointing another European as chief assistant. His assistance would also be available during bad weather connected with typhoons, when as a rule the native assistants desert, as might be expected from them, and he would assist in collecting information about typhoons. Such an appointment would enable His Excellency to grant leaves of absence to which the officials are entitled. This is at present impossible without stopping some of the work, as substitutes cannot be found to act for half of the small salaries available.

4. Direct and efficient telegraphic connection with the Telegraph Companies' Offices in Queen's Road and also with the station at Victoria Peak, which are absolutely necessary for the issue of local storm-warnings, have been ordered and will probably be ready for use during next typhoon-season.

5. Very important returns are received monthly from South Cape (Formosa),—the most important meteorological station in the Far East. Telegraphic information from there would make a great advance in the storm-warnings but the necessary connections have not yet been established by the Chinese authorities. Meantime I receive messages from Anping, which although irregular and liable to interruption are of some importance. Returns from South Cape would not only furnish negative evidence in case of typhoons in the China Sea but would enable the isobars to be projected more exactly. It is to be remarked that observations made in Formosa and in Luzon are generally of comparatively inferior value owing to wind-deflection caused by the high mountain-chains, that form the backbones of those islands. This is more especially the case in Northern Formosa and telegrams from there would be only misleading but as proved in my paper in *Nature* referred to below, the returns from South Cape are usually not at all affected by the hills. For the exact determination of the situation of the centre of a typhoon raging in the China Sea, the latter should be by degrees surrounded by telegraphic reporting stations.

6. During a stay in June in the Government Pavilions at the Peak, which I had not before visited, I made observations, which shewed the importance of the signal-station for meteorological records but unfortunately also indicated that those kept there at present are not at all sufficient. I introduced some minor improvements and reported to the Governor concerning the extension required. His Excellency took my suggestions into consideration but deferred the final decision. The case is that a certain kind of typhoons is indicated much earlier at the Peak than in the Observatory, near sea level, so that information from there would be a great help for the issue of early warnings. This has been fully explained in the paper in *Nature* referred to below.

7. A self-recording anemometer, rain-gauge, and sunshine recorder (duplicates of the apparatus in Hongkong) have been erected by the Imperial Maritime Customs at South Cape, Formosa, and the curves are received regularly. A similar station is wanted at the Peak. Major-General PALMER, R.E.; foresaw this many years ago and recommended an anemograph in his ably written report.

8. Some further information concerning the typhoons of 1888 has been collected, but the data are not yet complete. With reference to the past year in addition to observations made at over 40 stations on shore, the logs of 93 different vessels containing entries on 1216 days (counting those made on board different ships on the same date separately) are available. A number of log-books have of course been looked through without entries bearing on typhoons having been found. By order of His Excellency the Admiral, Commander-in-Chief, a copy of all meteorological observations made on board men-of-war belonging to the squadron stationed in these seas are sent to the Observatory and Commanders of foreign vessels of war send such observations as are requested direct or through the Commodore.—86 log-books or extracts of log-books were received through the Harbour Master's Office, 44 direct from the Captains or Owners, and 5 were copied on board ship in the harbour. Owing to the illness of one of the assistants it was impossible for me to have log-books inspected on board ship since October, so that the information available is not yet complete.

9. Information has been supplied to the Royal Engineers, the Royal Navy, the Imperial Maritime Customs of China, the Public Works and the Medical Departments, the Harbour Office and to masters of vessels trading in the Chinese Seas.

10. All necessary repairs to buildings were made by the Public Works Department last autumn, and the Honourable S. BROWN, Surveyor General, introduced several improvements of great value, but the building is at present too small for the purpose. This is a serious drawback, as it lessens the amount of work that can be done here. Even the transit-room has to be used for tabulation and drawing.

11. Among scientific men who visited the Observatory may be mentioned Professors MICHIE SMITH and S. A. HILL from India and Mr. WADA from Tokio.

12. The sudden snap of cold weather that set in during November caused a great deal of sickness in Kowloon and it became nearly impossible to continue the records without interruption.

13. The following papers were published in Europe in the course of the past year:—

“The Law of Storms in China,” (*Nature*, Vol. XXXIX, p. 301).

“Rainfall in China in 1888,” (*Quart. Journ. R. Met. Soc.* Vol. XV, No. 72.)

“Sunshine in Formosa in 1888.”

“Meteorological Observations made at Ichang and South Cape in 1888.”

“Mean pressure of the air in Iloilo” (Philippines) (*Meteorologische Zeitschrift*. VI p. 156).

A larger investigation of the climate of Hongkong from five years' observations on which much work has been expended is now nearly ready for press besides some papers of minor importance. Professor HANN in Vienna, who had previously published monthly means of air-pressure in Hongkong in which several years of observations made by the Royal Engineers were added to the series given in “Observations and Researches made during the year 1884” and who has also harmonically analysed the hourly means of air-pressure obtained during the last few years, has published an investigation of the rainfall in Hongkong on the basis of the hourly readings taken here from the beginning of 1884 till the end of 1888.

14. The volunteer, who last year contributed observations of crepuscular rays, observed during a portion of the past year the spectroscopic rain-band every morning at 10a. The figures from the 12th June till the 8th July were entered on the Peak. By comparing the intensity of the band (0-5) with the rainfall during the subsequent 24 hours, printed in inches and decimals beside the intensity of the rainband, it was noticed that intensities 0 and 1 forecast absence of rain very accurately, and that intensities 4 and 5 forecast as a rule very wet weather,—the latter indication moreover being frequently followed by great thunderstorms, that cannot be otherwise forecast from local observations. The following record from which the annual variation of the band is seen to be great, is therefore interesting.

TABLE I.

Rain-band in Hongkong in 1889.

Date.	April.		May.		June.		July.		August.		September.		October.		November.		December.	
1,	4	0.11	3	0.24	2	—	2	0.09	0	0.55	3	0.53	4	0.16	3	0.01	3	0.01
2,	3	0.88	3	—	2	0.71	3	—	4	0.29	3	0.09	3	0.01	2	—	2	—
3,	2	—	2	—	2	0.24	2	—	4	1.23	1	—	2	0.01	1	—	1	—
4,	3	0.07	2	—	2	0.06	1	—	5	2.58	0	—	1	—	1	—	0	—
5,	2	2.36	1	0.00	4	0.07	2	—	4	2.10	1	—	2	0.01	2	—	0	—
6,	4	0.08	2	—	2	0.65	2	—	3	0.39	1	—	2	0.01	2	0.01	2	—
7,	2	0.10	2	0.11	3	0.09	1	—	4	1.23	1	—	1	—	3	—	2	0.04
8,	3	0.01	3	—	4	0.85	1	—	3	0.01	3	3.99	1	—	3	—	2	0.01
9,	2	—	3	—	4	0.29	1	—	4	0.01	5	1.84	3	0.06	2	—	1	—
10,	2	—	2	—	3	0.08	1	—	2	0.09	1	0.04	3	—	1	—	1	—
11,	2	—	2	—	3	—	1	—	3	0.69	3	0.02	1	—	1	—	1	—
12,	3	—	2	—	2	—	2	—	4	0.75	2	—	2	—	1	—	0	—
13,	3	0.03	1	0.01	2	0.21	2	—	3	0.52	0	—	1	—	1	—	0	—
14,	2	—	1	—	2	0.36	1	—	4	2.48	1	—	1	—	0	—	0	—
15,	3	—	1	—	4	0.57	2	—	4	0.13	0	—	4	2.65	0	—	0	—
16,	2	0.01	2	—	4	2.61	2	0.94	3	0.04	1	0.05	5	1.10	0	—	2	—
17,	?	—	3	0.21	4	0.53	3	0.83	2	—	3	1.94	4	—	1	—	2	—
18,	?	0.22	3	4.83	3	0.23	3	0.26	2	—	4	0.12	2	—	0	—	1	—
19,	?	—	5	2.07	3	0.36	3	0.01	1	—	4	0.03	1	—	1	—	1	—
20,	2	—	5	1.95	3	0.03	1	0.04	1	0.38	3	—	3	0.18	0	—	1	—
21,	?	1.29	4	1.42	2	0.20	2	0.25	4	1.97	1	—	4	0.13	0	—	0	—
22,	?	—	4	1.55	2	0.41	3	0.04	3	0.42	1	—	4	0.10	3	0.43	0	—
23,	1	—	3	0.05	2	0.07	3	0.02	3	0.04	2	—	4	—	4	0.71	0	—
24,	?	0.10	3	0.02	2	0.53	2	—	4	2.18	3	0.06	3	—	4	0.06	1	—
25,	?	—	3	1.71	2	0.55	3	0.09	4	0.01	3	0.95	4	0.45	3	0.01	1	0.11
26,	?	—	4	0.43	2	0.18	2	—	2	—	4	0.82	5	3.16	2	0.08	2	—
27,	?	0.02	4	0.73	2	—	3	1.31	1	—	4	0.16	3	—	2	0.01	2	—
28,	?	0.01	3	6.06	1	0.18	3	—	1	—	3	0.55	2	—	3	—	2	—
29,	?	5.50	5	22.86	3	0.51	2	—	0	—	4	0.29	3	—	3	0.02	0	—
30,	4	1.47	5	4.53	3	0.24	2	—	1	0.04	4	0.92	2	—	4	0.01	0	—
31,	—	—	2	0.03	—	—	1	—	2	0.10	—	—	2	0.18	—	—	0	—
Mean,...	2.6	—	2.8	—	2.6	—	2.0	—	2.7	—	2.2	—	2.7	—	1.8	—	1.0	—

15. The number of transits observed during the past year was 367, and the inclination of the axis was determined 124 times. The mean daily rates during ten-days periods in 1889 are exhibited in the following table, where -- means gaining and + losing rate. The rates are represented by the following formula:—

$$R_o = +0^{\circ}.09 - 0^{\circ}.00197t - 0^{\circ}.0000018t^2 - 0^{\circ}.063 (\tau - 70^{\circ}).$$

where t is counted from the 3rd July 1889. The observed rate minus the computed rate is exhibited under the heading $R_o - R_c$.

TABLE II.

Rate of Sidereal Standard Clock in 1889.

Period.	Rate.	Temp.	$R_o - R_c$.
December 30- 9,	+0 ^s .59	66° 0	-0 ^s .05
January 9-19,	+0. 51	65. 8	-0. 13
" 19-29,	+0. 71	64. 9	+0. 03
" 29- 8,	+0. 69	64. 1	-0. 03
February 8-18,	+0. 81	64. 9	+0. 16
" 18-28,	+0. 60	66. 5	+0. 06
" 28-10,	+0. 53	66. 9	+0. 04
March 10-20,	+0. 42	66. 7	-0. 07
" 20-30,	+0. 40	66. 0	-0. 12
" 30- 9,	+0. 36	66. 5	-0. 11
April 9-19,	+0. 14	70. 9	-0. 04
" 19-29,	+0. 15	71. 4	+0. 02
" 29- 9,	-0. 14	77. 0	+0. 11
May 9-19,	-0. 39	81. 1	+0. 14
" 19-29,	-0. 35	77. 5	-0. 03
" 29- 8,	-0. 62	81. 4	-0. 03
June 8-18,	-0. 74	81. 6	-0. 13
" 18-28,	-0. 77	83. 7	-0. 02
" 28- 8,	-0. 77	85. 0	+0. 08
July 8-18,	-0. 78	85. 8	+0. 14
" 18-28,	-0. 82	84. 2	+0. 02
" 28- 7,	-0. 75	82. 3	0. 00
August 7-17,	-0. 80	81. 6	-0. 08
" 17-27,	-0. 90	83. 1	-0. 07
" 27- 6,	-0. 83	83. 1	+0. 02
September 6-16,	-0. 81	81. 3	-0. 06
" 16-26,	-0. 80	80. 6	-0. 07
" 26- 6,	-0. 87	81. 8	-0. 03
October 6-16,	-0. 90	82. 0	-0. 02
" 16-26,	-0. 89	80. 1	-0. 11
" 26- 5,	-0. 78	75. 6	-0. 27
November 5-15,	-0. 48	70. 7	-0. 25
" 15-25,	-0. 32	70. 2	-0. 09
" 25- 5,	-0. 28	69. 0	-0. 10
December 5-15,	-0. 08	66. 7	-0. 02
" 15-25,	-0. 02	66. 7	+0. 07
" 25- 4,	+0. 04	66. 4	+0. 14

16. As stated in the time-ball notice published in the *Government Gazette* on the 10th January, 1885, the ball is not dropped on Sundays and on Government Holidays. The ball was dropped every working day during the past year except on the 28th February, when it failed to drop owing to the spring in the lock not being tight enough, on the 3rd of May, when it failed owing to a broken wire in the reversing galvanometer, on the 11th November, when it failed owing to the discharging battery working badly, and on the 20th December, when it failed owing to the spring in the lock not being tight enough.—On the 29th and 30th May and on the 17th June the ball was not hoisted on account of thunderstorms, and on the 16th October owing to the absence of all the native assistants on account of bad weather.—On July 23rd the ball was not hoisted owing to the failure of one of the switches.—On the 13th June the ball could not be hoisted as it jammed against the mast and from the 21st to the 29th October it was under repair because the top of the ball was torn by the mast being out of shape, which was apparently due to the constant action of more or less strong monsoon.—New switches have been procured, new batteries have been ordered and it is intended to procure a new reversing galvanometer, as the old one requires to have all the covered wires renewed.

TABLE III.

Errors of Time-Ball in 1889.

- means too late.

+ means too early.

Date.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1, .....	...	0 ^s .1	+0 ^s .2	+0 ^s .8	+0 ^s .5	0 ^s .1	0 ^s .1	0 ^s .1	...	0 ^s .1	0 ^s .1	...
2,	0 ^s .1	0.1	+0.2	+0.8	+0.6	...	0.1	0.1	0 ^s .1	0.1	0.1	-0 ^s .5
3,	0.1	...	...	+0.9	...	+0.2	0.1	+0.2	0.1	-0.2	...	-0.2
4,	0.1	0.1	+0.3	+0.9	+0.7	0.1	+0.2	...	0.1	0.1	0.1	-0.5
5,	0.1	0.1	+0.4	+0.7	...	0.1	0.1	...	0.1	0.1	0.1	+0.2
6, .....	...	+0.2	0.1	0.1	0.1	0.1	0.1	+0.5	0.1	...	-0.2	0.1
7,	-0.5	0.1	0.1	...	-0.2	0.1	...	0.1	0.1	0.1	-0.2	0.1
8,	-0.7	-0.2	+0.2	0.1	-0.1	0.1	0.1	0.1	...	0.1	-0.3	...
9,	0.1	-0.4	+0.2	+0.2	0.1	...	0.1	0.1	0.1	0.1	0.1	0.1
10,	0.1	...	...	+0.3	0.1	...	0.1	0.1	0.1	0.1	...	-0.2
11,	+0.2	-0.2	+0.4	+0.4	+0.2	0.1	0.1	...	-0.3	0.1	...	0.1
12,	+0.3	0.1	+0.5	0.1	...	0.1	0.1	0.1	0.1	0.1	0.1	0.1
13, .....	...	0.1	+0.6	+0.2	+0.4	...	+0.2	0.1	0.1	...	0.1	-0.3
14,	+0.7	+0.2	+0.2	...	+0.5	0.1	...	0.1	0.1	0.1	-0.2	-0.5
15,	0.1	0.1	+0.2	+0.5	+0.6	0.1	0.1	0.1	...	+0.2	0.1	...
16,	0.1	0.1	+0.3	+0.6	0.1	...	-0.1	-0.1	0.1	...	0.1	-0.1
17,	-0.2	...	...	0.1	0.1	...	0.1	+0.3	0.1	+0.3	...	0.1
18,	-0.3	+0.2	0.1	0.1	0.1	0.1	0.1	...	0.1	0.1	+0.2	+0.2
19,	-0.5	0.1	-0.2	...	...	0.1	0.1	0.1	+0.2	0.1	+0.4	0.1
20, .....	...	+0.2	0.1	+0.2	-0.3	0.1	+0.2	0.1	0.1	...	+0.6	...
21,	-0.9	0.1	0.1	...	0.1	0.1	...	+0.3	0.1	...	0.1	0.1
22,	-1.1	0.1	0.1	...	0.1	0.1	+0.3	+0.4	...	...	+0.3	...
23,	0.1	0.1	+0.2	0.1	0.1	...	...	0.1	+0.2	...	+0.4	0.1
24,	-0.2	...	...	-0.2	...	0.1	+0.2	0.1	+0.3	...	...	...
25,	0.1	+0.2	+0.3	0.1	0.1	0.1	+0.2	...	+0.4	...	+0.6	...
26,	0.1	+0.2	+0.3	0.1	...	-0.2	+0.3	0.1	+0.6	...	+0.5	...
27, .....	...	+0.2	+0.4	0.1	0.1	0.1	0.1	-0.2	0.1	...	0.1	0.1
28,	0.1	...	+0.4	...	0.1	0.1	...	0.1	0.1	...	-0.2	-0.3
29,	0.1	...	+0.5	0.1	...	0.1	-0.2	-0.1	...	...	-0.3	...
30,	+0.2	...	+0.7	+0.3	...	...	0.1	0.1	...	0.1	-0.4	0.1
31, .....	...	...	...	...	-0.3	...	-0.2	0.1	...	0.1	...	0.1

17. The probable errors of the signal in the different months of 1889 (with the average percentage of clouded sky added in parenthesis) were as follows:—

January 0^s.24 (86), February 0^s.13 (62), March 0^s.23 (94), April 0^s.28 (84), May 0^s.20 (81), June 0^s.09 (76), July 0^s.12 (50), August 0^s.12 (63), September 0^s.13 (57), October 0^s.10 (57), November 0^s.20 (62), December 0^s.16 (60).—The mean of the probable errors was 0^s.17.

18. During the past five years the time-ball has been dropped 1465 times, or perhaps about 1500 times if the experiments be taken into account.—An error of less than 0^s.15 occurred 804 times, of 0^s.2 = 249 times, of 0^s.3 = 142 times, of 0^s.4 = 88 times, of 0^s.5 = 61 times, of 0^s.6 = 36 times, of 0^s.7 = 30 times, of 0^s.8 = 16 times, of 0^s.9 = 15 times, of 1^s.0 = 9 times, of 1^s.1 = 5 times, of 1^s.2 = 3 times, of 1^s.3 = 3 times, of 1^s.4 = 1 time, of 1^s.5 = 2 times, of 1^s.6 = 1 time.—From this distribution of errors it appears that the accuracy of the signal has been under-estimated. In the calculation in fact all errors less than 0^s.15 have been taken as equal to 0^s.1:—With the value of the probable error 0^s.15, which follows from the figures, we obtain for the frequency of errors less than 0^s.15 = 733, of 0^s.2 = 350, of 0^s.3 = 213, of 0^s.4 = 106, of 0^s.5 = 43, of 0^s.6 = 15, of 0^s.7 = 4, of 0^s.8 = 1.—The occurrence of errors more than five times as large as the probable error is common enough in practise although it is not explained by the theory of least squares in the form in which it is given in the text books.

19. As stated in the "Instructions for making Meteorological Observations, etc." meteorological instruments forwarded by observers who regularly send their registers this Observatory, are verified here free of cost. During the past year, the following number of instruments was verified and certificates issued:—Barometers = 3, Thermometers = 6. The index errors of barometers read off on board ship are determined whenever required by comparing readings made near this port with the barograms.

20. In the "China Coast Meteorological Register," based on information transmitted by the Eastern Extension, the Great Northern and the Imperial Chinese Telegraph Companies, which was daily published is given a summary of the atmospheric circumstances in the Far East. It contains also information concerning the first appearance and progress of typhoons and gives an account of all storm-warnings issued.

21. From 3.30 p. on the 29th of May till the same time on the 30th there fell 22.535 inches of rain. This occurred during thunderstorms of unusually great duration. The floods caused by the rain proved a disaster to the Colony. Roads and streets were cut up, retaining walls carried away, sewers burst and houses undermined, but only few persons were killed by the lightning.

22. At the Observatory the cisterns of the barograph and standard barometer are placed 109 feet above mean sea level. The bulbs of the thermometers are rotated 108 feet above mean sea level and 4 feet above the grass. The solar radiation thermometer is placed at the same height. The rim of the rain-gauge is 105 feet above mean sea level and 21 inches above the ground. At Victoria Peak the instruments, except the solar radiation thermometer and the rain-gauge are placed in the lookout. The cistern of the barometer is 1814 feet above sea level. The bulbs of the thermometers are 4 feet above the floor except the maximum thermometer, which is a few inches higher. The rim of the rain-gauge is 8 inches in diameter and one foot above the ground.

23. The monthly Weather Reports are arranged as follows:—

Table I. exhibits the hourly readings of the barometer reduced to freezing point of water but not to sea level, as measured (at two minutes to the hour named) from the barograms.

Tables II. and III. exhibit the hourly readings of the temperature of the air, and of the temperature of evaporation as determined from readings of thermometers exposed in a suitable shelter, and as measured from the thermograms. All readings are reduced to the rotating thermometers by comparisons made every three hours. Table II exhibits also the extreme temperatures during the day reduced to the rotating thermometer by aid of comparisons made during the hottest and coldest part of the day. Table III. exhibits also the solar radiation (black bulb in vacuo) maximum temperature reduced to the Kew arbitrary standard.

Table IV. exhibits the mean relative humidity in percentage of saturation and mean tension of water vapour present in the air expressed in inches of mercury for every hour in the day and for every day in the month calculated by aid of Blanford's tables from the data in Tables II and III.

Table V. exhibits the duration of sunshine expressed in hours from half an hour before to half an hour after the hour (true time) named.

Table VI. exhibits the amount of rain in inches registered from half an hour before to half an hour after the hour named. It exhibits also the duration of rain estimated at the Observatory. The rainfall at Victoria Peak is measured at 10a. and entered to preceding day, but it is evident that the observer does not attend to the gauge every day.

Table VII. exhibits the velocity of the wind in miles and its direction in points (0—31). The velocity of the wind is measured from half an hour before to half an hour after the hour named; but the direction is read off at the hour except when it is very light and changeable, in which case the average direction during the hour is estimated, taking into account the velocity from different quarters. The direction is not noted when the velocity is below 1.5 miles an hour. The vane is to be depended on except when the velocity is uniform (which of course rarely happens) and below 3 miles an hour.

Table VIII. exhibits for every hour in the day the mean velocity of the wind reduced to 4 as well as to 2 directions, according to strictly accurate formulæ, and also the mean direction of the wind. The method made use of during the past five years has been abandoned as it does not furnish the mean direction for every day, which latter is this year given in Table VII.

Table IX. exhibits the readings of the barometer reduced to freezing point of water but not to sea level, and of the thermometers, and the observations of the direction (to two points) and force (0—12) of the wind at Victoria Peak.

Table X. exhibits the amount (0—10), name and direction whence coming of the clouds. Where the names of upper and lower clouds are given but only one direction, this refers to the lower clouds.

24. The following annual weather report for 1889 is arranged as follows:—

Table IV. exhibits the mean values for the year (or hourly excess above this) obtained from the means given in the monthly reports. The mean hourly intensity of rain is obtained from Table VI. of the monthly reports in connection with Table V of this report. The total amount of rain was 119.715 at the Observatory and 133.32 at the Peak. The total duration registered at the Observatory was 905 hours. There fell at least 0.01 inch of rain on 161 days at the Observatory. The figure 103 given for the Peak is evidently inaccurate.

Table V. exhibits the number of hours during a portion of which at least 0.005 inch of rain was registered.

Table VI. exhibits the total distance traversed by as well as the direction and average velocity of winds from bi-quadrantal points, obtained from the tables published on the first page of each monthly report.

Table VII. exhibits the number of days on which certain meteorological phenomena were registered and also the total number of thunderstorms noted in the neighbourhood during the past year.

Table VIII. shows the frequency of clouds of the different classes.

Table IX. is arranged the same as last year.

Table X. exhibits the monthly and annual extremes. The extremes given for humidity and vapour tension can be regarded as only approximate as the hourly values are not calculated.

Table XI. contains the five-day means.

25. The following table exhibits the differences between the monthly mean components (exactly computed) and direction of the wind given in Table VIII. of the monthly reports and those computed by the methods used in the five years 1884-1888, and explained in previous reports; the exact values minus the approximate values:—

1889.	N.	E.	S.	W.	+N-S	+E-W	Direction (0°-359°).
January,	+1.01	+0.35	+0.30	+0.03	+0.82	+0.32	-4°
February,	+0.99	+0.20	+0.40	+0.03	+0.69	+0.17	-3°
March,	+1.37	+0.16	+0.22	0.00	+1.05	+0.05	-5°
April,	+1.36	+0.11	+0.42	+0.02	+0.94	+0.09	-4°
May,	+0.80	+0.21	+0.39	+0.07	+0.40	+0.24	-3°
June,	+0.08	+0.28	+0.45	+0.18	-0.36	+0.10	-1°
July,	+0.15	+0.20	+0.47	+0.24	-0.31	+0.05	0°
August,	+0.32	+0.18	+0.46	+0.06	-0.04	+0.11	+1°
September,	+0.80	+0.35	+0.34	+0.01	+0.46	+0.34	-2°
October,	+0.71	+0.35	+0.28	+0.08	+0.43	+0.27	-1°
November,	+0.75	+0.60	+0.18	-0.03	+0.47	+0.63	-1°
December,	+0.67	+0.60	+0.39	+0.02	+0.28	+0.58	0°
Mean,.....	+0.75	+0.30	+0.36	+0.06	+0.40	+0.25	-2°

26. Magnetic Observations made during the year 1889:—

The observations of Declination and Horizontal Force were made with the Unifilar Magnetometer, Elliott Brothers, No. 55, and the Dips were observed with Dip Circle Dover, No. 71.

The methods adopted in making the observations and in determining and applying the corrections are explained in *Appendix G. of Obs. and Res. made in 1885*: "On the verification of the Unifilar Magnetometer, Elliott Brothers, No. 55." The value of $\log. H^2 K.$ was 3.44944 at 20° Cent., and the value of P was + 7.596. The mean value of the magnetic moment of the vibrating needle was 0.47487 in British Units and 619.97 in C.G.S. Units.

The times of vibration exhibited in the table are each derived from 12 observations of the time occupied by the magnet in making 100 vibrations, corrections having been applied for rate of chronometer and arc of vibration.

The observations of horizontal force are expressed in C. G. S. Units (one centimeter, one gramme, one second), but the monthly synopsis exhibits X, the horizontal as well as Y, the vertical, and the total forces, which have been computed by aid of the observed dips, and their values are also given in British Units (one foot, one grain, one second), and in Gauss's Units (one millimeter, one milligram, one second).

27. Dr. C. Schrader explains in his report on the magnetic survey of German New Guinea that the constants of his magnetometer were determined from comparisons made at the observatories in Hongkong, Washington and Wilhelmshafen. The comparisons made in Batavia did not agree as far as the horizontal intensity was concerned.

I have the honour to be,

Sir,

Your most obedient Servant,

W. DOBERCK,
Director.

The Honourable W. M. DEANE,
Acting Colonial Secretary,

§c., §c., §c.

TABLE IV.
Mean Values and Hourly Excess above the Mean of Meteorological Elements in 1889.

	Mean or Total.																									
	1 a.	2 a.	3 a.	4 a.	5 a.	6 a.	7 a.	8 a.	9 a.	10 a.	11 a.	Noon.	1 p.	2 p.	3 p.	4 p.	5 p.	6 p.	7 p.	8 p.	9 p.	10 p.	11 p.	Midt.	Observ-atory.	Peak.
Pressure,	+ .003	-.008	-.016	-.018	-.013	+ .001	+ .017	+ .033	+ .044	+ .046	+ .035	+ .017	-.006	-.027	-.040	-.045	-.042	-.032	-.017	-.001	+ .013	+ .021	+ .020	+ .013	29.844	28.113
Temperature,	- 1.3	- 1.6	- 1.7	- 1.9	- 2.1	- 2.1	- 1.5	- 0.5	+ .04	+ .13	+ .20	+ .23	+ .26	+ .26	+ .23	+ 1.7	+ 1.1	+ 0.2	- 0.2	- 0.4	- 0.6	- 0.7	- 1.0	- 1.1	72.1	66.6
Diurnal Range,	+ .005	+ .004	-.001	-.005	-.009	-.012	+ .009	-.009	-.011	-.009	-.004	-.000	+ .002	+ .003	+ .001	+ .002	-.003	+ .006	+ .003	+ .002	+ .008	+ .008	+ .008	+ .007	8.2	5.6
Humidity,	+ .455	.470	.615	.527	.687	.742	.457	.519	.497	.753	.647	.835	.317	.366	.384	.347	.287	.320	.198	.172	.220	.280	.152	.288	0.663	1755.3
Vapour Tension, .....	.41	.188	.148	.135	.156	.189	.119	.138	.149	.238	.259	.133	.106	.152	.125	.130	.088	.110	.091	.057	.085	.084	.054	.115	119.715	133.32
Shine (Total), .....	.133	.188	.148	.135	.156	.189	.119	.138	.149	.238	.259	.133	.106	.152	.125	.130	.088	.110	.091	.057	.085	.084	.054	.115	905	905
Hours of Rain (Total),	- 1.0	- 1.2	- 1.2	- 1.1	- 1.1	- 1.1	- 0.7	- 0.1	+ .04	+ 1.2	+ 2.2	+ 2.1	+ 2.0	+ 2.1	+ 1.9	+ 1.2	+ 0.3	- 0.6	- 0.9	- 1.0	- 0.9	- 0.9	- 0.9	- 0.9	0.131	0.131
Intensity of Rain,	- 1.0	- 1.2	- 1.2	- 1.1	- 1.1	- 1.1	- 0.7	- 0.1	+ .04	+ 1.2	+ 2.2	+ 2.1	+ 2.0	+ 2.1	+ 1.9	+ 1.2	+ 0.3	- 0.6	- 0.9	- 1.0	- 0.9	- 0.9	- 0.9	- 0.9	13.6	22.5
Wind-Velocity,	+ 3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	E 4° S	E 29° S
Wind-Direction, .....	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	69	69
Cloudiness, .....	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	129.0	129.0
Solar Radiation, .....	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	52.4	52.4
Excess of do. do., .....	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE V.

Number of Hours, during portion of which it rained, for each Month in the Year 1889 at the Observatory.

Month.	Number of Hours												Total.												
	1 a.	2 a.	3 a.	4 a.	5 a.	6 a.	7 a.	8 a.	9 a.	10 a.	11 a.	Noon.		1 p.	2 p.	3 p.	4 p.	5 p.	6 p.	7 p.	8 p.	9 p.	10 p.	11 p.	Midt.
January,	1	1	3	4	2	...	1	1	2	3	2	3	2	...	...	...	1	2	3	2	1	2	1	2	39
February,	3	1	3	4	2	1	1	...	2	2	1	1	2	2	1	5	2	4	2	4	3	4	2	1	46
March,	5	2	6	4	2	...	4	3	2	2	...	...	3	3	3	3	5	3	2	2	3	4	4	4	60
April,	3	4	3	1	3	4	4	3	2	2	1	1	3	3	3	6	8	5	4	4	4	3	3	4	74
May,	6	5	6	8	7	4	7	8	8	7	9	8	5	5	7	4	4	8	3	2	2	1	3	4	137
June,	3	4	5	4	4	5	8	7	5	7	4	3	5	5	9	4	4	5	4	4	3	2	2	3	107
July,	2	3	5	3	7	3	1	2	2	1	1	2	1	1	1	2	1	2	1	1	1	1	2	2	55
August,	6	6	9	8	10	7	8	5	8	7	3	3	4	1	5	4	5	7	7	3	6	6	3	5	185
September,	3	5	2	2	5	4	8	9	5	4	5	4	5	4	3	2	1	...	...	2	2	3	4	1	84
October,	6	5	5	4	6	10	4	5	3	3	3	3	4	3	4	4	5	5	2	4	3	5	6	2	100
November,	2	3	3	4	5	5	2	2	1	...	...	1	2	1	2	1	3	3	4	2	3	3	3	2	58
December,	1	2	...	1	...	1	1	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	10
Total,	41	41	50	47	53	47	46	45	40	38	30	30	36	28	37	32	39	36	26	36	31	33	34	30	905

TABLE VI.

Total Distance traversed by, as well as Total Duration and Average Velocity of Winds from eight different Points of the Compass during the year 1889.

WIND.	TOTAL DISTANCE. <i>Miles.</i>	DURATION. <i>Hours.</i>	VELOCITY. <i>Miles per hour.</i>
N,	12405	1045	11.9
NE,.....	10659	800	13.3
E,	67445	3799	17.8
SE,	6734	595	11.3
S,.....	9520	879	10.8
SW,.....	6112	504	12.1
W,.....	3840	437	8.8
NW,	2304	282	8.2
Calm,	261	419	0.6
Sums and Mean,.....	119280	8760	13.62

TABLE VII.

Total Number of Days on which different Meteorological Phenomena were noted and Total Number of Thunderstorms during each month of the year 1889.

Month.	Fog.	Electric Phenomena.	Lightning.	Thunder.	Thunderstorms.	Unusual Visibility.	Dew.	Rain-bows.	Lunar Halo.	Lunar Corona.	Solar Halo.	Solar Corona.
January, .....	...	...	...	...	...	1	2	...	...	...	...	...
February,	10	...	...	...	...	...	2	...	...	...	...	...
March,	14	3	3	2	1	1	...	...	2	1	3	...
April,	17	8	7	7	6	1	3	...	1	3	3	...
May,	3	15	14	10	5	1	7	...	4	5	1	...
June,	3	19	18	13	5	5	4	2	7	5	6	2
July,.....	2	12	11	4	...	7	7	5	4	5	9	3
August,	4	16	15	9	5	...	9	8	4	4	7	1
September, .....	...	11	11	1	1	1	1	3	6	8	5	2
October,	4	11	10	2	1	3	6	3	1	7	2	1
November,	4	...	...	...	...	...	2	...	3	7	1	...
December,	3	...	...	...	...	...	2	...	1	5	...	...
Sums,	64	95	89	48	24	20	45	21	33	50	37	9

TABLE VIII.

Total Number of Times that Clouds of different Forms were observed in each month of the year 1889.

Month.	c.	c-str.	c-cum.	sm-cum.	cum.	cum-str.	str.	R-cum.	cum-nim.	nim.
January,.....	...	3	2	22	110	...	29	40	34	20
February,	1	12	54	...	21	22	24	25
March,	7	...	18	110	...	65	18	16	39
April,.....	2	23	5	17	116	1	38	11	26	32
May,.....	...	41	23	19	137	2	5	26	37	44
June,	67	39	22	168	4	13	15	18	25
July,.....	...	78	19	12	156	1	1	14	17	13
August,	68	30	33	127	11	3	...	21	43
September,.....	...	47	22	14	149	2	2	7	9	23
October,	21	15	27	135	...	9	5	15	33
November,.....	...	28	17	52	76	...	16	8	24	22
December,	10	8	62	92	...	20	5	19	3
Sums,.....	2	393	181	310	1430	21	222	171	260	322

TABLE IX.

Month.	Baro- metric Tide.	Mean diurnal variabi- lity of Tempera- ture.	Tem- perature decrease. Height for 1°	RAIN FALL.		Hourly Intensity of Rain.	MEAN DIRECTION OF CLOUDS WHENCE COMING.			NUMBER OF DAYS WITH CLOUDS BELOW.	
				Mean 1878- 1887 inclus.	1889.		Lower.	Upper.	Cirrus.	2000 ft.	1000 ft.
	<i>ins.</i>	°	<i>feet.</i>	<i>ins.</i>	<i>ins.</i>	<i>ins.</i>					
January,	0.111	1.91	295	1.47	0.730	0.012	E	W	...	20	6
February,	0.103	2.99	380	1.66	0.720	0.015	SE by E	WSW	...	14	6
March,.....	0.098	3.26	518	3.53	2.490	0.028	ESE	W	...	24	16
April,.....	0.090	2.34	777	6.55	12.270	0.139	S by E	W by S	W	25	21
May,	0.092	1.63	311	9.82	48.840	0.379	S	W	...	29	11
June,	0.070	0.85	255	12.67	9.715	0.152	SSW	NW by W	...	22	4
July,	0.079	0.68	237	16.41	4.575	0.139	SSW	E by N	...	21	0
August,.....	0.075	1.04	295	16.93	18.140	0.211	SE by E	E	...	17	3
September,	0.080	0.96	259	9.89	11.800	0.223	E by S	E by S	...	12	1
October,.....	0.092	1.53	276	5.06	8.720	0.098	E	E by N	...	9	2
November,	0.104	1.99	276	1.04	1.540	0.024	E	SW by W	...	9	4
December,.....	0.119	2.16	290	0.49	0.175	0.016	E by N	WSW	...	4	1
Mean,.....	0.093	1.78	347	85.52	119.715	0.120	E 40° S	S 24° W	W	206	75

TABLE X.

Monthly Extremes of the Principal Meteorological Elements registered at the Observatory during the year 1889.

MONTH.	BAROMETER.		TEMPERATURE.		HUMI- DITY.	VAPOUR TENSION.		RAIN.		WIND VELOCITY.	RADIA- TION.
	Max.	Min.	Max.	Min.	Min.	Max.	Min.	Daily Max.	Hourly Max.	Max.	Sup. Max.
January,	30.250	29.794	69.6	46.6	51	0.604	0.205	0.250	0.105	34	139.4
February, .....	.390	.776	76.2	40.3	11	0.767	0.036	0.265	0.115	53	133.9
March, .....	.308	.696	77.8	52.5	56	0.799	0.293	0.810	0.335	36	136.3
April,.....	29.989	.604	81.3	61.8	44	0.863	0.294	3.595	1.345	37	143.1
May, .....	.968	.497	88.8	71.4	61	1.011	0.646	20.495	3.400	34	151.1
June, .....	.819	.469	89.6	75.1	62	1.018	0.740	1.720	0.570	29	155.8
July, .....	.845	.340	92.5	75.0	47	1.010	0.710	1.170	0.570	46	150.5
August, .....	.835	.380	89.8	74.8	47	1.022	0.595	3.155	1.890	43	154.8
September, ....	.951	.628	91.2	73.0	43	0.993	0.443	5.710	1.700	39	156.2
October, .....	.983	.383	90.5	67.1	49	0.945	0.394	3.470	0.600	61	155.8
November,	30.282	.758	81.4	55.8	24	0.756	0.142	0.445	0.135	38	145.2
December, .....	.266	.796	78.2	49.9	20	0.570	0.109	0.105	0.090	36	143.1
Year,.....	30.390	29.340	92.5	40.3	11	1.022	0.036	20.495	3.400	61	156.2

TABLE XI.

Monthly Extremes of the Principal Meteorological Elements registered at Victoria Peak during the year 1889.

MONTH.	BAROMETER.		TEMPERATURE.		RAIN.	WIND.
	Max.	Min.	Max.	Min.	Daily Max.	Force Max.
January,	28.41	28.06	66	42	0.26	6
February, .....	.50	.07	68	38	0.46	6
March, .....	.43	.00	70	47	1.34	6
April, .....	.21	27.93	75	57	6.84	6
May, .....	.22	.85	78	66	?	7
June,.....	.12	.79	79	71	2.76	6
July, .....	.14	.69	83	72	1.10	6
August,.....	.13	.71	80	70	3.80	6
September, .....	.19	.95	80	69	4.35	7
October, .....	.24	.80	79	60	2.30	8
November, .....	.47	28.05	72	52	0.60	6
December, .....	.44	.10	69	47	0.05	7
Year,.....	28.50	27.69	83	38	?	8

TABLE XII.

Five-Day Means of the Principal Meteorological Elements observed in Hongkong in 1889.

FIVE-DAY PERIODS.	OBSERVATORY.								VICTORIA PEAK.			
	Barometer.	Temperature.	Humidity.	Vapour Tension.	Wind Velocity.	Nebulosity.	Sunshine.	Rain.	Barometer.	Temperature.	Wind Force.	Rain.
January..... 1- 5	30.066	60.0	75	0.399	14.1	7.2	4.7	0.055	28.245	54.4	3.8	0.10
"..... 6-10	.134	58.0	73	.356	11.2	8.6	2.7	0.001	.316	50.5	4.3	0.00
".....11-15	29.913	64.2	89	.537	18.1	8.5	3.1	0.019	.162	59.7	3.7	0.04
".....16-20	30.100	57.0	81	.382	9.9	9.1	1.9	0.056	.306	51.2	3.9	0.07
".....21-25	.137	54.1	73	.310	14.2	8.5	2.8	0.015	.320	46.8	3.8	0.00
".....26-30	.089	58.2	83	.404	13.4	9.5	0.3	0.000	.291	51.4	3.3	0.00
".....31- 4	.031	55.6	86	.385	15.4	9.6	0.6	0.018	.234	49.6	3.9	0.12
February..... 5- 9	.104	52.0	72	.280	9.8	6.0	3.3	0.091	.281	44.6	3.8	0.09
".....10-14	.123	55.3	60	.279	15.6	1.9	9.8	0.003	.313	49.7	3.8	0.00
".....15-19	.079	59.5	76	.389	18.4	2.0	9.2	0.000	.289	55.0	4.0	0.00
".....20-24	29.913	63.4	94	.552	17.3	9.5	1.8	0.002	.169	61.8	3.7	0.00
".....25- 1	30.017	60.3	74	.419	14.5	9.7	0.5	0.056	.231	55.3	4.1	0.06
March..... 2- 6	29.998	62.5	96	.544	19.3	9.9	0.2	0.001	.233	63.1	3.9	0.00
"..... 7-11	.912	69.0	93	.660	13.2	9.5	1.3	0.003	.172	66.6	4.3	0.00
".....12-16	30.131	60.5	81	.434	12.9	10.0	0.3	0.071	.338	54.9	3.6	0.10
".....17-21	29.961	64.7	81	.492	16.3	8.0	3.3	0.002	.204	60.1	4.3	0.04
".....22-26	.943	64.4	83	.509	16.1	9.5	1.6	0.256	.179	60.9	3.9	0.27
".....27-31	.873	63.3	87	.508	19.2	9.5	1.6	0.139	.109	59.7	4.2	0.11
April..... 1- 5	.799	65.4	97	.607	21.2	9.9	0.0	0.498	.060	66.7	4.2	0.77
"..... 6-10	.811	67.2	95	.636	20.3	9.5	0.6	0.225	.077	67.1	4.2	0.07
".....11-15	.848	69.6	94	.685	19.6	8.8	4.0	0.006	.125	68.1	3.9	0.00
".....16-20	.901	70.4	83	.619	14.1	7.9	3.3	0.046	.159	66.3	3.6	0.07
".....21-25	.863	68.6	73	.514	11.9	7.3	4.4	0.280	.122	63.0	3.7	0.35
".....26-30	.691	74.8	89	.767	11.1	7.0	5.0	1.399	27.987	70.4	3.5	1.66
May..... 1- 5	.798	76.1	91	.823	14.3	7.4	5.2	0.049	28.088	72.0	3.8	0.00
"..... 6-10	.852	77.5	84	.799	12.3	6.3	7.4	0.023	.147	72.6	3.9	0.00
".....11-15	.799	81.4	81	.871	9.1	7.5	8.3	0.002	.110	74.1	3.9	0.00
".....16-20	.759	80.2	84	.860	10.3	7.5	5.8	1.625	.054	73.2	3.9	1.74
".....21-25	.744	75.2	88	.767	12.4	9.9	0.1	0.908	.084	69.3	4.0	0.97
".....26-30	.628	77.1	91	.848	15.0	9.8	1.0	7.155	27.933	71.7	4.7	?
".....31- 4	.606	81.6	86	.930	15.3	8.3	4.5	0.196	.919	75.4	4.4	0.39
June..... 5- 9	.655	81.8	84	.918	8.7	9.3	2.4	0.345	.967	74.5	4.3	0.59
".....10-14	.627	80.1	85	.873	11.1	7.0	6.7	0.117	.939	74.7	3.3	0.03
".....15-19	.634	81.9	86	.942	12.7	9.5	1.8	0.753	.948	75.0	4.7	0.99
".....20-24	.677	83.8	80	.926	13.1	7.6	6.8	0.164	.993	76.0	4.4	0.28
".....25-29	.755	83.5	79	.909	7.7	4.7	8.1	0.237	28.073	76.2	3.5	0.34
".....30- 4	.731	83.9	79	.923	11.1	4.0	10.0	0.292	.043	75.8	4.1	0.05
July..... 5- 9	.657	84.5	77	.910	8.1	2.0	11.2	0.000	27.987	76.5	3.5	0.00
".....10-14	.551	84.2	77	.902	6.8	4.6	11.2	0.000	.882	77.8	2.5	0.00
".....15-19	.526	83.1	81	.911	17.4	7.5	5.0	0.407	.853	76.6	4.3	0.42
".....20-24	.604	84.1	80	.940	17.7	8.7	3.9	0.072	.919	76.2	4.5	0.15
".....25-29	.700	82.0	83	.906	11.3	4.9	7.7	0.281	28.015	75.0	3.8	0.22
".....30- 3	.599	81.8	82	.893	10.1	4.5	7.5	0.277	27.913	75.0	3.7	0.31
August..... 4- 8	.743	79.2	89	.886	16.6	9.4	2.7	1.397	28.043	73.3	4.0	1.06
"..... 9-13	.674	81.4	86	.920	13.5	6.7	5.8	0.353	27.977	75.0	3.7	0.63
".....14-18	.565	81.1	84	.892	17.6	7.8	4.0	0.593	.887	74.2	4.3	0.76
".....19-23	.547	82.4	82	.909	5.1	5.7	6.5	0.553	.869	76.2	2.9	0.84
".....24-28	.646	80.6	80	.834	5.4	3.8	7.2	0.446	.955	75.3	2.8	0.23
".....29- 2	.745	81.1	81	.858	8.0	4.0	7.0	0.152	28.055	74.8	3.8	0.24
September..... 3- 7	.725	83.5	80	.921	6.0	3.1	10.1	0.000	.045	76.0	3.3	0.02
"..... 8-12	.743	79.5	72	.732	8.7	6.5	7.1	1.178	.052	73.6	3.9	0.90
".....13-17	.829	78.5	71	.691	22.7	6.2	7.2	0.067	.599	71.3	5.1	0.43
".....18-22	.826	79.8	84	.854	14.2	5.2	4.6	0.361	.114	73.3	3.9	0.03
".....23-27	.715	80.7	83	.863	20.8	7.5	4.9	0.391	.013	73.9	5.1	0.62
".....28- 2	.851	80.5	86	.897	11.5	5.2	6.1	0.391	.147	74.6	3.2	0.16
October..... 3- 7	.859	81.2	82	.868	11.0	2.1	9.8	0.005	.165	75.7	3.1	0.00
"..... 8-12	.776	80.9	69	.730	10.4	3.1	10.0	0.012	.081	74.3	4.1	0.01
".....13-17	.614	78.8	74	.730	14.9	8.8	2.7	0.751	27.933	72.0	4.7	0.87
".....18-22	.783	79.8	83	.850	17.9	5.6	5.6	0.077	28.080	73.7	4.3	0.31
".....23-27	.816	77.3	82	.774	19.2	8.1	3.3	0.728	.098	70.3	4.5	0.60
".....28- 1	.870	73.7	68	.576	12.0	7.5	3.9	0.036	.135	65.8	4.0	0.03
November..... 2- 6	.871	71.6	60	.466	16.8	7.2	5.6	0.004	.138	63.6	4.5	0.02
"..... 7-11	.882	70.8	66	.509	15.2	5.1	6.0	0.001	.141	64.0	4.3	0.00
".....12-16	30.184	63.5	47	.276	13.9	4.3	6.5	0.002	.401	55.6	4.0	0.00
".....17-21	29.917	68.5	71	.499	11.1	2.2	9.4	0.000	.172	63.8	3.2	0.00
".....22-26	.848	70.3	88	.653	18.8	9.2	2.2	0.258	.117	64.8	3.9	0.28
".....27- 1	.919	66.5	82	.536	11.9	8.9	1.4	0.008	.157	60.5	3.8	0.02
December..... 2- 6	30.007	58.8	54	.272	15.2	4.5	5.0	0.003	.214	52.0	4.7	0.01
"..... 7-11	29.926	66.5	74	.479	12.5	6.8	5.1	0.009	.179	60.1	3.5	0.00
".....12-16	30.149	60.2	58	.310	14.0	4.0	8.0	0.001	.349	54.5	3.9	0.00
".....17-21	.094	63.9	65	.386	13.6	8.6	1.6	0.000	.321	56.0	4.1	0.00
".....22-26	.083	63.3	75	.439	13.4	5.9	5.6	0.021	.307	57.8	3.4	0.00
".....27-31	29.987	62.8	74	.427	10.7	5.4	5.7	0.000	.225	58.6	3.0	0.00

TABLE XIII.

Observations of Magnetic Declination and Dip.

1889.	H.K.M.T.	Declination, East.	Observer.	H.K.M.T.	A.	B.	Dip, North.	Needle.	Observer.
January, ...	14 ^d 2 ^h 30 ^m p.	0° 38' 42"	F.G.F.	13 ^d 3 ^h 50 ^m p.	32° 17'.83 19.71	90° 0'.00	32° 17'.83 19.71	No. 6	W.D.
				15 3 " 2 p.	42 53.19	40 44.60	16.60	5	"
				16 3 10 p.	41 46.40	41 56.02	21.00	2	F.G.F.
February, .	13 2 35 p.	0 40 21	"	16 3 12 p.	38 22.50	46 21.80	17.48	6	M.A.
				15 3 23 p.	38 29.44	46 7.46	16.82	5	"
March,	14 2 43 p.	0 39 15	M.A.	16 3 17 p.	35 28.63	54 17.07	23.15	5	"
				16 3 17 p.	35 12.78	54 4.50	8.65	6	"
April,	15 2 38 p.	0 39 16	F.G.F.	11 3 2 p.	33 25.50	64 43.60	12.90	1	W.D.
				20 3 25 p.	33 29.90	64 56.47	18.18	2	F.G.F.
May,	15 3 12 p.	0 37 56	M.A.	13 3 15 p.	33 32.50	64 8.57	18.55	1	M.A.
				14 2 59 p.	33 30.50	64 14.22	14.32	2	"
				16 3 3 p.	33 37.64	64 7.81	20.00	5	"
				17 3 5 p.	33 28.82	64 8.28	12.20	6	"
June,	15 2 14 p.	0 38 17	F.G.F.	14 3 5 p.	32 17.60	90 0.00	17.60	1	F.G.F.
					32 20.00	"	20.00	2	"
July,	15 2 30 p.	0 39 16	"	16 3 " 22 p.	32 14.60	"	14.60	5	"
					32 18.63	"	18.63	6	"
August, ...	16 2 24 p.	0 37 41	"	15 3 " 20 p.	32 17.11	"	17.11	1	"
					32 18.16	"	18.16	2	"
September,	16 2 32 p.	0 37 21	"	16 3 " 40 p.	32 14.64	"	14.64	1	"
					32 19.18	"	19.18	2	"
				17 3 " 24 p.	32 16.08	"	16.08	5	"
October, ...	15 2 46 p.	0 38 18	M.A.	14 3 12 p.	32 16.32	"	16.32	1	M.A.
					32 13.75	"	13.75	2	"
November,	15 2 45 p.	0 39 1	F.G.F.	16 3 " 15 p.	32 18.28	"	18.28	1	F.G.F.
					32 19.32	"	19.32	2	"
December,	13 2 25 p.	0 36 39	M.A.	14 2 " 57 p.	32 14.79	"	14.79	1	M.A.
				"	32 16.07	"	16.07	2	"

TABLE XIV.

Observations of Horizontal Magnetic Force.

DATE. 1889.	H.K.M.T.	Time of one Vibra- tion.	Tem- perature Cent.	Log m X.	Value of m.	H.K.M.T.	Distance in Centi- meters.	Tem- perature Cent.	Deflec- tion.	Log $\frac{m}{X}$ Mean.	Value of X.	Obser- vor.
January 14,...	2 ^h 58 ^m p.	^s 3.5406	20°.8	2.35260	623.01	3 ^h 42 ^m p.	30 40	19°.5	7° 20' 22" 3 4 52	3.23640	0.36149	F.G.F.
February 13,...	3 4 p.	3.5403	21 .4	2.35260	622.80	3 34 p.	30 40	20 .5	7 19 51 3 4 41	3.23611	0.36161	"
March 14,...	3 8 p.	3.5393	17 .0	2.35232	622.34	4 15 p.	30 40	15 .9	7 20 25 3 1 49	3.23574	0.36165	M.A.
April 15,...	3 15 p.	3.5452	25 .5	2.35251	622.20	3 39 p.	30 40	23 .8	7 18 39 3 4 1	3.23534	0.36190	F.G.F.
May 15,...	2 36 p.	3.5505	32 .2	2.35232	621.94	3 52 p.	30 40	29 .15	7 17 20 3 3 34	3.23518	0.36188	M.A.
June 15,...	2 50 p.	3.5532	29 .2	2.35105	620.40	3 23 p.	30 40	28 .8	7 16 31 3 3 12.5	3.23428	0.36173	F.G.F.
July 15,...	3 20 p.	3.5559	32 .5	2.35089	619.80	3 44 p.	30 40	30 .4	7 15 42.5 3 2 42.5	3.23360	0.36195	"
August 16,...	2 52 p.	3.5571	30 .45	2.35029	619.13	3 23 p.	30 40	28 .8	7 15 37 3 2 44	3.23327	0.36183	"
September 14,...	3 18 p.	3.5567	28 .45	2.34992	618.46	3 42 p.	30 40	27 .1	7 15 34 3 2 33	3.23270	0.36192	"
October 17,...	2 41 p.	3.5606	29 .35	2.34918	616.98	3 32 p.	30 40	28 .45	7 13 57.5 3 1 52.5	3.23135	0.36218	M.A.
November 15,...	3 18 p.	3.5572	22 .8	2.34891	616.36	3 47 p.	30 40	21 .5	7 14 40 3 2 10	3.23075	0.36231	F.G.F.
December 13,...	2 49 p.	3.5558	19 .3	2.34883	616.20	3 37 p.	30 40	17 .5	7 15 12.5 3 2 25	3.23061	0.36233	M.A.

TABLE XV.

Results of Magnetic Observations in 1889.

MONTH. 1889.	Declina- tion, East.	Dip, North.	MAGNETIC FORCE.								
			BRITISH UNITS.			METRIC UNITS.			C. G. S. UNITS.		
			X.	Y.	Total Force.	X.	Y.	Total Force.	X.	Y.	Total Force.
January,	0° 38' 42"	32° 18' 47"	7.8400	4.9589	9.2766	3.6149	2.2864	4.2773	0.36149	0.22864	0.42773
February,	40 21	17 9	7.8426	4.9552	9.2768	3.6161	2.2847	4.2774	0.36161	0.22847	0.42774
March,	39 15	15 54	7.8436	4.9518	9.2758	3.6165	2.2832	4.2769	0.36165	0.22832	0.42769
April,	39 16	15 32	7.8490	4.9539	9.2816	3.6190	2.2842	4.2796	0.36190	0.22842	0.42796
May,	37 56	16 16	7.8486	4.9561	9.2824	3.6188	2.2852	4.2800	0.36188	0.22852	0.42800
June,	38 17	18 48	7.8453	4.9621	9.2828	3.6173	2.2879	4.2802	0.36173	0.22879	0.42802
July,	39 16	16 37	7.8500	4.9581	9.2847	3.6195	2.2861	4.2810	0.36195	0.22861	0.42810
August,	37 41	17 38	7.8475	4.9599	9.2834	3.6183	2.2869	4.2805	0.36183	0.22869	0.42805
September,	37 21	16 38	7.8493	4.9578	9.2838	3.6192	2.2859	4.2806	0.36192	0.22859	0.42806
October,	38 18	15 2	7.8548	4.9562	9.2877	3.6218	2.2852	4.2824	0.36218	0.22852	0.42824
November,	39 1	18 48	7.8578	4.9700	9.2976	3.6231	2.2916	4.2870	0.36231	0.22916	0.42870
December,	36 39	15 26	7.8583	4.9597	9.2926	3.6233	2.2868	4.2847	0.36233	0.22868	0.42847
Mean,	0° 38' 30"	32° 16' 53"	7.8489	4.9583	9.2838	3.6190	2.2862	4.2806	0.36190	0.22862	0.42806