EXTRACTS

FROM

NARRATIVE REPORTS

OF OFFICERS OF THE

Survey of India

FOR THE SEASON

1908-09

PREPARED UNDER THE DIRECTION OF

COLONEL F. B. LONGE, R.E., C.B., A.-D.-C.
SURVEYOR GENERAL OF INDIA

CONTENTS

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CONTENTS.

I

THE MAGNETIC SURVEY OF INDIA.

Extracted from the Narrative Report of Captain R. H. Thomas, R.E., in charge No. 26 Party (Magnetic) for season 1908-09.

Personnel.

Imperial Officers.

Captain R. H. Thomas, R.E., in charge from 1st April 1909.

Lieutenant H. J. Couchman, R.E., till 30th April 1909 (in charge till 31st March 1909).

Lieutenant H. T. Morshead, R.E., till 31st March 1909.

Provincial Officers.

Messrs. E. C. J. Bond, H. P. D. Morton, R. P. Ray, N. R. Mazumdar and R. B. Mathur.

Subordinate establishments.

2 Observers, 13 Recorders, 1 Computer, 2 Surveyors and 1 Writer.

The personnel of the party is shown in the margin.

Health of party.—The health of the party was on the whole satisfactory, but the detachments working in Burma suffered severely at times from malaria.

INTRODUCTION.

The present report deals with the work of the Magnetic Survey in 1908-09. The report is divided into three main parts as follows :—

I.—A brief account of the operations in the field and recess quarters, with a table of the preliminary values of the magnetic elements at field and repeat stations in 1908-09, and an index chart showing the positions of all stations of observation to date.

NOTE.—For convenience of reference the table of preliminary values and index chart are placed at the end of Part III.

II.—A note on the working of the magnetic observatories in 1908-09.

III.—Tables of results at the magnetic observatories in 1908.

PART I.

FIELD OPERATIONS AND RECESS WORK IN 1908-09.

(*a*) Work of the field detachments.
(*b*) Field work of the Imperial officers.
(*c*) Work during recess.
 Reduction of field work.
 Computation of Chin-Lushai-Arakan Boundary triangulation.
 Investigation of differences of instruments in H. F.
(*d*) Diurnal variation in H. F. in Southern India.
(*e*) Comparison of a set of instruments belonging to the Carnegie Institution, Washington, U. S. A., with the survey standards.
(*f*) Differences of survey instruments in 1908-09.
(*g*) Values of distribution co-efficients in 1908-09
(*h*) Programme of work in 1909-10.
(*i*) Results published in this report.

(*a*) *Work of the field detachments.*—The field season opened on October 26th, 1908, and closed on May 3rd, 1909. Four field detachments were employed during the year under report; two of these worked in Burma completing the preliminary survey of that country, the remaining two were occupied in the detailed examination of three areas shown in the index map attached.

Of the Burma detachments, one observer worked along the South-West coast and in the Irrawaddy delta; this observer also completed observations at three stations on the Kaladan river, on the border of the unadministered area of the Chin Hills, thus materially reducing the gap hitherto existing in this district: the second detachment completed the magnetic survey of Tenasserim and in addition established a repeat station at Port Blair; the latter had long been considered advisable, but hitherto it had been found impracticable to spare the time required. Owing to the difficult country met with the total outturn of new stations of the preliminary survey was 41 only.

The total number of stations of the preliminary survey to date is 1,255 to which must be added 6 stations in Kashmir and Ladákh, the results at which have been kindly communicated by Mr. D. C. Sowers of the Carnegie Institution of Terrestrial Magnetism, Washington, U. S. A., who observed in September and October of the present year.

The two detachments engaged on the detail survey occupied 122 new stations and in addition repeated observations at 11 old field stations falling in their respective areas.

(*b*) *Work of the Imperial Officers.*—Two officers of the Imperial Service were available throughout the year.

The four survey observatories were inspected and comparative observations carried out at each and also at Alíbág.

In addition to those at 22 repeat stations, observations were made at 15 old field stations, suitably situated between the former to obtain further values of the secular change in the magnetic elements.

Fifty-seven old field stations have now been revisited and a preliminary reduction of the secular change values made: an examination of the results showed that while the secular change values in dip and declination were on the whole fairly in accord with those from repeat stations, the secular changes in horizontal force revealed unexpected abnormalities. It thus became evident that our repeat stations are too few in number and the practice of reobserving at suitable old field stations will therefore be continued. At most of these it should be possible to identify the station site within a few feet, but in order to guard against accidental error in areas of local disturbance, it will probably be advisable to reobserve at groups of two or three stations.

In paragraph 3 of last year's report, it was noted that, if time was available, hourly observations of H. F. would be taken in Southern India and possibly also in Lower Burma and the results compared with the curves at Kodaikánal. For Southern India this has been done: Lieutenant Couchman, R.E., made half-hourly observations from 8 A.M. to 4 P.M. on 5 days at Trichinopoly (latitude 10° 48′ 10″ longitude 78° 40′ 40″): the results are discussed elsewhere in this report.

(*c*) *Work during recess.*—During the recess season the computations of the previous season's field work, and the reduction and tabulation of the base station results for 1908 have been completed.

Reduction of field work.—The reduction of the field work with reference to the correction for diurnal variation in horizontal force and declination, and instrumental difference in declination has been continued, the repeat stations and reobserved field stations being first dealt with, with a view to obtaining the best available values of secular change. The repeat stations and reobserved field stations have been completed up to 1907-08, the field stations up to 1903-04.

The party was inspected in recess by the Superintendent, Trignometrical Surveys, on 24th June 1909.

Computation of Chin-Lushai-Arakan boundary triangulation.—The imperial officers recomputed the triangulation carried out by Mr. Morton of this party in 1907-08 in connection with the Chin-Lushai-Arakan Boundary survey. This triangulation was executed rapidly without previous reconnaissance in densely wooded country and in unfavourable weather: its adjustment proved difficult.

Satisfactory results were finally obtained, but not without the expenditure of considerable time, during which the investigation of the many pressing questions arising out of the magnetic work was necessarily in abeyance.

Investigation of differences of instruments in H. F.—The principal subject of investigation during the recess season was the differences of the various instruments from the standard in horizontal force.

The system of computing H in use at present is as follows:—The mH and $\frac{m}{H}$ of the vibration and deflection observations are combined to obtain values of m_0 only. These values show appreciable fluctuations from the mean value, due to errors of observation and changes in H during the time of observation: it is the practice to repeat observations where the value of m_0 differs more than 0·5 from the previous mean value.

Ordinarily the value of m_0 falls slowly with lapse of time, it is also liable to sudden falls which are probably due to accidental rough handling: cases have also occurred where the magnetic moment has, during the recess season, apparently recovered from slight temporary losses. The values of m_0 obtained as above are divided into groups and a scrutiny of these enables a mean value of m_0 applicable to any given period to be readily ascertained. This value is then applied to the deflection observations and the value of H obtained.

A table was published in last year's report showing the differences of the various instruments from the standard after recomputation as above.

These differences show considerable variation from time to time: apart from gross errors of observation, the principal causes of these variations may be either change in the value of the moment of inertia of any or all the magnets, change of the distribution co-efficients or both these causes combined; in the first case the value of mH is affected, in the second $\frac{m}{H}$, thus there will be errors in the assumed value of m_0 and also in the deduced value of H. Changes in the moment of inertia have not been considered for the present: the observations of π^2K carried out prior to 1906 have no great weight owing to the changes in the inertia bars Nos. 17 and 2 (see Narrative Report 1904-05), but since the receipt of the standard bar (S. G.) observations have been made with all the field magnets in 1906, 1908 and recently in the present year: these observations will serve to show whether changes in the moment of inertia are sufficiently large to appreciably alter the value of H.

As regards the size of the error which might be introduced by neglecting changes in log π^2K, the observations with the standard magnet No. 17 show an apparent gradual and regular fall in the value, corresponding to a correction of—19γ between 1901 and 1908. Though corrections of similar amount are unlikely with the field magnets, owing to these being subjected to less handling, it is evident that this source of error requires investigation.

The absolute moment of inertia (irrespective of dimensions) of the bar S. G. was determined in 1905 ; changes in this value are easily determined by periodic weighments, such changes being a function of the mass of the bar.

The following are the values found :—

1906	68·3903 grammes.
1908	·3878 "
1909	·3839 "

The corresponding decrement of the log K from 1906 to 1909 is 0·000057 a quantity which is considerably less than the error of observation of the moment of inertia of the magnet and its appendages.

As regards the distribution co-efficients the expression for the connection between m, H, the deflecting distance (r) and the angle of deflection (u) is

$$\frac{2m}{r^3}\left(1-\frac{2u}{r^3}-qt-q't'\right)\left(1+\frac{P}{r^2}+\frac{Q}{r^4}+\frac{R}{r^6}+\;.\;.\;.\;.\;.\;.\;.\;\right)=H\sin u;$$

when P and Q are the distribution constants.

To obtain P, observations at two distances are required ; if Q is also required to be taken into account, observations at three distances and similarly for R observations at 4 distances are necessary.

It has, however, been pointed out by Dr. Chree (*Phil. Mag.* 1904) that the co-efficient R is seldom likely to be of practical moment in English magnetometers : it has been considered negligible in the Indian survey instruments.

Observations at the three distances 22·5, 30 and 40 cms. have been the invariable rule almost from the beginning of the survey, but the practice has been to apply a distribution co-efficient $(1-\frac{P'}{r^2})$ found from the two nearer distances only. $\frac{Q}{r^4}$ was clearly not negligible, the corrections on this account varying considerably in magnitude with different instruments, but it was hoped that the corrections would be sufficiently invariable to enable them to be easily applied to the values of H in the final reduction.

It seemed not unlikely, however, that changes in the differences of various instruments from the standard might be, in part at least, ascribed to changes in P and Q and an investigation of these changes has therefore been commenced.

In the first instance P and Q were calculated from the formulæ

$$P'_{1,2}=P+Q\left(\frac{1}{r_1^2}+\frac{1}{r_2^2}\right)+\frac{PQ}{r_1^2\,r_2^2}\text{——}(i)$$

$$P'_{1,2}-P'_{2,3}=Q\left(\frac{1}{r_1^2}-\frac{1}{r_3^2}\right)\text{——}(ii)$$

(See Narrative Report, 1902-03, for the complete demonstration).

The values $P'_{1,2}$ and $P'_{2,3}$ being the means of months or groups after rejection of values lying outside 5°/₀ and 10°/₀ limits respectively.

The corrections to m_0 and H resulting from the substitution of $(1+\frac{P}{r^2}+\frac{Q}{r^4})^{-1}$ for $1-\frac{P'}{r^2}$ were then calculated and applied to the comparative observations. The resulting values of the differences of instruments from the standard showed much better agreement than those published, moreover the base lines of the variation instruments at the observatories were much improved as regards the elimination of sudden changes for which it was otherwise difficult to account.

This method of finding P and Q did not prove altogether satisfactory as it is difficult to determine where changes occur in the values of $P'_{1,2}$ and $P'_{2,3}$ by mere inspection and the method of rejection of individual values is somewhat arbitrary.

The grouping of values was determined therefore by changes of m_0 rather than changes in P's, but this is also unsatisfactory since m_0 will apparently remain unchanged (when $\frac{m}{H}$ is computed with $1-\frac{P_{1,2}}{r^2}$) if $P_{2,3}$ alone changes.

It was therefore decided to compute P and Q from the formulæ given by Dr. Chree (*Phil. Mag.*, Aug. 1904).

$$\text{where } P=\frac{W_1 r_1^4(r_3^4-r_2^4)+W_2 r_2^4(r_1^4-r_3^4)+W_3 r_3^4(r_2^4-r_1^4)}{W_1 r_1^4(r_2^2-r_3^2)+W_2 r_2^4(r_3^2-r_1^2)+W_3 r_3^4(r_1^2-r_2^2)}$$

$$\text{and } Q=\frac{r_1^2 r_2^2 r_3^2 \{W_1 r_1^2(r_2^2-r_3^2)+W_2 r_2^2(r_3^2-r_1^2)+W_3 r_3^2(r_1^2-r_2^2)\}}{W_1 r_1^4(r_2^2-r_3^2)+W_2 r_2^4(r_3^2-r_1^2)+W_3 r_3^4(r_1^2-r_2^2)}$$

where $W_1=\frac{1}{2}r_1^3 \sin u \left(1-\frac{2u}{r_1^3}-qt-q't^2\right)^{-1}$ and similarly W_2 and W_3: W_1 W_2 and W_3 are means from a number of observations and r_1, r_2, r_3 the actual distances corresponding to 22·5, 30 and 40 cms.

The procedure adopted is as follows:—The individual values of W_1 W_2 and W_3 are written down and the differences $W_1—W_2$, $W_2—W_3$ and $W_1—W_3$ are taken out. A scrutiny of these differences enables indifferent observations to be rejected.

Means of W_1 W_2 and W_3 are then taken, only those days' results being used on which observations at all three distances are accepted.

The observations at Kodaikánal observatory only have been worked up by this method at present: monthly means of W_1 W_2 and W_3 were taken out but the means of two or three months were used for computing P and Q according to the number of individual values and evidence of change in the value of the mean differences.

The results showed that the values of P and Q had probably changed on at least three occasions, the corrections to H by the substitution of $(1+\frac{P}{r^2}+\frac{Q}{r^4})^{-1}$ for $1-\frac{P'_{1,2}}{r^2}$ varying from 50 to 74γ.

This subject will be further referred to in next year's report when the values of P and Q for the remaining magnets should be available: there is sufficient evidence that variations in P and Q are appreciable enough to warrant careful investigation.

A point worthy of notice is that the approximation $1-\frac{P}{r^2}$ for $(1+\frac{P}{r^2})^{-1}$ in the formula for $\frac{m}{H}$ is objectionable with the Indian survey magnets.

If H is measured to 5 significant figures the substitution is objectionable when the values of H is affected by 5×10^{-6} C. G. S.

Dr. Chree has shown that the limiting value of $\frac{P}{r^2}$ for which the approximation is justified is given by $\frac{P}{r^2}$ = ·0053 or at 22·5 cms. P=2.68 when H=0·36 C. G. S.

The values of $P_{1,2}$ in the Indian magnets range from 5·8 to 8·3 the corresponding errors in H are at Dehra Dún 2γ and 8γ.

(*d*) *Diurnal variation in H. F. in Southern India.*—In Part I, paragraph 3 of last year's Narrative Report it was stated that when the Kodaikánal observatory results were used to obtain the horizontal force diurnal variation correction for field stations by an empirical linear formula depending on the geographical latitude, the difference between such correction and that obtained from any other two observatories was commonly large. During the field season, therefore, special observations were made at Trichinopoly (some 35 miles north of Kodaikánal) to endeavour to determine whether Kodaikánal only was abnormal or whether the empirical formula employed did not hold good in low magnetic latitudes.

These special observations consisted in taking deflections at every half hour from 8 A.M. to 4 P.M. for 5 days and thus obtaining diurnal variation figures which could be directly compared with those at Kodaikánal and the other observatories.

Fortunately the 5 days selected were all calm, and no correction for disturbance has been applied to the values given below.

Mean values of H. F. at Trichinopoly and Kodaikánal, January 18th—22nd, 1909, with diurnal variation deduced therefrom.

Hours.	Trichinopoly.		Kodaikanal.		Difference T–K.
	Mean values of H. F.	Diurnal range T.	Mean values of H. F.	Diurnal range K.	
8-0	·38050	–12	·37512	–10	– 2
8-30	62	± 0	20	2	+ 2
9-0	65	+ 3	26	+ 4	– 1
9-30	74	12	33	11	+ 1
10-0	75	13	37	15	– 2
10-30	81	19	45	23	– 4
11-0	85	23	49	27	– 4
11-30	91	29	53	31	– 2
12-0	86	24	47	25	– 1
12-30	77	15	40	18	– 3
13-0	66	4	28	6	– 2
13-30	57	– 5	15	– 7	+ 2
14-0	45	17	03	19	+ 2
14-30	39	23	495	27	+ 4
15-0	33	29	90	32	+ 3
15-30	34	28	89	33	+ 5
16-0	33	29	89	33	+ 4
Mean	·38062		·37522		

It will be at once noticed that, while the agreement is good, there is distinct evidence that the range at Kodaikánal is greater than at Trichinopoly by about 8γ.

If the linear relation between diurnal variation and geographical latitude is warranted in India, the range in H. F. at Kodaikánal should only be 1 or 2γ greater than that at Trichinopoly and it remains, therefore, to determine whether the Trichinopoly values follow the latitude law.

This may be done by computing the diurnal variation at Toungoo from the observed values at Barrackpore and Trichinopoly and the table below shows the result of such computation: the similar figures obtained from Barrackpore and Kodaikánal are given for comparison in column 7.

Hours.	Diurnal variation at Barrackpore.	Diurnal variation at Trichinopoly.	Computed variation at Toungoo.	Observed variation at Toungoo.	Difference O-C from Barrackpore and Trichinopoly.	Difference O-C from Barrackpore and Kodaikanal.
1	2	3	4	5	6	7
8-0	+6	−12	0	+ 1	+ 1	0
8-30	6	0	+ 4	4	0	0
9-0	9	+3	7	5	− 2	− 2
9-30	10	12	11	8	− 3	− 2
10-0	8	13	10	9	− 1	− 1
10-30	7	19	11	13	+ 2	+ 1
11-0	4	23	10	12	+ 2	+ 1
11-30	3	29	11	9	− 2	− 3
12-0	1	24	8	7	− 1	− 2
12-30	− 1	15	4	4	0	− 1
13-0	3	4	− 1	2	+ 3	+ 2
13-30	5	− 5	2	− 3	− 1	+ 3
14-0	8	17	11	8	+ 3	+ 3
14-30	9	23	14	12	+ 2	+ 3
15-0	10	29	16	16	0	+ 1
15-30	11	28	16	18	− 2	0
16-0	12	29	17	17	0	+ 1

Columns (6) and (7) show that the differences are in every case less than the probable error of observation and thus no useful conclusion can be drawn from the table.

In view, however, of the rapid increase of range between Trichinopoly and Kodaikánal, it is advisable to obtain diurnal variation figures for some place south of Kodaikánal to determine whether the range at Kodaikánal is abnormal or does actually increase rapidly in low magnetic latitudes. This will be done at Tuticorin (Lat. 8° 48′) during the ensuing field season.

With regard to the discrepancies noted in the corrections when Kodiakánal results are used, it is possible that in a number of cases this has arisen from the selected quiet days not being the same at all the observatories. The practice has been to supply the Director, Kolába Observatory, with a classification of the curves for each observatory and five quiet days have been selected by him. It has frequently happened, however, that in one or other observatory the declination trace has been defective on one of the selected days and another day has been substituted in that observatory. In referring results to five arbitrarily selected days per month, it is essential that the days should be the same in each observatory : it is possible in many months to select several combinations of five quiet days whose mean approximately coincides with the middle of the month, but the diurnal variations so deduced will vary considerably.

(*e*) *Comparison of the Dehra Dún standards with instruments belonging to the Carnegie Institute, Washington, U. S. A.*—In October 1909, Mr. D. C. Sowers of the Carnegie Institute of Terrestrial Magnetism who had made a series of observations while travelling overland from Pekin to Srínagar arrived at Dehra Dún to compare his instruments with the Indian Survey Standards.

Direct comparisons were made between the various instruments, sites being interchanged, the north and south houses being used.

Mr. Sowers used unifilar magnetometer No. 10 by Cooke and Sons and dip circle 171 by Dover: the Dehra standards are magnetometer 17 by Elliott and Earth Inductor No. 30 by Schultze.

In the abstracts which follow the notation $\frac{SH}{I_{30}}$ $\frac{NH}{10}$, etc. mean the results of observations in the southern and northern houses with the instrument in the denominator.

Abstract of comparisons in Dip.

	Needle. No. 5.	Needle. No. 6.	Needle. No. 7.
$\frac{SH}{I_{30}} - \frac{NH}{D.C.\ 171} =$	+1·6	−1·9	−0·4
	+3·7	−1·1	+1·0
	+1·0	+0·2	+1·6
Mean = x =	+2·1	−0·9	+0·7
$\frac{SH}{D.C.\ 171} - \frac{NH}{I_{30}} =$	−2·3	+0·1	+5·0
	−3·7	0·0	+3·3
	−2·0	−1·4	+3·4
Mean = x_1 =	−2·7	−0·4	+3·9

Then $x = s + i$ where $s = SH - NH$

$x_1 = s - i$ $\quad i = I_{30} - D.\ C.\ 171$

	Needle No. 5.	Needle No 6.	Needle No. 7.
∴ SH − NH =	−0′·3	−0′·6	+2′·3
I_{30} − D. C. $_{171}$ =	+2′·4	−0′·3	−1′·6

From the site errors given by the various needles it is evident that needles Nos. 5 and 6 give fairly good results, needle No. 7 is evidently unreliable. Needle No. 6 is practically in accord with the Dehra standard when the dip is in the neighbourhood of 44°.

Abstract of comparison in declination.

$\frac{SH}{17} - \frac{NH}{10} =$ +0·4

0·9

1·3

0·4

1·2

0·7

Mean +0·8

$$\frac{SH}{10}-\frac{NH}{17}= \quad -0.5$$

0·5

0·2

Mean $-0{\cdot}4$

SH−NH= $+0'{\cdot}2$

17− 10 = $+0'{\cdot}6$

The magnetometers are thus in close agreement.

As many observations of declination had been taken with the compass attachment of the dip circle this was also compared. The result is given below.

$$\frac{SH}{D.\,C.\ 171\ \text{compass}}-\frac{NH}{17}= \quad +2{\cdot}1$$

1·9

1·2

Mean $+1'{\cdot}7$

or adopting the difference SH—NH = $+0'{\cdot}2$ the difference becomes

D. C. 171 compass − 17 = $+1'{\cdot}5$

Comparison in H. F.

Below is an abstract of the comparisons in horizontal force. The observations with Dehra Dún standard have been computed with the mean m_0 and mean $P_{\prime\prime}$, derived from the values obtained during the comparisons : these values accord well *inter se* and agree with the mean values before and after the comparison.

With the Dehra standard deflections were observed at 22·5, 30 and 40 cms., but the value of $\frac{m}{H}$ used is that derived from the observations at 22·5 cms. only. Mr. Sowers observed at 30 and 40 cms. only, the mean value of $\frac{m}{H}$ at these distances being used to find H.

As the magnetic moment of his magnet was very low the angle of deflection at 40 cms. was small and consequently the probable error of observation large.

The mean times of observations were not strictly synchronous and the results with the Dehra standard have therefore been reduced to the mean times of observation with No. 10 by means of the magnetograph curves.

The base lines deduced from the observations with No. 17 in the northern and southern houses are identical, showing that there is no site difference : the comparisons of the field instruments has frequently given the same result.

The values of H. F. for 17 have therefore been deduced from the magnetograph curves using the above base lines found from the series of comparative observations : errors of observation are thus to a certain extent eliminated.

Abstract of comparison in H. F.

SH / 17 (1)	NH / 10 (2)	Difference. (1)—(2) =X
·33219 C. G. S.	·33250 C. G. S.	−31
214	256	42
204	244	40
204	242	·38
216	233	17
215	260	45
		Mean = -39γ

S H / 10 (1)	N H / 17 (2)	Difference. (1)—(2) $=X_1$
·33206	·33183	+23
228	188	40
218	200	18
240	203	37
270	233	37
292	237	55
194	172	22
224	176	48
		Mean = +37γ

Whence S H—N H = —1 γ.
17—10 = —38γ.

The accordance of the site difference with that found above shows that the resulting difference of instruments is probably fairly correct.

The correction to No. 17 for the Q term by using $(1+\frac{P}{r^2}+\frac{Q}{r^4})^{-1}$ for $(1+\frac{P}{r^2})^{-1}$ amounts to +30γ: the latest determination of log π^2 K for No. 17 (in September 1909) gives a value 3·41495 as compared with the accepted value 3·41579; the correction for the new value is — 32γ.

The difference then becomes 17—10 = — 40γ.

No. 10 requires a correction to reduce its indications to the Carnegie Institution standard: this will be determined when the instruments reach Washington.

It is hoped that Mr. Sowers will be able to compare his instruments at Kew *en route* to enable a further determination of the difference of the Dehra standard from Kew to be made. The comparison originally made was unsatisfactory for several reasons, and has never been repeated.

(*f*) *Comparison of instruments with the standards in 1908.*—The following abstract gives the differences of the survey instruments from the standards in 1908. The instruments were compared at the beginning and end of the field season.

Comparison of instruments with the standard in declination and H. F.

Magnetometer and Magnet.	Declination.		Horizontal Force.	
	End of field season, 1907-08.	Beginning of field season, 1908-09.	End of field season, 1907-08.	Beginning of field season, 1908-09.
	′	′	γ	γ
17— 1 (2 A)	0·0	+0·8	—27	—18
17— 3 (3 A)	—0·1	+1·3	—1	+11
17— 4 (4 A)	—0·6	+0·6	—16	— 6
17— 5 (5 A)	—0·4	+1·0	—8	— 1
17— 6 (6 A)	+0·1	+1·7	—29	—24
17— 10 (10)	+0·1	+0·7	+2	+12

Comparison of dip circles with the standard (Inductor No. 30).

Instrument.		End of field season, 1907-08.	Beginning of field season, 1908-09.
		′	′
I_{30}—	135	−1·5	−2·3
	136	+1·3	+0·5
	138	+5·5	+2·7
	139	+4·6	+1·6
	140	+2·9	+0·9
	171	+1·6	+0·8

(*g*) *Values of the distribution co-efficients $P_{1,2}$ and $P_{2,3}$ for field instruments.*—The table below gives the values of $P_{1,2}$ and $P_{2,3}$ for the field magnets in 1908-09.

There was a considerable change in No. 1 during the journey from the field to Dehra Dún. Similar changes have been previously noticed on the journeys to and from the field: they are probably caused by the magnets being subjected to vibration and jolting for many hours continuously.

Numbers of Magnetometers.	P. from 22·5 and 30 cms.					P. from 30 and 40 cms.					Remarks.
	Mean from all observations.	Adopted mean value.	Total number of observations.	Number of rejected observations.	Number of observations used in finding mean.	Mean from all observations.	Adopted mean value.	Total number of observations.	Number of rejected observations.	Number of observations used in finding mean.	
1	7·49	7·48	64	9	55	9·52	9·44	138	35	103	From 14th November 1908 to 21st February 1909.
2	7·09	7·09	6	...	6	9·29	9·29	10	...	10	From 24th February 1909 to 27th February 1909.
3	6·13	6·14	29	1	28	7·42	7·44	45	10	35	
4	7·58	7·58	73	...	73	8·77	8·75	113	30	83	
5	7·27	7·27	83	...	83	8·04	8·03	96	11	85	
6	7·84	7·85	40	1	39	7·90	7·87	50	4	46	
10	5·77	5·76	41	4	37	7·26	7·34	77	27	50	

(*h*) *Programme for the ensuing field season.*—During the field season 1909-10 four field detachments will be employed.

Two of these have been allotted to the area lying between Lat. 16°—19° and Long. 73°—78°. Observations repeated at four old field stations in two groups in this area revealed an abnormal secular change in H. F., the values given by one group being the largest minus values yet found in India: the repeat stations near this area gave small + and — values, with a view to determining the limits of this area of abnormal change, a considerable number of old stations will be revisited and in addition certain anomalous districts will be surveyed in detail. One of these detachments will in addition investigate some abnormal values in the Narbada Valley about Lat. 22° Long. 76½°.

A third detachment will be employed in detail survey in two districts of Central India and will be transferred at the end of January to the Andamans where observations will be taken along the coast line. It is hoped that this detachment will be able in addition to observe at two or three islands of the Nicobar group thus affording a valuable connecting link with the magnetic survey of Sumatra.

The fourth detachment will work along the outer ranges of the Himalayas.

The two imperial officers will inspect and take comparative observations at the survey base stations: they will observe at 22 repeat stations and also at a number of old field stations as time permits.

The computing section in Dehra Dún will continue the reduction of the field results in addition to its normal work of computing and tabulating the base station results.

(*i*) *Results published in this report.*—A table showing the approximate preliminary values (uncorrected) at the field and repeat stations in 1908-09 is appended (see Tables) together with an index chart showing all stations of observations to date. The detail survey areas are hachured, the scale of the map being too small to show the individual stations easily.

The tabulations of the results obtained at Dehra Dún, Barrackpore, Toungoo and Kodaikánal observatories are published for 1908.

PART II.

THE MAGNETIC OBSERVATORIES IN 1908-09.

A. Dehra Dún Observatory.
B. Barrackpore „
C. Toungoo „
D. Kodaikánal „

A.—*Dehra Dún Observatory.*

(*a*) General remarks on working.
(*b*) Mean values of H. F. and declination constants.
(*c*) Mean values of base lines.
(*d*) Mean scale value and temperature range in 1908.
(*e*) Mean monthly values of magnetic elements and secular change, in 1907-08.

(*a*) *General remarks on working.*—The observatory remained in charge of Surveyor K. K. Dutta throughout the year under report.

The magnetographs continued to give good results until work was unavoidably stopped by water flooding the underground room during the heavy rains of August last. It was found impossible to cope with the inrush of water and finally on August 15th, it was deemed advisable to dismount the self-registering instruments.

The H. F. and declination magnetographs had been working since January 1903 with only minor interruptions while the V. F. instrument was erected in September 1905. The magnetographs were re-erected on September 11th and 12th, but the break in the continuity of the records is a great misfortune.

The total loss of record was from August 13th to September 14th, inclusive.

In the Narrative Report of 1902-03 an account is given of the measures taken to obviate a recurrence of the flooding of the observatory in the autumn of 1901, but the experience of the past few years has shown that the hopes then expressed were unduly optimistic.

The rainy season has always been a period of anxiety: in 1904 and 1906 water entered the magnetograph room, in sufficient volume in the former year to stop the working: in 1905 and 1907, however, no trouble was experienced, but the rainfall was less than the normal; in 1908 also though the total rainfall was heavy the room remained practically dry, but there was no prolonged period of heavy rain as in the present year. The cause of the trouble seems to be that after three or four days' heavy rain the subsoil becomes waterlogged, water increases in the catchment pit faster than it can be pumped out, and the walls and floor of the observatory are subjected to a head of 10 feet or more pressure, which they are ill-calculated to resist. Pumping with two pumps had been proceeding day and night for more than a week before the instruments were removed, yet at the time of their removal the water had risen to within an inch of the top of the driving clock pillar, which later on the same day was submerged: at the time the water level in the catchment pit was 11 feet above the floor level of the building.

The question remains what measures should be taken to avoid further trouble.

There are two alternatives: either water should be prevented from entering the building altogether, or if this is regarded as unavoidable adequate means should be provided for coping with the influx.

Before considering the second of these alternatives the walls and floor of the observatory and surrounding passage will be lined with neat Portland cement plaster which will, it is hoped, make the building watertight: this work will involve little interference with the recording instruments.

(*b*) *Mean values of constants.*—The following table gives the monthly mean values of the magnetic collimation, the distribution co-efficients $P_{1.2}$ and $P_{2.3}$ and the moment (m_0) of the magnet No. 17 (the survey standard) during 1908.

Mean values of the constants of the Magnetometer No. 17.

Months, 1908.	DECLINATION CONSTANTS. Mean Magnetic Collimation.	HORIZONTAL FORCE CONSTANTS. MEAN VALUE OF P'S. $P_{1.2}$.	$P_{2.3}$.	Accepted value of $P_{1.2}$.	Accepted value of $P_{2.3}$.	Mean value of M.	Accepted value of M.	REMARKS.
	′ ″							
January	—8 37	7·41	7·79			911·82	911·82	
February	—8 32	7·47	7·95			911·82	911·82	
March	—8 32	7·41	8·05			911·39	911·62 (1)	
April	—8 31	7·42	7·96			911·39	911·62 (1)	(1) By chronograph in April.
May	—9 20	7·16	7·44			911·39(2) 893·77	911·62 (1)	(2) 6th May.
June	—9 22	7·24	7·38	7·43 to 6th May. 7·20 from 9th „	7·92 to 6th May. 7·51 from 9th „	894·42		The values are fluctuating, hence M is rejected from 9th May to 19th August.
July	—9 28	7·27	7·49			894·72		
August	—9 40	7·16	7·18			894·57		
September	—9 28	7·21	7·52			894·54(3)	894·48	(3) From 26th August.
October	—9 24	7·17	7·67			894·56	894·48	
November	—9 31	7·20	7·50			894·61	894·48	
December	—9 31	7·17	7·65			894·41 894·48(4)	894·48	(4) By chronograph in December.

(*c*) *Mean values of base lines.*—The table below gives the mean values of the H. F. and declination base lines actually used. The base lines of the V. F. magnetograph are not given as there have been frequent changes.

Dehra Dûn Observatory.

The abstract of the base line value of the Magnetographs in 1908.

Months, 1908.	Declination. Mean value of Base line.	Declination. Remarks.	Horizontal Force. Mean value of Base line.	Horizontal Force. Remarks.
	° ′			The Base lines are reduced to 27°c. To compare these with previous years' 25γ is to be subtracted from the present values.
January . .	1 40·6	......	{ ·33028 ·33030	(1) to 20th. (2) from 21st to end.
February . .	40·7	......	·33027	
March . .	40·6	......	·33024	
April . .	40·6	......	·33026	
May . . .	40·6	......	·33026	
June . . .	40·3	......	*·33025*	As the M of magnet 17 was fluctuating and had to be rejected the base lines for June, July and August could not be determined and have been found by interpolation between May and September.
July . . .	40·0	......	*·33025*	
August . .	40·2	......	*·33025*	
September .	40·7	to 12th October.	{ ·33024 *a*	to 25th. from 26th to 30th.
October . .	41·1	from 15th October	{ ·33016 *a*	to 6th November. from 7th to 10th.
November . .	41·1	......	·33025	from 11th.
December . .	41·1	......	·33025	

NOTE.—*a*=Base line value assumed to be varying uniformly. The values for individual days are found by interpolation.

(*d*) *Mean scale value and temperature range.*—The mean scale value of the H. F. magnetograph for 1908 was 4·12γ for an ordinate of 0″·04 with limiting values of 4·09 and 4·14. The mean temperature of the H. F. magnetograph was 27°·10 C with a maximum of 27°·40 in December and a minimum of 26°·62 in January.

The scale value of the V. F. magnetograph varied from 4·70 to 4·90 : the mean temperature was 80·45 F. with a minimum of 79·7 in January and a maximum of 81·2 in July.

The temperatures of reduction are 27° C for the H. F., 81° F. for the V. F. instrument.

(*e*) *Mean monthly values and secular change.*—The following table gives the mean monthly values of the magnetic elements with the secular change for 1907-08 deduced therefrom.

Dehra Dún Observatory.

Secular change.

Months.	Horizontal Force ·33000+			Declination E. 2°+			Dip 43°+			Vertical Force ·31000+			Remarks.
	Values 1907.	Values 1908.	Secular change, 1907-08.	Values 1907.	Values 1908.	Secular change, 1907-08.	Values 1907.	Values 1908.	Secular change, 1907-08.	Values 1907.	Values 1908.	Secular change, 1907-08.	
	C. G. S.	C. G. S.	γ	′	′	′	′	′	′	C. G. S.	C. G. S.	γ	
January .	336	306	−30	39·0	37·4	−1·6	34·1	38·7	+4·6	711	767	+56	
February .	333	303	−30	38·7	37·5	−1·2	35·8	39·5	+3·7	738	779	+41	
March .	322	299	−23	39·2	37·2	−2·0	33·7	40·1	+6·4	690	785	+95	
April . .	335	292	−43	38·6	37·2	−1·4	33·9	41·6	+7·7	706	807	+101	
May . .	330	297	−33	38·5	37·0	−1·5	35·3	41·8	+6·5	725	815	+90	
June . .	333	296	−37	38·0	36·4	−1·6	35·6	42·5	+6·9	735	828	+93	
July . .	322	300	−22	38·1	36·1	−2·0	36·4	42·1	+5·7	739	824	+85	
August .	325	296	−29	37·9	36·0	−1·9	36·4	42·8	+6·4	742	833	+91	
September .	323	273	−50	37·8	36·5	−1·3	37·1	44·1	+7·0	752	836	+84	
October .	310	280	−30	37·8	36·3	−1·5	38·0	44·3	+6·3	758	845	+87	
November .	309	283	−26	37·5	36·5	−1·0	37·9	45·0	+7·1	755	861	+106	
December .	305	286	−19	37·5	36·3	−1·2	38·7	44·3	+5·6	765	850	+85	
Means .	324	293	−31	38·2	36·7	−1·5	36·1	42·2	+6·2	735	819	+84	

B.—Barrackpore Observatory.

(*a*) General remarks on working.

(*b*) Mean values of H. F. and declination constants.

(*c*) Mean values of base lines.

(*d*) Mean scale values and temperature range.

(*e*) Mean monthly values of magnetic elements and secular change, 1907-08.

(*a*) *General remarks on working.*—The observatory remained in charge of K. N. Mukerji throughout the year, with the exception of 2½ months when Abdul Majid was in charge during the former's absence on leave.

The magnetographs were opened and cleaned and a new base mirror was fitted to the declination magnetograph in December 1908. All the instruments have given good results throughout the year.

(*b*) *Mean values of constants.*—The following table gives the monthly mean values of magnetic collimation, the distribution co-efficients P_{1}, and

$P_{2\cdot3}$ and the magnetic moment (m_0) of the magnet No. 20 for 1908. It will be seen that the value of m_0 has changed but little, which is satisfactory.

Mean values of the constants of the Magnetometer No. 20.

Months, 1908.	Declination Constants.	Horizontal Force Constants.						Remarks.
	Mean Magnetic Collimation.	Mean value of P's.				Mean value of M.	Accepted mean value of M.	
		$P_{1\cdot2}$.	$P_{2\cdot3}$.	Accepted values of $P_{1\cdot2}$.	Accepted values of $P_{2\cdot3}$.			
	′ ″							
January	−7 12	6·86	7·98	6·76 throughout.	8·00 throughout.	949·13	949·18	
February	−7 14	6·79	8·05			949·20	949·18	
March	−7 14	6·80	7·97			949·19	949·18	
April	−7 12	6·76	8·03			949·02	948·97	
May	−7 15	6·71	8·00			948·92	948·97	To 6th June.
June	−7 14	6·82	8·08			948·70	948·69	
July	−7 11	6·77	7·99			948·67	948·69	
August	−7 12	6·87	8·01			948·68	948·69	
September	−7 11	6·73	8·07			948·71	948·69	
October	−7 16	6·81	7·89			948·90	948·88	
November	−7 17	6·73	7·89			948·87	948·88	
December	−7 17	6·60	8·04			948·87	948·88	

(*c*) *Mean values of base lines.*—The table below gives the mean monthly values of the H. F. and declination base lines for 1908.

The V. F. base lines are not shown as there have been frequent changes.

Mean base line values of the Magnetographs in 1908.

Months, 1908.	Declination.		Horizontal Force.	
	Mean value of Base line.	Remarks.	Mean value of Base line.	Remarks.
	° ′			
January	0 25·3	......	·36991	
February	0 25·3	......	·36991	
March	0 25·2	......	·36991	to 22nd, 23rd, and 24th.
			a	
			·37003	from 25th.

Note—*a* = Base line value assumed to be varying uniformly. The values for individual days are found by interpolation.

Mean base line values of the Magnetographs in 1908—contd.

Months, 1908.	Declination.			Horizontal Force.	
	Mean value of Base line.		Remarks.	Mean value of Base line.	Remarks.
	°	′			
April . . .	0	25·1	......	·37005	
May . . .	0	25·0		*a*	
June . . .	0	24·9	......	·37013	
July . . .	0	24·8	......	·37013	
August . . .	0	24·8		·37013	
September . .	0	24·7	......	·37013	
October . . .	0	24·7	. ....	·37013	
				a	from 1st to 12th.
November . .	0	24·6	to 4th December	·37000	13th to 4th December.
				·37034	from 16h on 4th to 11h on 7th.
December . .	—0	4·4	from 7th „		
				·37068	from noon of 7th to end.
					A new base mirror was fitted in the declination magnetograph in December 1908.

NOTE.—*a* = Base line value assumed to be varying uniformly. The values for individual days are found by interpolation.

(*d*) *Mean scale values and temperature range.*—The mean scale value of the H. F. magnetograph for 1908 was 4·85γ with limiting values of 4·81 and 4·89: the mean temperature was 31°·9C with maxima of 33°·6 in May, June and July and a minimum of 28° in December.

The mean scale value of the V. F. magnetograph was 4·53γ the mean monthly values ranging from 4·50 to 4·56: the mean temperature for the year was 89°·6 F, with a maximum of 93°·1 in June and a minimum of 82°·6 in December.

The selected mean temperatures are 31° C for the H. F. magnetograph, 89° F for the V. F.

(*e*) *Mean monthly values and secular change.*—The following table gives the mean monthly values of the magnetic elements in 1907 and 1908 and the secular change deduced therefrom.

Barrackpore Observatory.

Secular change.

Months.	HORIZONTAL FORCE. ·37000+.			DECLINATION E1°+.			DIP 30°+.			VERTICAL FORCE. ·21000+.			REMARKS.
	Values 1907.	Values 1908	Secular change, 1907-08.	Values 1907.	Values 1908.	Secular change, 1907-08.	Values 1907.	Values 1908.	Secular change, 1907-08.	Values 1907.	Values 1908.	Secular change, 1907-08.	
	C. G. S.	C. G. S.		′	′	′	′	′	′	C. G. S.	C. G. S.	γ	
January	281	301	+20	12·0	7·6	−4·4	27·6	32·0	+4·4	925	1000	+75	
February	280	305	+25	11·0	7·4	−3·6	30·5	33·0	+2·5	967	1017	+50	
March	281	306	+25	11·2	6·8	−4·4	28·0	32·9	+4·9	931	1018	+87	
April	297	293	−4	10·6	6·4	−4·2	28·7	34·6	+5·9	951	1034	+83	
May	289	301	+12	10·3	6·4	−3·9	29·8	34·2	+4·4	961	1034	+73	
June	290	300	+10	9·8	5·7	−4·1	29·8	34·5	+4·7	962	1038	+76	
July	283	301	+18	9·7	5·6	−4·1	30·6	34·3	+3·7	970	1034	+64	
August	293	294	+1	9·4	5·1	−4·3	30·8	35·1	+4·3	978	1042	+64	
September	293	275	−18	9·0	4·8	−4·2	31·0	36·1	+5·1	982	1045	+63	
October	284	294	+10	8·6	4·3	−4·3	31·8	35·8	+4·0	988	1053	+65	
November	290	299	+9	8·4	3·8	−4·6	31·8	36·4	+4·6	991	1064	+73	
December	290	308	+18	7·9	3·6	−4·3	32·1	36·3	+4·2	996	1068	+72	
MEANS	288	298	+11	9·8	5·6	−4·2	30·2	34·6	+4·4	967	1037	+70	

C.—Toungoo Observatory.

(*a*) General remarks on working.
(*b*) Mean values of H. F. and declination constants.
(*c*) Mean monthly values of base lines.
(*d*) Mean scale values and temperature range.
(*e*) Mean monthly values of the magnetic elements and secular change, 1907-08.

(*a*) ***General remarks on working.***—The observatory has remained in charge of Shri Dhar throughout the year.

The V. F. magnetograph was opened up and cleaned in December 1908. The temperature compensation arm was inadvertently moved in the process and a new determination of the temperature co-efficient was made. The value found was —2·0γ per +1° F.

The torsion head of the H. F. magnetograph was turned at the same time increasing the value of the base line by about 200γ.

(*b*) ***Mean values of H. F. and declination constants.***—The following table gives the monthly mean values of the magnetic collimation, the distribution co-efficients P_{1}, and P_{2}, and the magnetic moment m_o for 1908. A new magnet No. 19A was used from April 1908 which explains the changes in the constants.

Mean values of the constants of the Magnetometer No. 19.

Months, 1908.	Declination Constants. Mean Magnetic Collimation.	Horizontal Force Constants. Mean value of P's. P1·2.	P2·3.	Accepted value of P1·2.	Accepted value of P2·3.	Mean value M.	Accepted mean value M.	Remarks.
	′ ″							
January . .	−3 36	7·74		7·71, up to March with 5R. 8·30, 25th April to 20th May. 8·80, from 29th May to end.	9·08, from 25th April to end.	948·34	948·36	From 12th December 1907 to 14th March 1908 with 5B.
February .	−3 44	7·73				948·36	948·36	
March . .	−3 47	7·35				...	948·36	
April . .	−0 38	8·34	8·92			905·17	905·17	From 25th April to 30th April.
May. . .	−0 21	8·28	9·10			904·89	904·89	From 3rd May to 9th June.
June . .	Fluctuating hence rejected.	8·88	9·15			904·50	904·50	From 11th June to 1st July.
July . .		8·79	9·01			904·33	904·33	From 4th July to 11th July.
August . .		8·87	9·15			903·74	903·74	From 15th July to 31st July.
September .	−1 27	8·76	9·14			903·17	903·17	From 7th August to 13th September.
October. . .	−1 26	8·87	8·98			902·38	902·38	From 17th September to 12th October.
November. .	−1 10	8·73	9·01			899·64	899·64	From 14th November to 5th December.
December. .	−1 16	8·70	9·09			899·42	899·42	From 9th December to end.

(*c*) ***Mean monthly values of base lines.***—The table below gives the monthly mean values of the H. F. and declination base lines.

There has been a progressive fall in the base line of the H. F. magnetograph.

The V. F. base lines are not given as there have been frequent changes.

Toungoo Observatory.

The abstract of the base line value of the Magnetographs in 1908.

Months, 1908.	Declination. Mean value of Base line.	Declination. Remarks.	Horizontal Force. Mean value of Base line.	Horizontal Force. Remarks.
	° ′			
December 1907 . .	......		·38351	
January 1908 . .	−0 9·2		*a*	
February . . .	9·7		*a*	
March . . .	9·7		*a*	
April . . .	9·8		*a*	
May	9·4		·38311 *a*	
June	9·8		·38305 *a*	
July	9·8		·38296	
August . . .	9·9		*a*	
September . . .	9·5		·38291 *a*	

Note.—*a*=Base line value assumed to be varying uniformly. The values for individual days are found by interpolation.

Toungoo Observatory—contd.

Months, 1908.	Declination.		Horizontal force.	
	Mean value of Base line.	Remarks.	Mean value of Base line.	Remarks.
	° ′			
October . . .	9·6		{·38288 *a*	
November . . .	9·6		{·38279 *a*	
December . .	9·1		{·38276	to 12th.
			·38496	for the rest.

Note *a*=Base line value assumed to be varying uniformly. The values for individual days are found by interpolation.

(*d*) *Mean scale values and temperature range. H. F. magnetograph.*—The mean scale value for 1908 was 5·52γ with limiting values of 5·50 and 5·53. The mean temperature for the year was 89°·1 C: the maximum monthly mean temperature was 89°·3 in March, the minimum 89°·0 in January, July, September.

V. F. magnetograph.—The mean scale value was 5·51γ for the first quarter of the year and subsequently 5·04γ: the mean temperature for the year was 88°·7 F. with a maximum of 89°·0 in May a minimum of 88°·4 in December.

The selected mean temperature is 89° F. for both instruments.

(*e*) *Mean monthly values of the magnetic elements and secular change, 1907 08.*—The following table gives the mean monthly values of the magnetic elements year 1907 and 1908 with the secular change deduced therefrom.

The values of H. F. and V. F. from July 1907 are preliminary only as the corrections to be applied to magnets 5A and 19A to reduce them to the original magnet No. 19 have not yet been finally settled.

Toungoo Observatory.
Secular change.

Months.	Horizontal force. ·38000+.			Declination. E 0°+.			Dip. 22°+.			Vertical force. ·16000+.			Remarks.
	Values 1907.	Values 1908.	Secular change, 1907-08.	Values 1907.	Values 1908.	Secular change, 1907-08.	Values 1907.	Values 1908.	Secular change, 1907-08.	Values 1907.	Values 1908.	Secular change, 1907-08.	
	C. G. S.	C. G. S.	γ	′	′	′	′	′	′	C. G. S.	C. G. S.	γ	
January .	718	766	+48	41·5	36·7	−4·8	59·4	61·1	+1·7	427	469	+42	
February .	709	767	+58	41·0	36·3	−4·7	62·5	60·8	−1·7	464	466	+02	
March .	732	769	+37	40·4	35·8	−4·6	61·1	61·4	+0·3	456	475	+19	
April . .	748	758	+10	40·0	35·1	−4·9	61·5	63·1	+1·6	467	493	+26	
May . .	740	763	+23	39·4	35·5	−3·9	62·1	61·9	−0·2	472	479	+07	
June . .	752	762	+10	39·3	34·5	−4·8	61·2	61·8	+0·6	465	477	+12	
July . .	746	766	+20	38·8	34·2	−4·6	61·8	61·7	−0·1	470	477	+07	
August .	761	762	+01	38·9	33·6	−5·3	62·0	61·5	−0·5	480	473	−07	
September .	771	748	−23	38·3	33·5	−4·8	61·5	62·2	+0·7	477	477	00	
October .	782	764	−18	38·1	32·9	−5·2	61·2	62·7	+1·5	478	490	+12	
November .	792	763	−29	37·9	32·5	−5·4	62·0	63·2	+1·2	493	496	+03	
December .	802	764	−38	37·4	32·6	−4·8	61·8	61·4	−0·4	494	473	−21	
Means .	754	763	+8	39·3	34·4	−4·8	61·5	61·9	+0·4	470	479	+09	

D.—*Kodaikánal Observatory.*

(*a*) General remarks on working
(*b*) Mean values of H. F. and declination constants.
(*c*) Mean values of base lines.
(*d*) Mean scale values and temperature range.
(*e*) Mean monthly values of magnetic elements and secular change, 1907-08.

(*a*) *General remarks on working.*—The observatory remained in charge of Surveyor Ramaswami Iyengar throughout the year under report.

The magnetographs gave good results throughout the year. Thanks are due to the Director, Solar Physics Observatory, for his cordial assistance in all matters concerning the magnetic work.

(*b*) *Mean values of constants.*—The table below gives the monthly mean values of the magnetic collimation, the distribution co-efficients $P_{1\cdot3}$ and $P_{2\cdot5}$ and the magnetic moment (m_0) of magnet No. 16 for 1908.

The low observed values of m_0 in August and September are incorrect—they are the result of personal error on the part of a second observer who held charge of the observatory while the permanent incumbent was on leave.

Mean values of the constants of the Magnetometer No. 16.

Months, 1908.	Declination Constants.	Horizontal Force Constants.						Remarks.
	Mean Magnetic Collimation.	Mean values of P's.				Mean value of M.	Accepted mean value of M.	
		$P_{1\cdot3}$.	$P_{2\cdot5}$.	Accepted value of $P_{1\cdot3}$.	Accepted value of $P_{2\cdot5}$			
	′ ″							
January	−2 23	6·87	8·87	6·81	8·87	923·28	923·29	
February	−2 23	6·78	8·94	6·81	8·87	923·35	923·29	
March	−2 24	6·76	8·99	6·81	8·87	923·26	923·29	
April	−2 21	6·77	8·91	6·81	8·87	923·39	923·29	
May	−2 24	6·81	8·72	6·81	8·87	923·27	933·29	
June	−2 24	6·83	8·84	6·81	8·87	923·29	923·29 923·29	 to 11th July.
July	−2 23	6·76	8·81	6·81	8·87	923·04	923·24	from 18th.
August	−2 27	6·81	8·84	6·81	8·87	922·71	923·24	from 18th July to 13th October.
September	−2 29	6·92	8·84	6·81	8·87	922·77	923·24	M is found by interpolation.
October	−2 28	6·78	8·95	6·81	8·87	923·02	923·24 923·19	to 13th October. from 17th October.
November	−2 25	6·87	8·83	6·81	8·87	923·34	923·19	
December	−2 23	7·76	8·91	6·81	8·87	923·10	923·19	

(*c*) *Mean values of base lines.*—The annexed table shows the base lines of the H. F. and declination magnetographs. The declination base line has been extremely steady while the H. F. base line shows a slight fall throughout.

The base lines of the V. F. instrument are not shown as the balance of the magnet required adjustment on several occasions.

Kodaikánal Observatory.

The abstract of the base line value of the Magnetographs in 1908.

Months, 1908.	Declination.			Horizontal Force.	
	Mean value of Base Line.		Remarks.	Mean value of Base Line.	Remarks.
	°	′			
January	1	32·7	......	·36953	
February	1	32·9	......	·36951	
March	1	32·6	......	·36949	
April	1	32·7	......	·36947	
May	1	32·6	......	·36948	
June	1	32·9	......	·36948	
July	1	32·7	......	·36947	
August	1	32·9	......	·36947 *a*	to 20th. 21st to 10th September.
September	1	33·0	......	·36943	from 11th.
October	1	32·7	......	·36943 *a*	to 20th. 21st to 10th November.
November	1	32·7	......	·36939	from 11th.
December	1	32·7	......	·36941	

NOTE.—*a*=Base line value assumed to be varying uniformly. The values for individual days are found by interpolation.

(*d*) ***Mean scale values and temperature range. H. F. magnetograph.***—The mean scale value for the year was 6·14 γ with a range from 6·13 to 6·15 : the mean temperature was 19°·1 C the monthly mean values varying from 19°·0 to 19°·2. The selected mean temperature is 19°·0 C.

V. F. magnetograph.—The mean scale value was 4·69 γ to May and subsequently 5·90 γ. The mean temperature for the year was 66°·5 F. with a minimum of 66°·1 in January and a maximum of 66°·9 in June.

The selected mean temperatures are 19° C and 66° F.

(*e*) ***Mean monthly values and secular change.***—The following table gives the mean monthly values of the magnetic elements in 1907 and 1908 with the secular change deduced therefrom.

Kodaikánal Observatory.

Secular change.

Months.	Horizontal force. ·37000 +.			Declination. W 0° +.			Dip 3° +.			Vertical Force ·02000 +.			Remarks.
	Values 1907.	Values 1908.	Secular change, 1907-08.	Values 1907.	Values 1908.	Secular change, 1907-08.	Values 1907.	Values 1908.	Secular change, 1907-08.	Values 1907.	Values 1908.	Secular change, 1907-08.	
	C. G. S.	C. G. S.		′	′	′	′	′	′	C. G. S.	C. G. S.	γ	
January .	426	436	+10	38·8	43·2	+4·4	25·8	30·5	+4·7	243	294	+51	
February .	415	434	+19	39·0	43·7	+4·7	27·2	31·0	+3·8	258	300	+42	
March .	423	438	+15	39·2	44·4	+5·2	24·1	31·1	+7·0	224	302	+78	
April .	439	430	—09	39·9	44·3	+4·4	26·7	31·7	+5·0	253	308	+55	
May .	429	435	+06	40·2	44·6	+4·4	26·3	31·9	+5·6	249	310	+61	
June .	430	431	+01	40·5	45·3	+4·8	27·7	34·0	+6·3	264	332	+68	
July .	423	438	+15	40·7	45·4	+4·7	27·9	33·9	+6·0	265	332	+66	
August .	430	431	+01	41·1	46·1	+5·0	28·3	34·2	+5·9	270	335	+65	
September .	438	424	—14	41·7	46·3	+4·6	27·4	34·3	+6·9	261	336	+75	
October .	436	437	+01	41·8	46·6	+4·8	27·7	34·0	+6·3	265	333	+68	
November .	437	430	—07	42·4	47·2	+4·8	29·4	35·1	+5·7	283	345	+62	
December .	440	439	—01	42·8	47·6	+4·8	29·7	36·3	+6·6	286	358	+72	
Means .	431	434	+3	40·7	45·4	+4·7	27·4	33·2	+5·8	260	324	+64	

Part III.

Tables of Results.

INDEX TO TABLES.

For each observatory the following tables are given :—

1. Hourly means (corrected for temperature) of declination, horizontal force, vertical force and dip from 5 selected quiet days per month.
2. Diurnal inequality of each deduced from 1.

Table A.

Mean values of the magnetic elements at the Observatories in 1908.

Observatory.	Latitude.	Longitude.	Declination.	Horizontal Force. C. G. S.	Vertical Force. C. G. S.	Dip.
	° ′ ″	° ′ ″	° ′			° ′
Dehra Dún . .	30 19 19 N	78 3 19 E	2 36·7 E	·33293	·31819	43 42·2 N
Barrackpore .	22 46 29 ,,	88 21 39 ,,	1 5·7 ,,	·37031	·2[illegible]038	30 34·5 ,,
Toungoo . .	18 55 45 ,,	96 27 3 ,,	0 34·4 ,,	·38763	·16479	23 2·0 ,,
Kodaikánal . .	10 13 50 ,,	77 27 46 ,,	0 45·4 W	·37434	·02324	3 31·2 ,,

B.—Dates of magnetic disturbances, 1908.

		°	′	″
D=Dehra Dún	Lat.	30	19	19
	Long.	78	3	19
B=Barrackpore	Lat.	22	46	29
	Long.	88	21	39
T=Toungoo	Lat.	18	55	45
	Long.	96	27	3
K=Kodaikánal	Lat.	10	13	50
	Long.	77	27	46

Date.	January.				February.				March.				April.			
1908	D	B	T	K	D	B	T	K	D	B	T	K	D	B	T	K
1	(C)	(C)	(C)	(C)	C	C	C	C	S	S	S	S	S	S	S	S
2	C	C	C	C	(C)	(C)	(C)	(C)	S	S	S	S	C	C	C	C
3	C	C	C	C	S	S	S	S	S	S	S	S	(C)	(C)	(C)	(C)
4	C	C	C	C	S	S	S	S	S	S	S	S	C	C	C	C
5	S	C	C	C	S	S	S	S	S	S	S	S	S	C	S	S
6	C	C	C	C	M	S	S	S	(C)	(C)	(C)	(C)	S	S	S	S
7	S	C	C	C	S	S	S	S	C	C	C	C	S	S	S	S
8	C	C	C	C	S	S	S	S	M	S	S	S	S	S	S	S
9	M	M	M	M	C	C	C	C	S	S	S	S	C	C	C	C
10	S	S	C	C	S	S	S	S	S	C	C	C	(C)	(C)	(C)	(C)
11	C	C	C	C	S	S	S	S	C	C	C	C	C	C	C	C
12	C	C	S	C	S	S	S	S	C	C	C	C	(C)	(C)	(C)	(C)
13	C	C	C	C	S	C	C	S	C	C	C	C	C	—	C	C
14	(C)	(C)	(C)	(C)	(C)	(C)	(C)	(C)	(C)	(C)	(C)	(C)	S	S	S	S
15	S	C	C	C	(C)	(C)	(C)	(C)	(C)	(C)	(C)	(C)	S	S	S	S
16	C	C	C	C	C	C	C	C	S	S	S	S	S	S	S	S
17	(C)	(C)	(C)	(C)	S	S	C	C	C	C	C	C	C	C	S	S
18	C	C	C	C	C	C	C	C	(C)	(C)	(C)	(C)	C	C	C	C
19	C	C	C	C	(C)	(C)	(C)	(C)	S	C	C	C	S	S	S	S
20	(C)	(C)	(C)	( )	C	C	C	C	S	S	C	S	(C)	(C)	(C)	(C)
21	S	S	S	S	(C)	(C)	(C)	(C)	S	S	C	S	S	C	C	C
22	C	C	C	C	M	M	S	S	C	C	C	C	S	S	S	S
23	C	C	C	C	S	S	S	S	C	C	C	C	S	S	S	S
24	S	S	C	C	S	S	S	S	(C)	(C)	(C)	(C)	S	S	S	S
25	S	S	S	S	S	S	C	C	C	C	C	S	S	S	S	S
26	(C)	(C)	(C)	(C)	C	C	C	C	G	G	S	M	S	C	S	S
27	—	S	S	C	C	C	S	S	G	M	M	M	S	C	S	S
28	S	S	S	S	S	C	S	S	M	S	M	S	S	C	S	C
29	M	M	M	M	S	S	S	S	S	S	S	S	C	C	C	S
30	C	C	C	C	...	...	...	...	S	S	S	S	(C)	(C)	(C)	(C)
31	C	C	C	C	...	...	...	...	S	S	S	S	...	...	...	...
	20	23	24	26	12	14	14	13	13	15	17	14	13	17	13	13
	8	6	5	3	15	14	15	16	14	14	12	15	17	12	17	17
	2	2	2	2	2	1	...	...	2	1	2	2	...	...	...	...
	...	...	...	...	...	...	...	...	2	1	...	...	...	...	...	...
G.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
race lost	1	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...

Date.	May.				June.				July.				August.			
1908	D	B	T	K	D	B	T	K	D	B	T	K	D	B	T	K
1	S	S	S	S	C	C	C	C	C	C	C	C	S	S	S	S
2	S	S	S	S	C	C	C	C	(C)	(C)	(C)	(C)	S	S	S	S
3	S	S	S	S	S	S	S	S	C	C	C	C	S	S	C	S
4	S	S	S	S	S	S	S	S	C	C	C	C	S	S	S	S
5	S	S	S	S	(C)	(C)	(C)	(C)	S	C	C	C	(C)	(C)	(C)	(C)
6	C	C	S	S	S	S	S	S	S	C	C	C	(C)	(C)	(C)	(C)
7	(C)	(C)	(C)	(C)	C	C	C	C	C	C	C	S	S	S	S	S
8	S	C	C	S	C	C	C	C	(C)	(C)	(C)	(C)	S	S	S	S
9	C	C	C	C	C	C	C	C	C	C	C	C	M	M	M	M
10	S	C	C	C	(C)	(C)	(C)	(C)	C	C	C	C	S	S	S	S
11	S	S	S	S	(C)	(C)	(C)	(C)	C	C	C	C	S	S	S	S
12	S	C	C	C	C	C	C	C	S	S	C	C	M	M	M	M
13	S	S	S	S	S	S	S	S	S	C	C	S	S	S	S	S
14	S	S	C	C	C	C	C	C	(C)	(C)	(C)	(C)	S	S	S	S
15	(C)	(C)	(C)	(C)	C	C	C	C	M	M	S	S	C	C	C	—
16	(C)	(C)	(C)	(C)	C	C	C	C	M	S	S	S	C	C	C	—
17	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
18	S	C	C	C	S	S	S	S	S	S	S	S	S	S	S	S
19	(C)	(C)	(C)	(C)	S	S	S	S	C	C	C	C	M	M	M	M
20	C	C	C	C	S	S	S	S	C	C	C	C	C	C	C	C
21	S	S	C	C	S	C	S	S	C	C	C	C	S	S	S	S
22	(C)	(C)	(C)	(C)	C	C	C	C	C	C	C	C	S	S	S	S
23	S	S	S	S	(C)	(C)	(C)	(C)	(C)	(C)	(C)	(C)	(C)	(C)	(C)	(C)
24	S	S	S	S	S	S	S	—	S	S	C	C	(C)	(C)	(C)	(C)
25	S	S	S	S	S	S	S	—	S	S	S	S	C	C	C	C
26	M	M	S	M	S	S	S	S	C	C	C	C	C	C	C	C
27	S	S	S	S	S	C	S	S	C	C	C	C	(C)	(C)	(C)	(C)
28	S	S	S	S	C	C	C	C	C	C	C	C	C	C	C	C
29	S	S	S	S	C	C	C	C	C	C	C	C	S	S	S	S
30	S	S	S	S	(C)	(C)	(C)	(C)	C	C	C	C	S	C	S	S
31	S	S	S	S	...	...	...	...	(C)	(C)	(C)	(C)	S	C	S	S
	8	12	13	12	17	19	17	17	1	24	26	24	11	13	12	9
	22	18	18	18	13	11	13	11	8	6	5	7	17	15	16	17
	1	1	...	1	...	...	...	...	2	1	...	...	3	3	3	3
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
G.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
race lost	...	...	...	...	...		...	2	...	...	...	...	...	...	2	...

Date.	September.				October.				November.				December.				Remarks.
1908	D	B	T	K	D	B	T	K	D	B	T	K	D	B	T	K	
1	(C)	(C)	(C)	(C)	S	S	S	S	S	S	S	S	C	C	C	C	
2	C	C	C	C	C	C	C	C	S	S	C	C	(C)	(C)	(C)	(C)	
3	S	C	C	C	S	C	C	S	C	C	C	C	C	C	C	C	
4	M	S	S	S	S	C	C	C	(C)	(C)	(C)	(C)	S	S	S	S	
5	M	M	M	M	M	S	S	S	(C)	(C)	(C)	(C)	M	M	M	M	
6	S	S	S	S	S	S	S	S	C	C	C	C	C	C	C	C	
7	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	
8	S	S	S	S	C	C	C	C	M	M	M	M	C	C	C	C	
9	S	S	S	S	(C)	(C)	(C)	(C)	S	S	S	S	C	C	C	C	
10	S	S	S	S	(C)	(C)	(C)	(C)	S	S	S	S	C	C	C	C	
11	S	S	S	S	(C)	(C)	(C)	(C)	S	C	C	S	(C)	(C)	(C)	(C)	
12	VG	VG	VG	VG	S	S	S	S	C	C	C	C	S	S	S	C	
13	C	C	C	C	M	S	S	S	C	C	C	C	S	S	S	S	
14	C	C	C	C	S	S	S	S	C	—	C	C	S	—	S	C	
15	(C)	(C)	(C)	(C)	S	C	C	C	S	S	S	C	C	C	C	C	
16	S	S	S	S	S	S	S	C	(C)	(C)	(C)	(C)	(C)	(C)	(C)	(C)	
17	S	S	S	S	C	C	C	C	M	M	M	M	S	C	C	C	
18	S	C	C	S	S	S	S	S	S	S	S	S	C	C	C	C	
19	C	C	C	C	—	C	C	C	C	C	C	C	C	C	C	C	
20	C	C	C	C	—	C	C	C	C	C	C	C	(C)	(C)	(C)	(C)	
21	(C)	(C)	(C)	(C)	C	C	—	C	C	C	C	C	C	—	C	C	
22	C	C	C	S	C	C	C	C	C	C	C	C	C	—	C	C	
23	(C)	(C)	(C)	(C)	(C)	(C)	(C)	(C)	(C)	(C)	(C)	(C)	S	S	S	C	
24	S	S	S	C	C	C	C	C	C	C	C	C	C	C	C	C	
25	S	S	S	S	C	—	C	C	C	C	—	C	S	S	S	C	
26	(C)	(C)	(C)	(S)	(C)	(C)	(C)	(C)	C	C	C	C	M	M	S	S	
27	S	C	C	S	C	C	C	C	(C)	(C)	(C)	(C)	C	C	C	C	
28	M	M	M	M	C	—	C	C	S	S	S	S	(C)	(C)	(C)	(C)	
29	VG	VG	VG	VG	C	—	C	C	S	C	C	S	C	C	C	C	
30	M	M	M	M	C	C	C	C	C	—	C	C	C	C	C	C	
31	...	...	...	...	M	M	M	M	...	...	...	...	S	S	S.	S	
	12	15	15	12	17	19	21	22	19	19	21	21	21	20	22	26	
	12	10	10	13	9	8	8	8	9	7	6	7	8	6	8	4	
	4	3	3	3	3	1	1	1	2	2	2	2	2	2	1	1	
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
G.	2	2	2	2	...	...	...	...	...	...	...	...	...	...	...	...	
race lost	...	...	...	...	2	3	1	...	...	2	1	...	...	3	...	...	

(C) = Selected Quiet Day. C=Calm. S=Slight. M=Moderate. G=Great. VG=Very Great. —= Trace lost.

Abstract showing approximate magnetic values at stations observed at by No. 26 Party during season, 1908-09.

Serial No.	Name of Station.	Survey No.		Latitude.	Longitude.	Dip.	Declination.	Horizontal Force.	Remarks.
				° ′ ″	° ′ ″	° ′	° ′	C. G. S.	
1215	Kyauktaw .	20/92	3	20 50 30	92 58 40	26 52	E 0 39	0·3818	H is derived from mean M° throughout.
1216	Paletwa . .	21/92	8	21 18 10	92 51 40	27 50	,, 0 45	0·3807	
1217	Kaletwa . .	,,	9	21 44 0	92 47 50	28 39	,, 0 49	0·3798	
1218	Kyaukpyu .	19/93	12	19 26 0	93 33 30	23 58	,, 0 35	0·3862	
1219	Ramree .	,,	13	19 5 50	93 52 0	23 20	,, 0 34	0·3872	
1220	Cheduba .	18/94	1	18 51 10	93 43 30	22 44	,, 0 34	0·3882	
1221	Sandoway .	,,	2	18 27 50	94 22 0	21 53	,, 0 32	0·3889	
1222	Kyeintali .	,,	3	18 0 0	94 29 10	20 56	,, 0 29	0·3898	
1223	Gwa . .	,,	4	17 35 20	94 34 50	20 1	,, 0 24	0·3907	
1224	Bawmi . .	,,	5	17 18 30	94 34 40	19 22	,, 0 25	0·3912	
1225	Taseng . .	16/94	2	16 54 20	94 23 40	18 27	,, 0 23	0·3911	
1226	Ngo-yon-kaung .	,,	3	16 30 20	94 18 0	17 33	,, 0 20	0·3923	
1227	Ka-baung-hmau	,,	4	15 59 50	94 16 40	16 17	,, 0 19	0·3931	
1228	Labutta . .	,,	5	16 8 40	94 45 20	16 48	,, 0 38	0·3936	
1229	Wakéma .	16/95	2	16 36 0	95 10 10	17 50	,, 0 36	0·3925	
1230	Mya-tha .	,,	3	16 14 10	95 17 0	17 4	,, 0 24	0·3924	
1231	Maubin .	,,	4	16 44 20	95 39 10	18 13	,, 0 24	0·3916	
1232	Pyapôn . .	,,	5	16 17 10	95 40 50	17 15	,, 0 23	0·3925	
1233	Kadon-kani .	,,	6	15 46 40	95 12 50	16 17	,, 0 19	0·3932	
1234	Yandoon .	17/95	11	17 2 50	95 38 10	18 55	,, 0 27	0·3925	
1235	Me-za-li-gon .	,,	12	17 52 50	95 14 0	20 39	,, 0 27	0·3909	
1236	Petyé . .	,,	13	18 18 30	95 8 20	21 33	,, 0 29	0·3894	
1237	Tabee . .	18/94	6	18 38 20	94 40 20	22 16	,, 0 32	0·3888	
1238	Taungup .	,,	7	18 51 40	94 14 50	22 42	,, 0 33	0·3884	
1239	Mai . .	19/94	14	19 17 10	94 8 0	23 44	,, 0 35	0·3873	
1240	Sakamau .	,,	15	19 38 50	94 0 10	24 23	,, 0 36	0·3863	
1241	Thanbaya .	16/98	3	16 7 20	98 2 10	16 56	,, 0 35	0·3936	
1242	Kyunghaung	,,	4	15 32 10	98 15 20	15 37	,, 0 31	0·3942	
1243	Mi-tan . .	,,	5	16 0 10	98 26 30	16 40	,, 0 34	0·3938	
1244	Kyôndo . .	,,	6	16 35 50	98 3 50	17 55	,, 0 35	0·3929	
1245	Mya-wadi .	,,	7	16 41 20	98 29 50	18 8	,, 0 35	0·3926	
1246	Amherst . .	,,	8	16 4 50	97 34 0	16 38	,, 0 29	0·3932	
1247	Anin . .	,,	9	15 39 40	97 44 0	15 41	,, 0 26	0·3936	
1248	Ye . .	,,	10	15 14 40	97 51 10	14 52	,, 0 31	0·3948	
1249	Myitta . .	14/98	2	14 10 50	98 29 50	12 29	,, 0 31	0·3955	
1250	Gônnyin Seik .	,,	3	13 41 20	98 18 50	11 21	,, 0 27	0·3953	
1251	Malee . .	,,	4	13 6 50	98 19 40	10 12	,, 0 31	0·3975	

Abstract showing approximate magnetic values at stations observed at by No. 26 Party during season, 1908-09—contd.

Serial No.	Name of Station.	Survey No.		Latitude. ° ′ ″	Longitude. ° ′ ″	Dip. ° ′	Declination. ° ′	Horizontal Force. C. G. S.	Remarks.
1252	Kan-hmaw	12/98	3	11 48 20	98 33 20	7 4	E 0 21	0·3964	
1253	Bôkpyin	,,	4	11 16 40	98 49 30	5 48	,, 0 23	0·3970	
1254	Victoria Point	10/98	1	9 59 30	98 35 20	2 46	,, 0 20	0·3970	
1255	Tenasserim	12/100	1	12 5 40	99 3 30	7 43	,, 0 29	0·3972	
1256	Srínagar			34 4 17	74 49 1	49 18	,, 2 54	0·3101	Communicated by Mr. D. C. Sowers of the Carnegie Institution of Terrestrial Magnetism.
1257	Sonamarg			34 18 45	75 18 54	49 30	,, 3 55	0·3107	
1258	Múlbekh			34 23 2	76 21 29	49 30	,, 3 49	0·3154	
1259	Leh			34 9 30	77 34 15	49 24	,, 3 34	0·3123	
1260	Panamik			34 47 0	77 33 40	50 9	,, 3 53	0·3101	
1261	Kigil Langar			35 12 0	78 0 55	50 51	,, 3 59	0·3081	
	Old Stations re-observed—								
20	Asolai	[illegible]	1	26 42 10	72 15 50	37 46	E 0 13	0·3395	H is derived from mean M° throughout.
21	Phalodi	[illegible]	5	27 7 40	72 21 50	38 20	,, 2 4	0·3409	
21(*a*)	Phalodi (*a*)	,,	,,	27 7 30	72 21 20	38 15	,, 2 1	0·3415	
71	Lahore	[illegible]	8	31 35 50	74 18 50	45 59	,, 2 58	0·3210	
124	Bikaner	[illegible]	3	28 0 40	73 18 50	39 58	,, 2 6	0·3389	
139	Viramgám	[illegible]	13	23 8 10	72 3 30	31 19	,, 1 7	0·3565	
157	(Panth) Píplia	[illegible]	1	24 12 20	75 0 40	32 28	,, 1 19	0·3589	
158	Nímbahera	[illegible]	3	24 37 20	74 41 40	34 30	,, 1 38	0·3526	
172	Dhond	[illegible]	3	18 28 0	74 35 10	22 20	,, 0 18	0·3686	
207	Birur	14/76	4	13 35 50	75 58 10	11 26	W 0 34	0·3790	
217	Kolhápur	16/74	2	16 41 50	74 14 10	18 15	E 0 18	0·3733	
223	Manmád	20/74	2	20 14 40	74 26 20	25 29	,, 0 58	0·3654	
260	Kavas	[illegible]	6	25 52 20	71 31 40	35 59	,, 2 7	0·3457	
327	Tuticorin	8/78	1	8 48 10	78 9 0	0 7	W 1 20	0·3807	
387	Betragunta	14/80	7	14 48 40	79 57 20	14 13	,, 0 57	0·3807	
413	Hardikot G.T.S.	[illegible]	7	26 57 30	71 51 0	39 10	E 3 6	0·3378	
486	Daltonganj	[illegible]	3	24 2 0	84 4 30	32 54	,, 1 18	0·3665	
544	Bárán	[illegible]	5	25 5 30	76 30 30	35 18	,, 1 27	0·3527	
556	Bárwáha	[illegible]	2	22 15 20	76 1 30	29 40	,, 0 58	0·3631	
590	Anjhi	[illegible]	9	27 38 20	79 59 20	39 26	,, 1 53	0·3469	
598	Kathgodam	[illegible]	1	29 15 20	79 32 50	42 8	,, 2 24	0·3381	
621	Bistán	[illegible]	9	21 41 50	75 40 10	27 54	,, 0 59	0·3758	
622	Khal Ghát	,,	10	22 8 50	75 27 10	33 11	,, 1 54	0·3375	
623	Dhár	,,	11	22 36 0	75 18 30	30 2	,, 0 42	0·3670	
836	Parbatipur	[illegible]	3	25 39 10	88 55 10	36 19	,, 1 22	0·3629	
860	Lumding	[illegible]	6	25 44 50	93 10 40	36 21	,, 1 16	0·3609	

Abstract showing approximate magnetic values at stations observed at by No. 26 Party during season, 1908-09.—contd.

Detail Survey Stations.

Serial No.	Name of Station.	Latitude.	Longitude.	Dip.	Declination.	Horizontal Force.	REMARKS.
		° ′ ″	° ′ ″	° ′	° ′	C. G. S.	
1D	Mhow . .	22 33 0	75 45 0	30 1	E 0 49	0·3646	H is derived from mean M° throughout.
2D	Mánpur . .	22 25 50	75 36 40	29 23	„ 0 42	0·3670	
3D	Gujri . .	22 18 40	75 30 40	29 52	„ 1 0	0·3639	
4D	Lunera . .	22 27 40	75 25 20	30 2	„ 0 52	0·3647	
5D	Nímkhera .	22 26 10	75 11 30	29 57	„ 0 55	0·3648	
6D	Deola . .	22 19 0	75 5 30	29 29	„ 1 35	0·3627	
7D	Liwáni . .	22 18 50	75 18 30	29 43	„ 1 4	0·3631	
8D	Bákáner . .	22 11 10	75 9 30	29 16	„ 1 4	0·3629	
9D	Dharmpuri .	22 9 0	75 21 10	28 3	W 0 4	0·3886	
10D	„ A .	22 10 0	75 19 30	30 50	E 0 38	0·3532	
11D	„ B .	22 9 50	75 20 40	31 43	„ 0 47	0·3485	
12D	„ C .	22 9 20	75 20 50	29 50	„ 0 46	0·3661	
13D	Degáwa . .	22 10 10	75 22 10	29 9	„ 1 24	0·3618	
14D	Dasota . .	22 10 50	75 20 50	31 24	„ 1 13	0·3583	
15D	Dhegda . .	22 12 20	75 21 50	29 8	„ 0 58	0·3643	
16D	Chota Píplia .	22 11 20	75 18 40	29 26	„ 0 52	0·3622	
17D	Khárpura .	22 9 10	75 17 30	29 35	„ 0 49	0·3604	
18D	Mahápura .	22 8 40	75 14 50	30 51	„ 0 43	0·3596	
19D	Dédgaon . .	20 10 30	75 15 30	29 6	„ 0 53	0·3714	
20D	Baikhera . .	22 12 10	75 12 50	28 52	„ 0 46	0·3667	
21D	Potwár . .	22 8 20	75 11 30	30 59	„ 1 27	0·3562	
22D	Brahmangaon .	22 6 0	75 16 50	30 30	„ 0 56	0·3597	
23D	Balgaon No. 1 .	22 3 20	75 17 20	30 11	„ 0 32	0·3459	
24D	Khurrampura .	22 1 10	75 21 0	28 45	„ 0 42	0·3649	
25D	Thíkri . .	22 4 10	75 24 10	29 47	„ 1 1	0·3604	
26D	Abáli . .	22 5 20	75 20 50	33 14	„ 0 44	0·3356	
27D	Chichili . .	22 7 40	75 23 50	29 58	„ 1 10	0·3668	
28D	Khal Ghát A .	22 8 30	75 27 10	31 12	„ 0 53	0·3578	
29D	Dhámnod .	22 11 30	75 27 50	29 23	„ 1 10	0·3635	
30D	Regwán . .	22 6 0	75 29 40	27 33	„ 0 18	0·3744	
31D	Doláni . .	22 2 20	75 28 40	28 38	„ 0 31	0·3694	
32D	Dángri . .	22 0 0	75 14 40	28 48	„ 0 38	0·3665	
33D	Talwára . .	22 4 40	75 12 10	30 52	„ 0 26	0·3583	
34D	Kirmoi . .	22 5 30	75 8 50	30 46	„ 1 25	0·3623	
35D	Mundiakheri .	22 2 30	75 8 10	31 8	„ 1 12	0·3649	
36D	Salkhera . .	21 54 10	75 9 30	31 4	„ 1 18	0·3556	
37D	Pipri . .	21 57 10	75 11 40	28 51	„ 1 10	0·3663	
38D	Danund . .	21 53 20	75 5 0	28 4	„ 1 22	0·3552	

Abstract showing approximate magnetic values at stations observed at by No. 26 Party during season, 1908-09—contd.

Detail Survey Stations.

Serial No.	Name of Station.		Latitude.	Longitude.	Dip.	Declination.	Horizontal Force.	REMARKS.
			° ′ ″	° ′ ″	° ′	° ′	C. G. S.	
39D	Raita . .		21 51 50	75 8 30	30 20	E 0 39	0·3634	H is derived from mean M° throughout.
40D	Balgaon No. 2 .		21 51 20	75 12 40	28 14	„ 0 11	0·3773	
41D	Nágalwári .		21 45 30	75 15 40	29 30	„ 1 12	0·3641	
42D	Kheri .		21 52 30	75 20 50	28 42	„ 1 0	0·3643	
43D	Likhi . .		21 55 20	75 27 50	30 19	„ 0 40	0·3619	
44D	Khargon . .		21 50 0	75 36 0	29 34	„ 0 41	0·3657	
45D	Sirkandi . .		21 44 20	75 27 30	29 21	„ 0 33	0·3631	
46D	Dhulkot . .		21 36 30	75 33 10	28 49	„ 0 45	0·3631	
47D	Pipal Jopa .		21 33 10	75 41 20	27 49	„ 0 41	0·3670	
48D	Islámpura .		21 39 10	75 37 50	28 7	„ 0 57	0·3688	
49D	Ghári . .		21 39 40	75 43 50	28 28	„ 0 33	0·3671	
50D	Mogargaon .		21 42 0	75 49 30	28 31	„ 1 19	0·3640	
51D	Bistán A . .		21 42 0	75 40 10	27 59	„ 0 38	0·3690	
52D	Deoli . .		21 45 10	75 33 30	29 34	„ 0 28	0·3686	
53D	Piparker . .		21 45 20	75 39 20	25 25	W 0 31	0·3885	
54D	Julwána . .		21 48 40	75 44 0	30 22	E 1 2	0·3614	
55D	Sultánpura .		21 52 10	75 47 0	29 30	„ 0 45	0·3653	
56D	Lohári . .		21 57 40	75 37 50	28 4	„ 0 56	0·3667	
57D	Kamuthwára .		22 2 20	75 47 10	30 27	„ 0 28	0·3656	
58D	Kaori . .		22 2 50	75 41 40	29 54	„ 0 51	0·3631	
59D	Dogaonwa .		22 7 20	75 38 40	29 45	„ 0 49	0·3634	
60D	Chamu . .		26 39 20	72 34 50	37 38	„ 1 54	0·3439	
61D	Rájabás . .		26 34 30	72 28 50	37 14	„ 1 49	0·3448	
62D	Loharan . .		26 39 30	72 22 20	36 58	„ 0 47	0·3424	
63D	Gilankor . .		26 45 50	72 26 40	37 37	„ 1 55	0·3435	
64D	Pilu . .		26 50 50	72 26 20	37 56	„ 1 42	0·3415	
65D	Kolu . .		26 55 0	72 18 10	37 53	„ 2 2	0·3412	
66D	Sagra . .		26 47 20	72 17 20	36 57	„ 1 25	0·3404	
67D	Márla No. 1 .		26 51 10	72 13 0	36 45	„ 1 9	0·3375	
68D	Untwália . .		26 45 10	72 12 10	39 37	W 0 38	0·3345	
69D	Chansuma .		26 46 10	72 9 10	40 9	E 1 2	0·3368	
70D	Márla No. 2 .		26 48 40	72 12 30	41 20	„ 0 53	0·3207	
71D	Kaláo . .		26 39 40	72 6 30	39 9	„ 2 24	0·3410	
72D	Bhurkia . .		26 43 0	72 10 10	39 45	„ 0 58	0·3404	
73D	Shetráwa .		26 35 50	72 17 20	36 28	W 2 1	0·3500	
74D	Rainsar . .		26 29 0	72 18 50	36 59	E 0 36	0·3499	
75D	Soália . .		26 26 50	72 12 40	37 37	„ 1 1	0·3398	
76D	Somésar . .		26 34 20	72 10 0	37 56	„ 1 33	0·3513	

Abstract showing approximate magnetic values at stations observed at by No. 26 Party during season, 1908-09.—contd.

Detail Survey Stations.

Serial No.	Name of Station.	Latitude. ° ′ ″	Longitude. ° ′ ″	Dip. ° ′	Declination. ° ′	Horizontal Force. G. C. S.	REMARKS.
77D	Jethania	26 37 50	72 11 40	39 17	E 0 18	0·3465	H is derived from mean M° throughout.
78D	Rataria	26 36 50	72 1 50	38 34	" 2 44	0·3416	
79D	Sardar-Singh-ki-Dhoni	26 38 20	71 48 50	35 17	" 3 19	0·3297	
80D	Dhursar	26 49 30	72 0 10	40 6	" 2 25	0·3347	
81D	Marwa	26 45 0	71 54 10	38 6	" 4 45	0·3552	
82D	Modadri	26 49 50	71 44 10	37 19	" 2 19	0·3414	
83D	Udhánia	26 58 0	71 43 10	37 35	" 2 17	0·3405	
84D	Rathora	27 6 40	71 53 10	37 24	" 2 7	0·3439	
85D	Khara	27 1 50	72 7 30	38 7	" 1 51	0·3414	
86D	Bengti (Bari)	27 9 10	72 10 30	38 31	" 2 16	0·3429	
87D	Jalóra	26 59 40	72 24 30	38 15	" 2 12	0·3417	
88D	Uparli	27 3 10	72 16 0	38 20	" 2 11	0·3419	
89D	Dádu	26 55 10	72 8 0	38 5	" 1 38	0·3367	
90D	Ékka	26 57 30	71 59 30	38 23	" 1 55	0·3310	
91D	Dédia	26 50 30	72 6 30	39 57	" 1 1	0·3280	
92D	Moru	26 42 10	71 58 30	39 20	" 1 22	0·3475	
93D	Shetráwa (a)	26 35 50	72 17 20	36 9	W 0 12	0·3463	
94D	Garawad	24 14 20	75 10 20	34 23	E 1 31	0·3562	
95D	Jíran	24 18 40	74 53 30	33 35	" 2 9	0·3542	
96D	Thara	24 11 0	74 51 20	33 12	" 1 24	0·3555	
97D	Palsoda	24 21 40	74 59 20	33 22	" 1 0	0·3552	
98D	Neemuch	24 27 0	74 52 50	34 18	" 1 11	0·3551	
99D	Beri	24 23 10	74 45 10	33 51	" 1 21	0·3540	
100D	Bamora	24 24 50	74 34 10	33 57	" 1 41	0·3547	
101D	Bári	24 30 50	74 39 40	34 16	" 1 39	0·3544	
102D	Badésar	24 41 10	74 30 30	34 29	" 1 49	0·3522	
103D	Bhadaura	24 42 40	74 21 50	34 21	" 1 50	0·3524	
104D	Akola	24 45 0	74 12 0	34 13	" 1 38	0·3523	
105D	Newánia	24 38 20	74 3 0	34 1	" 1 33	0·3525	
106D	Hita	24 33 40	74 11 40	34 15	" 1 49	0·3506	
107D	Padampura	24 34 50	74 20 0	34 5	" 1 51	0·3530	
108D	Bhanuja	24 32 0	74 29 20	34 12	" 1 42	0·3535	
109D	Pachar	24 24 20	74 25 50	33 49	" 1 38	0·3538	
110D	Bhairvi	24 19 40	74 34 30	33 46	" 1 39	0·3552	
111D	Barol	24 17 50	74 43 20	33 43	" 1 27	0·3550	
112D	Barawarda	24 11 30	74 42 0	33 23	" 1 27	0·3555	
113D	Bamotar	24 4 20	74 45 20	33 21	" 0 58	0·3555	
114D	Kalianpura	24 4 30	74 54 20	33 21	" 1 16	0·3555	

Abstract showing approximate magnetic values at stations observed at by No. 26 Party during season, 1908-09—concld.

Detail Survey Stations.

Serial No.	Name of Station.		Latitude. ° ′ ″	Longitude. ° ′ ″	Dip. ° ′	Declination. ° ′	Horizontal Force. C. G. S.	Remarks.
115D	Khiraut . .		23 57 20	74 48 0	33 23	E 1 1	0·3508	H is derived from Mean M° throughout.
116D	Ságtali . .		23 49 10	74 48 10	32 52	„ 1 18	0·3564	
117D	Dhanderio .		23 50 10	74 56 40	32 42	„ 1 23	0·3564	
118D	Jawásia . .		23 57 30	74 59 30	33 9	„ 1 10	0·3556	
119D	Mandsaur .		24 4 10	75 4 40	34 1	„ 1 15	0·3637	
120D	Sunti . .		24 6 0	75 13 50	33 4	„ 1 18	0·3582	
121D	Barwan . .		23 56 50	75 11 0	32 55	„ 0 59	0·3573	
122D	Kachnara .		23 50 30	75 6 20	32 30	„ 1 2	0·3553	

Repeat Stations.

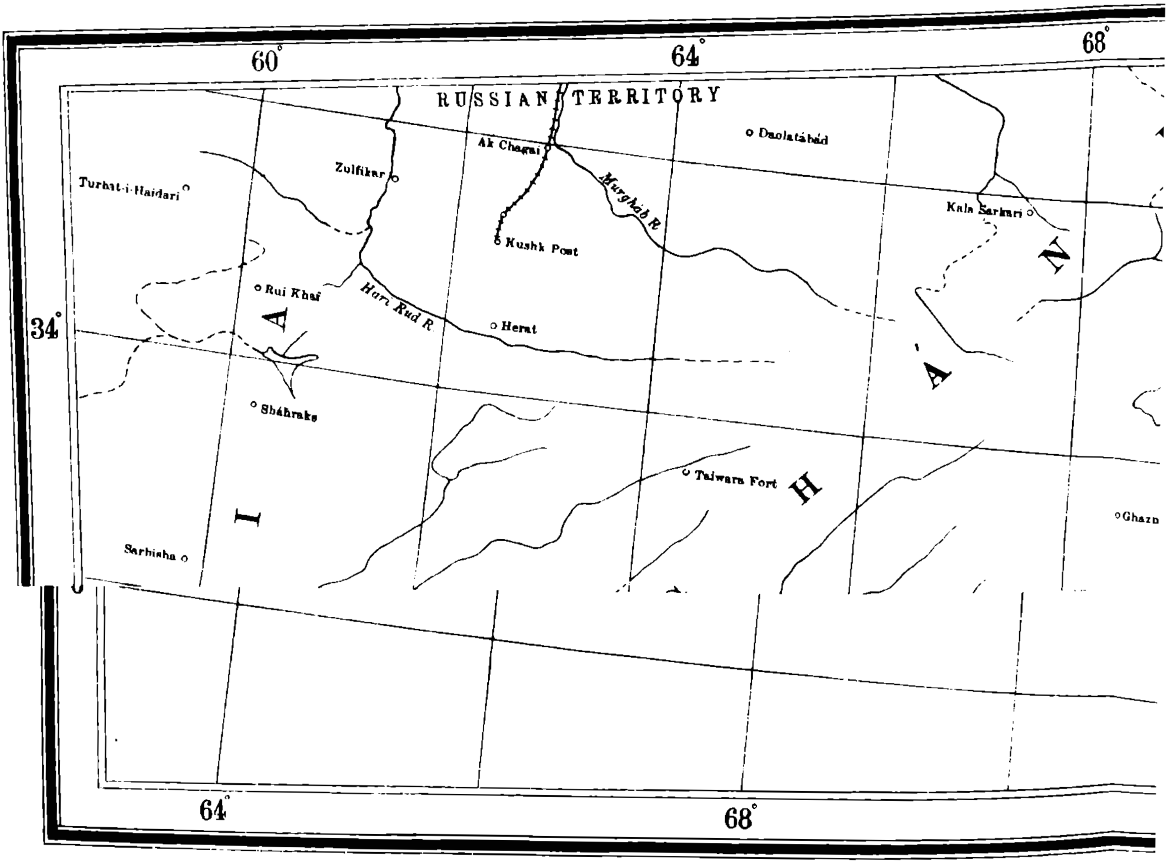
Serial No.	Name of Station.	Survey No.	Latitude. ° ′ ″	Longitude. ° ′ ″	Dip. ° ′	Declination. ° ′	Horizontal Force. C. G. S.	Remarks.
I	Udaipur . .		24 35 33	73 41 57	34 4	E 1 24	0·3527	H is derived from mean M° throughout.
II	Karáchi . .		24 49 50	67 2 2	34 23	„ 1 42	0·3453	
III	Quetta . .		30 11 52	67 0 20	43 12	„ 3 1	0·3230	
IV	Baháwalpur .		29 23 27	71 40 37	42 14	„ 2 51	0·3316	
V	Ráwalpindi .		33 35 16	73 3 6	48 21	„ 3 45	0·3116	
VI	Bharatpur .		27 13 27	77 29 28	38 52	„ 1 58	0·3454	
VII	Bangalore .		12 59 35	77 35 58	9 57	W 0 41	0·3816	
VIII	Dhárwár .		15 27 26	74 59 35	15 31	„ 0 16	0·3758	
IX	Porbandar .		21 38 20	69 37 6	28 57	E 1 13	0·3598	
X	Fyzabad . .		26 47 27	82 7 40	38 1	„ 1 45	0·3535	
XI	Sambalpur .		21 28 3	83 58 24	27 58	„ 0 46	0·3733	
XII	Waltair . .		17 42 57	83 19 1	21 20	„ 0 10	0·3785	
XIII	Darjeeling .		26 59 49	88 16 39	38 25	„ 1 32	0·3570	
XIV	Gaya . .		24 46 30	84 58 54	34 23	„ 1 7	0·3665	
XV	Secunderábád .		17 27 11	78 29 16	20 14	„ 0 15	0·3794	
XVI	Bhusával . .		21 2 46	75 47 18	27 5	„ 0 50	0·3678	
XVII	Jubbulpore .		23 8 57	79 56 44	31 11	„ 1 0	0·3641	
XVIII	Tavoy . .		14 4 50	98 12 30	12 16	„ 0 28	0·3960	
XIX	Lashio . .		22 56 47	97 44 40	31 18	„ 0 43	0·3766	
XX	Akyab . .		20 7 53	92 53 18	25 31	„ 0 42	0·3839	
XXI	Silchar or Cáchár		24 49 43	92 47 21	34 44	„ 1 8	0·3694	
XXII	Dibrugarh .		27 29 24	94 55 40	39 31	„ 1 15	0·3587	
XXIII	Port Blair .		11 39 10	92 43 13	6 18	W 0 8	0·3954	

NOTE.—The above values of Dip, Declination, and Horizontal Force are uncorrected for secular change, diurnal variation, instrumental differences etc., and are to be considered preliminary values only.

Where blanks occur, values have already been found during previous field seasons, or the observations have not been completed.

The survey numbers refer to the published chart: thus No. $\frac{26}{76}$ 3 denotes No. 3 station, the spherical co-ordinates of whose centre are 26° North Latitude and 76° East Longitude.

All Longitudes are referable to that of Madras Observatory taken at the value 80° 14′ 47″ East from Greenwich.



Reg. No. 46D. 1910-8. I.--1000

Note-The Longitudes are
taking that of the M

DEHRA DÚN OBSERVATORY TABLES.

Hourly Means of the Declination as determined at Dehra Dún from the selected quiet days in 1908.

Declination E2°+

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.	Means.
Winter.																										
Months.	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
January .	37·4	37·4	37·3	37·3	37·2	37·0	37·0	37·0	37·6	38·3	38·3	37·8	37·4	37·6	37·5	37·1	37·0	37·3	37·4	37·5	37·3	37·4	37·3	37·4	37·4	37·4
February .	37·6	37·5	37·5	37·4	37·3	36·9	36·7	36·5	37·6	38·7	39·1	39·1	38·5	37·7	37·3	36·9	37·1	37·2	37·2	37·2	37·4	37·5	37·4	37·5	37·5	37·5
March .	37·5	37·2	37·2	37·1	36·8	36·7	36·8	37·7	39·1	40·0	39·6	38·0	36·2	35·2	35·1	35·6	36·5	37·1	37·2	37·1	37·0	37·2	37·2	37·3	37·3	37·2
October .	36·8	36·8	36·7	36·7	36·5	36·4	36·4	37·3	38·3	38·5	37·0	35·5	33·8	33·3	34·2	35·6	36·3	36·4	36·3	36·3	36·3	36·3	36·5	36·6	36·7	36·3
November .	36·7	36·7	36·6	36·5	36·4	36·4	36·4	36·8	37·1	37·5	36·9	35·9	35·4	35·8	36·3	36·6	36·5	36·4	36·4	36·4	36·4	36·5	36·6	36·7	36·7	36·5
December .	36·5	36·6	36·5	36·3	36·2	35·9	35·9	35·9	36·3	36·9	36·8	35·7	35·2	35·4	36·1	36·6	36·8	36·5	36·5	36·5	36·5	36·4	36·4	36·4	36·4	36·3
Means .	37·1	37·0	37·0	36·9	36·7	36·6	36·5	36·9	37·7	38·3	38·0	37·0	36·1	35·8	36·1	36·4	36·7	36·8	36·8	36·8	36·8	36·9	36·9	37·0	37·0	36·9
Summer.																										
April .	37·6	37·6	37·6	37·4	37·3	37·3	38·0	39·7	40·5	40·0	38·6	36·4	35·0	34·2	34·8	35·7	36·6	37·2	37·3	36·9	36·8	37·1	37·2	37·3	37·5	37·2
May . .	37·3	37·3	37·5	37·4	37·3	37·5	38·6	39·9	40·2	39·3	37·4	35·4	34·2	33·8	34·5	35·5	36·3	37·0	37·1	36·9	36·8	36·8	36·9	37·0	37·2	37·0
June . .	36·8	37·0	37·0	36·9	36·9	37·2	38·5	39·5	39·3	38·2	36·7	35·1	33·9	33·5	33·5	33·8	34·7	35·7	36·3	36·4	36·2	36·4	36·5	36·7	36·7	36·4
July . .	36·1	36·4	36·3	36·4	36·6	36·9	38·4	39·8	39·7	38·8	37·4	35·5	33·8	33·0	32·9	33·8	34·8	35·6	36·2	35·8	35·6	35·7	35·8	35·8	36·0	36·1
August .	36·0	36·2	36·4	36·6	36·6	37·2	39·0	39·9	39·0	37·1	35·1	33·6	32·9	32·6	33·4	34·9	35·8	36·7	36·5	35·9	35·7	35·9	36·0	35·8	35·9	36·0
September	36·6	36·7	36·8	36·9	36·9	37·0	37·8	39·2	39·9	39·5	37·5	35·4	33·9	33·0	33·3	34·9	36·0	36·8	36·7	36·5	36·5	36·4	36·4	36·4	36·6	36·5
Means .	36·7	36·9	36·9	36·9	36·9	37·2	38·4	39·7	39·8	38·8	37·1	35·2	34·0	33·4	33·7	34·8	35·7	36·5	36·7	36·4	36·3	36·4	36·5	36·5	36·7	36·5

Diurnal Inequality of the Declination at Dehra Dún as deduced from the preceding Table.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.
Winter.																									
Months.	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
January	0.0	0.0	−0.1	−0.1	−0.2	−0.4	−0.4	−0.4	+0.2	+0.9	+0.9	+0.4	0.0	+0.2	+0.1	−0.3	−0.4	−0.1	0.0	+0.1	−0.1	0.0	−0.1	0.0	0.0
February	+0.1	0.0	0.0	−0.1	−0.2	−0.6	−0.8	−1.0	+0.1	+1.2	+1.6	+1.6	+1.0	+0.2	−0.2	−0.6	−0.4	−0.3	−0.3	−0.3	−0.1	0.0	−0.1	0.0	0.0
March	+0.3	0.0	0.0	−0.1	−0.4	−0.5	−0.4	+0.5	+1.9	+2.8	+2.4	+0.8	−1.0	−2.0	−2.1	−1.6	−0.7	−0.1	0.0	−0.1	−0.2	0.0	0.0	+0.1	+0.1
October	+0.5	+0.5	+0.4	+0.4	+0.2	+0.1	+0.1	+1.0	+2.0	+2.2	+0.7	−0.8	−2.5	−3.0	−2.1	−0.7	0.0	+0.1	0.0	0.0	0.0	0.0	+0.2	+0.3	+0.4
November	+0.2	+0.2	+0.1	0.0	−0.1	−0.1	−0.1	+0.3	+0.6	+1.0	+0.4	−0.6	−1.1	−0.7	−0.2	+0.1	0.0	−0.1	−0.1	−0.1	−0.1	0.0	+0.1	+0.2	+0.2
December	+0.2	+0.3	+0.2	0.0	−0.1	−0.4	−0.4	−0.4	0.0	+0.6	+0.5	−0.6	−1.1	−0.9	−0.2	+0.3	+0.5	+0.2	+0.2	+0.2	+0.2	+0.1	+0.1	+0.1	+0.1
Means	+0.2	+0.1	+0.1	0.0	−0.2	−0.3	−0.4	0.0	+0.8	+1.4	+1.1	+0.1	−0.8	−1.1	−0.8	−0.5	−0.2	−0.1	−0.1	−0.1	−0.1	0.0	0.0	+0.1	+0.1
Summer.																									
April	+0.4	+0.4	+0.4	+0.2	+0.1	+0.1	+0.8	+2.5	+3.3	+2.8	+1.4	−0.8	−2.2	−3.0	−2.4	−1.5	−0.6	0.0	+0.1	−0.3	−0.4	−0.1	0.0	+0.1	+0.3
May	+0.3	+0.3	+0.5	+0.4	+0.3	+0.5	+1.6	+2.9	+3.2	+2.3	+0.4	−1.6	−2.8	−3.2	−2.5	−1.5	−0.7	0.0	+0.1	−0.1	−0.2	−0.2	−0.1	0.0	+0.2
June	+0.4	+0.6	+0.6	+0.5	+0.5	+0.8	+2.1	+3.1	+2.9	+1.8	+0.3	−1.3	−2.5	−2.9	−2.9	−2.6	−1.7	−0.7	−0.1	0	−0.2	0	+0.1	+0.3	+0.3
July	0.0	+0.3	+0.2	+0.3	+0.5	+0.8	+2.3	+3.7	+3.6	+2.7	+1.3	−0.6	−2.3	−3.1	−3.2	−2.3	−1.3	−0.5	+0.1	−0.3	−0.5	−0.4	−0.3	−0.3	−0.1
August	0.0	+0.2	+0.4	+0.6	+0.6	+1.2	+3.0	+3.9	+3.0	+1.1	−0.9	−2.4	−3.1	−3.4	−2.6	−1.1	−0.2	+0.7	+0.5	−0.1	−0.3	−0.1	0.0	−0.2	−0.1
September	+0.1	+0.2	+0.3	+0.4	+0.4	+0.5	+1.3	+2.7	+3.4	+3.0	+1.0	−1.1	−2.6	−3.5	−3.2	−1.6	−0.5	+0.3	+0.2	0.0	0.0	−0.1	−0.1	−0.1	+0.1
Means	+0.2	+0.4	+0.4	+0.4	+0.4	+0.7	+1.9	+3.2	+3.3	+2.3	+0.6	−1.3	−2.5	−3.1	−2.8	−1.7	−0.8	0.0	+0.2	−0.1	−0.2	−0.1	0.0	0.0	+0.2

N.B.—When the sign is + the magnet points to the East and when — to the West of the mean position.

Hourly Means of Horizontal Force in C. G. S. Units (corrected for temperature) at Dehra Dún from the selected quiet days in 1908.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.	Means.
Winter.																										
·33000+																										
Months.	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ		γ	γ	γ	γ	γ	γ	γ	γ	γ
January .	303	303	303	302	303	303	306	306	312	315	312	309	309	310	308	308	308	308	305	303	302	304	304	304	305	306
February .	296	298	298	298	298	298	299	306	311	315	317	320	319	315	310	307	300	296	297	298	296	297	296	297	298	303
March .	289	293	293	294	295	296	296	298	300	304	312	318	320	319	313	304	295	292	292	289	288	290	292	294	295	299
October .	274	273	274	273	274	275	276	276	273	272	277	288	298	299	294	287	282	279	280	279	278	278	278	279	279	280
November .	277	277	277	278	278	279	281	284	287	291	291	290	293	291	285	281	282	281	282	282	282	281	280	279	281	283
December .	283	281	281	281	282	283	285	287	290	290	290	293	294	293	291	289	285	282	282	281	281	283	283	283	284	286
Means .	287	288	288	288	288	289	291	293	296	298	300	303	306	305	300	296	292	290	290	289	288	289	289	289	290	293
Summer.																										
April .	284	285	285	287	288	289	286	283	283	291	303	314	319	321	312	299	289	283	283	282	285	287	289	290	290	292
May .	290	291	292	291	293	293	296	295	294	297	302	308	313	314	314	309	303	296	292	290	290	289	291	291	293	297
June .	292	292	292	292	292	293	294	293	293	296	298	298	306	313	314	312	304	294	290	289	291	293	293	291	293	296
July .	295	295	296	295	296	296	299	301	299	298	301	305	309	311	311	309	304	298	295	296	297	297	298	298	299	300
August .	287	288	288	287	287	287	286	282	284	292	306	315	322	322	317	308	302	296	292	291	292	291	290	293	294	296
September .	273	272	270	270	269	272	272	264	258	257	262	270	284	294	293	286	279	275	274	273	271	273	274	273	275	273
Means .	287	287	287	287	288	288	289	286	285	289	295	302	309	313	310	304	297	290	288	287	288	288	289	289	291	292

Diurnal Inequality of the Horizontal Force at Dehra Dún as deduced from the preceding Table.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.
Winter.																									
Months.	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ		γ	γ	γ	γ	γ	γ	γ	γ
January	−3	−3	−3	−4	−3	−3	−0	0	+6	+9	+6	+3	+3	+4	+2	+2	+2	+2	−1	−3	−4	−2	−2	−2	−1
February	−7	−5	−5	−5	−5	−5	−4	+3	+8	+12	+14	+17	+16	+12	+7	+4	−3	−7	−6	−5	−7	−6	−7	−6	−5
March	−10	−6	−6	−5	−4	−3	−3	−1	+1	+5	+13	+19	+21	+20	+14	+5	−4	−7	−7	−10	−11	−9	−7	−5	−4
October	−6	−7	−6	−7	−6	−5	−4	−4	−7	−8	−3	+8	+18	+19	+14	+7	+2	−1	0	−1	−2	−2	−2	−1	−1
November	−6	−6	−6	−5	−5	−4	−2	+1	+4	+8	+8	+7	+10	+8	+2	−2	−1	−2	−1	−1	−1	−2	−3	−4	−2
December	−3	−5	−5	−5	−4	−3	−1	+1	+4	+4	+4	+7	+8	+7	+5	+3	−1	−4	−4	−5	−5	−3	−3	−3	−2
Means	−6	−5	−5	−5	−5	−4	−2	0	+3	+5	+7	+10	+13	+12	+7	+3	−1	−3	−3	−4	−5	−4	−4	−4	−3
Summer.																									
April	−8	−7	−7	−5	−4	−3	−6	−9	−9	−1	+11	+22	+27	+29	+20	+7	−3	9	−9	−10	−7	−5	−3	−2	−2
May	−7	−6	−5	−6	−4	−4	−1	−2	−3	0	+5	+11	+16	+17	+17	+12	+6	−1	−5	−7	−7	−8	−6	−6	−4
June	−4	−4	−4	−4	−4	−3	−2	−3	−3	0	+2	+2	+10	+17	+18	+16	+8	−2	−6	−7	−5	−3	−3	−5	−3
July	−5	−5	−4	−5	−4	−4	−1	+1	−1	−2	+1	+5	+9	+11	+11	+9	+4	−2	−5	−4	−3	−3	−2	−2	−1
August	−9	−8	−8	−9	−9	−9	−10	−14	−12	−4	+10	+19	+26	+26	+21	+12	+6	0	−4	−5	−4	−5	−6	−3	−2
September	−0	−1	−3	−3	−4	−1	−1	−9	−15	−16	−11	−3	+11	+21	+20	+13	+6	+2	+1	0	−2	0	+1	0	+2
Means	−5	−5	−5	−5	−4	−4	−3	−9	−7	−3	+3	+10	+17	+21	+18	+12	+5	−2	−4	−5	−4	−4	−3	−3	−1

N. B.—When the sign is + the H. F. is greater and when − it is less than the mean value.

Hourly Means of Vertical Force in C. G. S. Units (corrected for temperature) at Dehra Dún from the selected quiet days in 1908.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.	Means.
Winter.																										
·31000 C. G. S.+																										
Months.	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
January	768	768	769	768	768	768	768	767	770	770	766	762	759	760	763	766	769	768	770	771	769	771	771	771	771	767
February	784	784	783	783	783	782	782	783	784	781	776	773	769	769	771	772	772	776	779	779	780	780	782	781	781	779
March	788	789	788	788	788	788	788	792	791	787	779	772	770	772	778	783	787	787	788	783	789	790	790	791	790	785
October	852	851	852	851	850	850	849	852	852	847	842	835	832	835	841	844	843	841	843	843	843	843	843	843	843	845
November	863	862	863	862	862	862	862	862	863	862	858	857	857	858	859	859	859	860	862	862	862	862	863	863	863	861
December	852	852	852	853	852	852	852	853	853	850	846	841	842	846	848	85[illegible]	850	850	851	852	853	852	853	854	853	850
Means	818	818	818	818	817	817	817	818	819	816	811	807	805	807	810	812	813	814	816	816	816	816	817	817	817	815
Summer.																										
April	813	813	812	812	812	812	814	815	809	798	789	788	791	797	802	806	807	808	809	810	812	812	813	812	812	807
May	820	820	820	819	820	821	825	823	815	805	794	794	797	804	811	817	818	818	818	817	819	820	821	820	821	815
June	832	832	832	832	831	834	837	836	827	818	809	809	813	817	820	825	829	832	835	835	835	836	836	836	836	828
July	830	830	830	830	830	832	837	835	828	822	815	805	804	806	812	820	825	825	827	827	827	828	829	828	829	824
August	837	838	837	837	838	839	843	839	829	820	816	816	823	827	833	834	835	835	834	834	836	837	836	837	837	833
September	836	834	834	835	835	835	836	839	837	831	826	828	825	827	832	839	843	843	840	841	840	843	842	843	843	836
Means	828	828	828	828	828	829	832	831	824	816	808	807	809	813	818	824	826	827	827	827	828	829	830	829	830	824

Diurnal Inequality of the Vertical Force at Dehra Dún as deduced from the preceding Table.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	32	23	Mid.
Winter.																									
Months.	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
January	+1	+1	+2	+1	+1	+1	+1	0	+3	+3	−1	−5	−8	−7	−4	−1	+2	+1	+3	+4	+2	+4	+4	+4	+4
February	+5	+5	+4	+4	+4	+3	+3	+4	+5	+2	−3	−6	−10	−10	−8	−7	−7	−3	0	0	+1	+1	+3	+2	+2
March	+3	+4	+3	+3	+3	+3	+3	+7	+6	+2	−6	−13	−15	−13	−7	−2	+2	+2	+3	+3	+4	+5	+5	+6	+5
October	+7	+6	+7	+6	+5	+5	+4	+7	+7	+2	−3	−10	−13	−10	−4	−1	−2	−4	−2	−2	−2	−2	−2	−2	−2
November	+2	+1	+2	+1	+1	+1	+1	+1	+2	+1	−3	−4	−4	−3	−2	−2	−2	−1	+1	+1	+1	+1	+2	+2	+2
December	+2	+2	+2	+3	+2	+2	+2	+3	+3	0	−4	−9	−8	−4	−2	0	0	0	+1	+2	+3	+2	+3	+4	+3
Means	+3	+3	+3	+3	+2	+2	+2	+3	+4	+1	−4	−8	−10	−8	−5	−3	−2	−1	+1	+1	+1	+1	+2	+2	+2
Summer.																									
April	+6	+6	+5	+5	+5	+5	+7	+8	+2	−9	−18	−19	−16	−10	−5	−1	0	+1	+2	+3	+5	+5	+6	+5	+5
May	+5	+5	+5	+4	+5	+6	+10	+8	0	−10	−21	−21	−18	−11	−4	+2	+3	+3	+3	+2	+4	+5	+6	+5	+6
June	+4	+4	+4	+4	+3	+6	+9	+8	−1	−10	−19	−19	−15	−11	−8	−3	+1	+4	+7	+7	+7	+8	+8	+8	+8
July	+6	+6	+6	+6	+6	+8	+13	+11	+4	−2	−9	−19	−20	−18	−12	−4	+1	+1	+3	+3	+3	+4	+5	+4	+5
August	+4	+5	+4	+4	+5	+6	+10	+6	−4	−13	−17	−17	−10	−6	−0	+1	+2	+2	+1	+1	+3	+4	+3	+4	+4
September	0	−2	−2	−1	−1	−1	0	+3	+1	−5	−10	−8	−11	−9	−4	+3	+7	+7	+4	+5	+4	+7	+6	+7	+7
Means	+4	+4	+4	+4	+4	+5	+8	+7	0	−8	−16	−17	−15	−11	−6	0	+2	+3	+3	+3	+4	+5	+6	+5	+6

N.B.—When the sign is + the V. F. is more, and when—it is less than the mean.

Hourly Means of the Dip as determined at Dehra Dún from the selected quiet days in 1908.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.	Means.
Dip 43°+													Winter.													
Months.	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
January .	38.9	38.9	39.0	39.0	38.9	38.9	38.8	38.7	38.6	38.4	38.3	38.3	38.2	38.2	38.4	38.5	38.7	38.7	38.9	39.1	39.0	39.0	39.0	39.0	39.0	38.7
February .	40.2	40.0	40.0	40.0	40.0	39.9	39.9	39.6	39.4	39.0	38.6	38.3	38.2	38.3	38.7	38.9	39.3	39.7	39.8	39.8	39.9	39.9	40.0	39.9	39.9	39.5
March .	40.7	40.6	40.5	40.4	40.4	40.4	40.4	40.5	40.3	39.9	39.1	38.3	38.2	38.3	39.0	39.7	40.4	40.5	40.6	40.7	40.8	40.8	40.7	40.6	40.5	40.1
October .	45.0	45.0	45.0	45.0	44.8	44.8	44.7	44.9	45.0	44.8	44.3	43.3	42.6	42.7	43.3	43.9	44.0	44.1	44.2	44.2	44.2	44.2	44.2	44.2	44.2	44.3
November .	45.4	45.3	45.4	45.3	45.3	45.2	45.1	45.0	44.9	44.6	44.4	44.4	44.2	44.4	44.8	45.0	44.9	45.0	45.1	45.1	45.1	45.1	45.3	45.3	45.2	45.0
December .	44.5	44.6	44.6	44.6	44.6	44.5	44.4	44.4	44.2	44.0	43.8	43.4	43.4	43.6	43.8	44.1	44.3	44.4	44.5	44.6	44.6	44.5	44.6	44.6	44.5	44.3
Means .	42.5	42.4	42.4	42.4	42.3	42.3	42.2	42.2	42.1	41.8	41.4	41.0	40.8	40.9	41.3	41.7	41.9	42.1	42.2	42.3	42.3	42.3	42.3	42.3	42.2	42.0
												Summer.														
April .	42.3	42.3	42.2	42.1	42.1	42.0	42.3	42.5	42.2	41.2	40.1	39.4	39.3	39.6	40.3	41.2	41.7	42.1	42.2	42.3	42.2	42.1	42.1	42.0	42.0	41.6
May .	42.4	42.3	42.3	42.3	42.3	42.3	42.4	42.3	41.9	41.2	40.4	40.1	40.0	40.3	40.7	41.3	41.6	42.0	42.2	42.3	42.4	42.5	42.1	42.3	42.3	41.8
June .	42.9	42.9	42.9	42.9	42.9	43.0	43.1	43.1	42.7	42.0	41.4	41.4	41.2	41.1	41.2	41.6	42.1	42.8	43.2	43.3	43.1	43.1	43.1	43.2	43.1	42.5
July .	42.7	42.7	42.7	42.7	42.7	42.7	42.9	42.6	42.4	42.1	41.6	40.8	40.6	40.6	40.9	41.4	41.9	42.3	42.5	42.5	42.4	42.5	42.5	42.4	42.4	42.1
August .	43.5	43.5	43.4	43.5	43.6	43.6	43.8	43.8	43.2	42.3	41.4	40.9	40.9	41.2	41.7	42.2	42.6	42.9	43.1	43.1	43.2	43.3	43.3	43.2	43.1	42.8
September .	44.2	44.1	44.2	44.2	44.3	44.1	44.2	44.8	45.0	44.7	44.2	43.9	43.0	42.6	42.9	43.6	44.2	44.4	44.3	44.4	44.4	44.5	44.4	44.5	44.4	44.1
Means .	43.0	43.0	43.0	43.0	43.0	43.0	43.1	43.2	42.9	42.3	41.5	41.1	40.8	40.9	41.3	41.9	42.4	42.8	42.9	43.0	43.0	43.0	43.0	42.9	42.9	42.5

Diurnal Inequality of the Dip at Dehra Dún as deduced from the preceding Table.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.
Winter.																									
Months.	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
January	+0·2	+0·2	+0·3	+0·3	+0·2	+0·2	+0·1	0·0	−0·1	−0·3	−0·4	−0·4	−0·5	−0·5	−0·3	−0·2	0·0	0·0	+0·2	+0·4	+0·3	+0·3	+0·3	+0·3	+0·3
February	+0·7	+0·5	+0·5	+0·5	+0·5	+0·4	+0·4	+0·1	−0·1	−0·5	−0·9	−1·2	−1·3	−1·2	−0·8	−0·6	−0·2	+0·2	+0·3	+0·3	+0·4	+0·4	+0·5	+0·4	+0·4
March	+0·6	+0·5	+0·4	+0·3	+0·3	+0·3	+0·3	+0·4	+0·2	−0·2	−1·0	−1·8	−1·9	−1·8	−1·1	−0·4	+0·3	+0·4	+0·5	+0·6	+0·7	+0·7	+0·6	+0·5	+0·4
October	+0·7	+0·7	+0·7	+0·7	+0·5	+0·5	+0·4	+0·6	+0·7	+0·5	0·0	−1·0	−1·7	−1·6	−1·0	−0·4	−0·3	−0·2	−0·1	−0·1	−0·1	−0·1	−0·1	−0·1	−0·1
November	+0·4	+0·3	+0·4	+0·3	+0·3	+0·2	+0·1	0·0	−0·1	−0·4	−0·6	−0·6	−0·8	−0·6	−0·2	0·0	−0·1	0·0	+0·1	+0·1	+0·1	+0·1	+0·3	+0·3	+0·2
December	+0·2	+0·3	+0·3	+0·3	+0·3	+0·2	+0·1	+0·1	−0·1	−0·3	−0·5	−0·9	−0·9	−0·7	−0·5	−0·2	0·0	+0·1	+0·2	+0·3	+0·3	+0·2	+0·3	+0·3	+0·2
Means	+0·5	+0·4	+0·4	+0·4	+0·3	+0·3	+0·2	+0·2	+0·1	−0·2	−0·6	−1·0	−1·2	−1·1	−0·7	−0·3	−0·1	+0·1	+0·2	+0·3	+0·3	+0·3	+0·3	+0·3	+0·2
Summer.																									
April	+0·7	+0·7	+0·6	+0·5	+0·5	+0·4	+0·7	+0·9	+0·6	−0·4	−1·5	−2·2	−2·3	−2·0	−1·3	−0·4	+0·1	+0·5	+0·6	+0·7	+0·6	+0·5	+0·5	+0·4	+0·4
May	+0·6	+0·5	+0·5	+0·5	+0·5	+0·5	+0·6	+0·5	+0·1	−0·6	−1·4	−1·7	−·8	−1·5	−1·1	−0·5	−0·2	+0·2	+0·4	+0·5	+0·6	+0·7	+0·6	+0·5	+0·5
June	+0·4	+0·4	+0·4	+0·4	+0·4	+0·5	+0·6	+0·6	+0·2	−0·5	−1·1	−1·1	−1·3	−1·4	−1·3	−0·9	−0·4	+0·3	+0·7	+0·8	+0·6	+0·6	+0·6	+0·7	+0·6
July	+0·6	+0·6	+0·6	+0·6	+0·6	+0·6	+0·8	+0·5	+0·3	0·0	−0·5	−1·3	−1·5	−1·5	−1·2	−0·7	−0·2	+0·2	+0·4	+0·4	+0·3	+0·4	+0·4	+0·3	+0·3
August	+0·7	+0·7	+0·6	+0·7	+0·8	+0·8	+1·0	+1·0	+0·4	−0·5	−1·4	−1·9	−1·9	−1·6	−1·1	−0·6	−0·2	+0·1	+0·3	+0·3	+0·4	+0·5	+0·5	+0·4	+0·3
September	+0·1	0·0	+0·1	+0·1	+0·2	0·0	+0·1	+0·7	+0·9	+0·6	+0·1	−0·2	−1·1	−1·5	−1·2	−0·5	+0·1	+0·3	+0·2	+0·3	+0·3	+0·4	+0·3	+0·4	+0·3
Means	+0·5	+0·5	+0·5	+0·5	+0·5	+0·5	+0·6	+0·7	+0·4	−0·2	−1·0	−1·4	−1·7	−1·6	−1·2	−0·6	−0·1	+0·3	+0·4	+0·5	+0·5	+0·5	+0·5	+0·4	+0·4

N.B.—When the sign is + the Dip is more and when — it is less than the mean.

BARRACKPORE OBSERVATORY TABLES.

Hourly Means of the Declination as determined at Barrackpore from the selected quiet days in 1908.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.	Means.
Declination E. 1° –													Winter.													
Months.	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
January .	7.4	7.4	7.4	7.2	7.1	6.9	6.7	6.7	7.5	8.8	8.9	8.4	8.2	8.1	7.8	7.3	7.5	7.6	7.5	7.6	7.5	7.4	7.4	7.4	7.3	7.6
February .	7.3	7.2	7.4	7.2	6.9	6.5	6.3	6.3	7.3	8.7	9.5	9.7	9.2	8.3	7.3	7.2	7.1	6.9	6.7	7.0	7.1	6.9	7.2	7.1	7.3	7.4
March .	6.8	6.8	6.5	6.4	6.5	6.4	6.4	7.1	8.3	9.2	9.0	7.4	6.2	5.3	5.4	6.2	6.7	6.9	6.5	6.5	6.6	6.6	6.7	6.6	6.7	6.8
October .	4.6	4.6	4.7	4.6	4.5	4.2	4.1	5.2	6.1	6.2	5.1	3.3	2.1	2.0	3.1	4.1	4.9	4.5	4.0	4.2	4.3	4.1	4.3	4.4	4.6	4.3
November .	3.8	3.9	3.8	3.7	3.6	3.6	3.5	3.7	4.5	4.7	4.4	3.4	3.2	3.8	4.0	4.0	3.9	3.9	3.7	3.7	3.6	3.6	3.7	3.8	3.9	3.8
December .	3.6	3.7	3.6	3.6	3.5	3.3	3.1	3.0	3.5	4.1	4.3	3.2	2.9	3.3	3.7	4.2	4.3	3.9	3.6	3.7	3.7	3.7	3.5	3.6	3.6	3.6
Means .	5.6	5.6	5.6	5.5	5.4	5.2	5.0	5.3	6.2	7.0	6.9	5.9	5.3	5.1	5.2	5.5	5.7	5.6	5.3	5.5	5.5	5.4	5.5	5.5	5.6	5.6
													Summer.													
April .	6.5	6.7	6.7	6.5	6.4	6.5	7.5	8.8	9.0	8.0	6.6	4.9	3.7	3.8	4.4	5.5	6.4	6.6	6.7	6.3	6.2	6.2	6.3	6.4	6.5	6.4
May .	6.6	6.6	6.8	6.8	6.8	6.9	8.1	9.1	9.6	8.1	6.3	4.6	3.6	3.7	4.2	5.6	6.4	6.8	6.6	6.1	6.2	6.3	6.2	6.3	6.4	6.4
June .	6.1	6.2	6.1	6.1	5.9	6.4	8.2	8.6	8.3	7.0	5.4	3.8	2.8	3.0	3.2	3.9	4.9	5.8	6.3	5.9	5.8	5.8	6.0	6.0	6.0	5.7
July .	5.4	5.6	5.8	5.8	5.8	6.2	7.7	9.1	9.1	8.2	6.5	4.3	3.0	2.9	3.3	4.1	5.1	5.6	5.7	5.1	5.0	5.1	5.2	5.3	5.5	5.6
August .	4.8	5.0	5.2	5.3	5.6	5.9	7.8	8.7	7.6	5.9	4.4	2.9	2.4	2.8	3.5	4.7	5.6	6.0	5.5	4.7	4.7	4.6	4.8	4.9	4.9	5.1
September .	4.3	4.9	4.9	4.7	4.8	4.8	6.0	7.8	8.1	7.0	5.3	3.6	2.2	1.9	2.6	3.8	5.0	5.3	5.0	4.8	4.7	4.7	4.7	4.7	4.8	4.8
Means .	5.7	5.8	5.9	5.9	5.9	6.1	7.6	8.7	8.6	7.4	5.8	4.0	3.0	3.0	3.5	4.6	5.6	6.0	6.0	5.5	5.4	5.5	5.5	5.6	5.7	5.7

Diurnal Inequality of the Declination at Barrackpore as deduced from the preceding Table.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.
Winter.																									
Months.	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
January .	−0·2	−0·2	−0·2	−0·4	−0·5	−0·7	−0·9	−0·9	−0·1	+1·2	+1·3	+0·8	+0·6	+0·5	+0·2	−0·3	−0·1	0·0	−0·1	0·0	−0·1	−0·2	−0·2	−0·2	−0·3
February .	−0·1	−0·2	0·0	−0·2	−0·5	−0·9	−1·1	−1·1	−0·1	+1·3	+2·1	+2·3	+1·8	+0·9	−0·1	−0·2	−0·3	−0·5	−0·7	−0·4	−0·3	−0·5	−0·2	−0·3	−0·1
March .	0·0	0·0	−0·3	−0·4	−0·3	−0·4	−0·4	+0·3	+1·5	+2·4	+2·2	+0·6	−0·6	−1·5	−1·4	−0·6	−0·1	+0·1	−0·3	−0·3	−0·2	−0·2	−0·1	−0·2	−0·1
October .	+0·3	+0·3	+0·4	−0·3	+0·2	−0·1	−0·2	+0·9	+1·8	+1·9	+0·8	−1·0	−2·2	−2·3	−1·2	−0·2	+0·6	+0·2	−0·3	−0·1	0·0	−0·2	0·0	+0·1	+0·3
November	0·0	+0·1	0·0	−0·1	−0·2	−0·2	−0·3	−0·1	+0·7	+0·9	+0·6	−0·4	−0·6	0·0	+0·2	+0·2	+0·1	+0·1	−0·1	−0·1	−0·2	−0·2	−0·1	0·0	+0·1
December	0·0	+0·1	0·0	0·0	−0·1	−0·3	−0·5	−0·6	−0·1	+0·5	+0·7	−0·4	−0·7	−0·3	+0·1	+0·6	+0·7	+0·3	0·0	+0·1	+0·1	+0·1	−0·1	0·0	0·0
Means .	0·0	0·0	0·0	−0·1	−0·2	−0·4	−0·6	−0·3	+0·6	+1·4	+1·3	+0·3	−0·3	−0·5	−0·4	−0·1	+0·1	0·0	−0·3	−0·1	−0·1	−0·4	−0·1	−0·1	0·0
Summer.																									
April . .	+0·1	+0·3	+0·3	+0·1	0·0	+0·1	+1·1	+2·4	+2·6	+1·6	+0·2	−1·5	−2·7	−2·6	−2·0	−0·9	0·0	+0·2	+0·3	−0·1	−0·2	−0·2	−0·1	0·0	+0·1
May . .	+0·2	+0·2	+0·4	+0·4	+0·4	+0·5	+1·7	+2·7	+3·2	+1·7	−0·1	−1·8	−2·8	−2·7	−2·2	−0·8	0·0	+0·4	+0·2	−0·3	−0·2	−0·1	−0·2	−0·1	0·0
June . .	+0·4	+0·5	+0·4	+0·4	+0·2	+0·7	+2·5	+2·9	+2·6	+1·3	−0·3	−1·9	−2·9	−2·7	−2·5	−1·8	−0·8	+0·1	+0·6	+0·2	+0·1	+0·1	+0·3	+0·3	+0·3
July . .	−0·2	0·0	+0·2	+0·2	+0·2	+0·6	+2·1	+3·5	+3·5	+2·6	+0·9	−1·3	−2·6	−2·7	−2·3	−1·5	−0·5	0·0	+0·1	−0·5	−0·6	−0·5	−0·4	−0·3	−0·1
August .	−0·3	−0·1	+0·1	+0·2	+0·5	+0·8	+2·7	+3·6	+2·5	+0·8	−0·7	−2·2	−2·7	−2·3	−1·6	−0·4	+0·5	+0·9	+0·4	−0·4	−0·4	−0·5	−0·3	−0·2	−0·2
September .	0·0	+0·1	+0·1	−0·1	0·0	0·0	+1·2	+3·0	+3·3	+2·2	+0·5	−1·2	−2·6	−2·9	−2·2	−1·0	+0·2	+0·5	+0·2	0·0	−0·1	−0·1	−0·1	−0·1	0·0
Means .	0·0	+0·1	+0·2	+0·2	+0·2	+0·4	+1·9	+3·0	+2·9	+1·7	+0·1	−1·7	−2·7	−2·7	−2·2	−1·1	−0·1	+0·3	+0·3	−0·2	−0·3	−0·2	−0·2	−0·1	0·0

N. B.—When the sign is + the magnet points to the East, and when − to the West of the mean position.

Hourly Means of Horizontal Force in C. G. S. Units (corrected for temperature) at Barrackpore from the selected quiet days in 1908.

Winter.

37,000 C.G.S.+

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.	Means.
Months.		γ		γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
January .	292	293	294	294	294	297	297	300	305	313	315	315	312	309	304	304	303	303	301	297	297	295	295	297	296	301
February .	294	294	295	297	296	296	299	303	312	319	326	329	331	326	318	310	304	300	296	296	294	292	293	294	296	305
March .	292	291	295	294	295	298	300	302	308	319	330	339	342	337	327	314	303	297	297	296	292	290	292	294	297	306
October .	278	279	280	280	281	283	285	287	291	298	308	321	328	324	314	304	296	291	290	290	286	285	287	286	287	294
November .	289	289	291	291	293	294	295	300	305	312	317	321	321	313	307	300	297	295	293	290	290	291	291	290	291	299
December	299	300	299	300	301	304	305	310	314	319	322	324	325	323	318	314	308	302	300	299	298	298	299	299	299	308
Means .	291	291	293	293	293	295	297	300	306	313	320	325	327	322	315	308	302	298	296	295	293	292	293	293	294	302

Summer.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.	Means.
April .	276	277	279	278	281	283	283	283	292	310	325	331	333	326	317	303	290	284	282	279	278	279	282	283	283	293
May .	285	288	288	290	290	292	294	300	309	318	328	332	330	323	318	310	302	294	291	290	289	286	285	288	289	301
June .	289	290	290	290	290	291	293	295	299	310	320	324	327	327	323	314	305	296	289	286	287	287	292	288	288	300
July .	288	289	290	291	290	292	295	302	307	313	322	325	328	325	318	310	301	294	290	290	291	291	291	290	291	301
August .	281	283	285	283	282	285	285	288	293	304	315	321	321	320	315	305	297	290	287	288	286	284	285	283	286	294
September	[illegible]	[illegible]	268	267	268	269	270	263	259	265	277	287	297	301	298	290	280	275	275	273	270	267	270	270	270	275
Means .	281	283	283	283	284	285	287	289	293	303	315	320	323	320	315	305	296	289	286	284	284	282	284	284	285	294

Diurnal Inequality of the Horizontal Force at Barrackpore as deduced from the preceding Table.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.
Winter.																									
Months.	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
January	−9	−8	−7	−7	−7	−4	−4	−1	+4	+12	+14	+14	+11	+8	+3	+3	+2	+2	0	−4	−4	−6	−6	−4	−5
February	−11	−11	−9	−8	−9	−9	−6	−2	+7	+14	+21	+24	+26	+21	+13	+5	−1	−5	−9	−9	−11	−13	−12	−11	−9
March	−14	−15	−11	−12	−11	−8	−6	−4	+2	+13	+24	+33	+36	+31	+21	+8	−3	−9	−9	−10	−14	−16	−14	−12	−9
October	−16	−15	−14	−14	−13	−11	−9	−7	−3	+4	+14	+27	+34	+30	+20	+10	+2	−3	−4	−4	−8	−9	−7	−8	−7
November	−10	−10	−8	−8	−6	−5	−4	+1	+6	+13	+18	+22	+22	+14	+8	+1	−2	−4	−6	−9	−9	−8	−8	−9	−8
December	−9	−8	−9	−8	−7	−4	−3	+2	+6	+11	+14	+16	+17	+15	+10	+6	0	−6	−8	−9	−10	−10	−9	−9	−9
Means	−11	−11	−9	−9	−9	−7	−5	−2	+4	+11	+18	+23	+25	+20	+13	+6	0	−4	−6	−7	−9	−10	−9	−9	−8
Summer.																									
April	−17	−16	−14	−15	−12	−10	−10	−10	−1	+17	+32	+38	+40	+33	+24	+10	−3	−9	−11	−14	−15	−14	−11	−10	−10
May	−16	−13	−13	−11	−11	−9	−7	−1	+8	+17	+27	+31	+29	+22	+17	+9	+1	−7	−10	−11	−12	−15	−16	−13	−12
June	−11	−10	−10	−10	−10	−9	−7	−5	−1	+10	+20	+24	+27	+27	+23	+14	+5	−4	−11	−14	−13	−13	−8	−12	−12
July	−13	−12	−11	−10	−11	−9	−6	+1	+6	+12	+21	+24	+27	+24	+17	+9	0	−7	−11	−11	−10	−10	−10	−11	−10
August	−13	−11	−9	−11	−12	−9	−9	−6	−1	+10	+21	+27	+27	+26	+21	+11	+3	−4	−7	−6	−8	−10	−9	−11	−8
September	−8	−6	−7	−8	−7	−6	−5	−12	−16	−10	+2	+12	+22	+26	+23	+15	+5	0	0	−2	−5	−8	−5	−5	−5
Means	−13	−11	−11	−11	−10	−9	−7	−5	−1	+9	+21	+26	+29	+26	+21	+11	+2	−5	−8	−10	−10	−12	−10	−10	−9

N.B.—When the sign is + H. F. is greater and when − it is less than the mean value.

Hourly Means of Vertical Force in C. G. S. Units (corrected for temperature) at Barrackpore from the selected quiet days in 1908.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.	Means.
·21,900 C. G. S.+												Winter.														
Months.	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
January .	103	103	103	102	103	103	104	104	105	104	100	97	95	93	91	95	99	99	100	101	101	101	103	103	103	100
February .	121	121	122	122	122	122	123	125	125	121	116	111	103	102	104	107	111	115	117	119	119	120	121	121	121	117
March .	122	123	123	123	124	124	125	125	123	117	110	106	104	107	110	113	115	116	118	118	119	119	120	121	121	118
October .	156	156	157	157	158	158	160	161	157	149	143	141	141	146	149	150	151	152	153	153	153	154	154	154	154	153
November .	167	167	167	167	168	168	168	170	169	165	162	158	158	159	158	159	161	164	165	164	164	165	166	165	165	164
December	170	170	170	171	171	172	173	174	173	169	164	161	163	163	165	167	167	168	170	169	168	168	169	168	169	168
Means .	140	140	140	140	141	141	142	143	142	138	133	129	127	128	130	132	134	136	137	137	137	138	139	139	139	137
												Summer.														
April .	138	138	138	139	139	139	141	138	131	126	121	120	122	126	131	133	133	133	135	136	138	138	138	139	138	134
May .	139	139	139	139	139	140	142	139	134	129	124	124	123	126	129	132	133	133	133	134	135	136	137	136	136	134
June .	141	141	140	140	141	142	143	141	137	135	132	129	127	127	129	133	136	139	140	141	142	142	143	142	142	138
July .	140	140	140	140	140	141	142	140	137	132	127	122	122	125	127	129	131	134	135	135	137	137	137	137	137	134
August .	144	144	143	143	142	144	144	140	139	138	138	141	142	142	142	145	144	142	140	143	143	144	144	144	145	142
September .	148	148	148	148	148	149	150	151	147	143	138	135	137	140	142	145	145	145	145	146	147	148	149	149	149	145
Means	142	142	141	142	142	143	144	142	138	134	130	129	129	131	133	136	137	138	138	139	140	141	141	141	141	138

Diurnal Inequality of the Vertical Force at Barrackpore as deduced from the preceding Table.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.
Winter.																									
Months.	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
January . .	+3	+3	+3	+2	+3	+3	+4	+4	+5	+4	0	−3	−5	−7	−9	−5	−1	−1	0	+1	+1	+1	+3	+3	+3
February . .	+4	+4	+5	+5	+5	+5	+6	+8	+8	+4	−1	−6	−14	−15	−13	−10	−6	−2	0	+2	+2	+3	+4	+4	+4
March . .	+4	+5	+5	+5	+6	+6	+7	+7	+5	−1	−8	−12	−14	−11	−8	−5	−3	−2	0	0	+1	+1	+2	+3	+3
October . .	+3	+3	+4	+4	+5	+5	+7	+8	+4	−4	−10	−12	−2	−7	−4	−3	−2	−1	0	0	0	+1	+1	+1	+1
November . .	+3	+3	+3	+3	+4	+4	+4	+6	+5	+1	−2	−6	−6	−5	−6	−5	−3	0	+1	0	0	+1	+2	+1	+1
December . .	+2	+2	+2	+3	+3	+4	+5	+6	+5	+1	−4	−7	−5	−5	−3	−1	−1	0	+2	+1	0	0	+1	0	+1
Means .	+3	+3	+3	+3	+4	+4	+5	+6	+5	+1	−4	−8	−10	−9	−7	−5	−3	−1	0	0	0	+1	+2	+2	+2
Summer.																									
April . . .	+4	+4	+4	+5	+5	+5	+7	+4	−3	−8	−13	−14	−12	−8	−3	−1	−1	−1	+1	+2	+4	+4	+4	+5	+4
May . . .	+5	+5	+5	+5	+5	+6	+8	+5	0	−5	−10	−10	−11	−8	−5	−2	−1	−1	−1	0	+1	+2	+3	+2	+2
June . .	+3	+3	+2	+2	+3	+4	+5	+3	−1	−3	−6	−9	−11	−11	−9	−5	−2	+1	+2	+3	+4	+4	+5	+4	+4
July . .	+6	+6	+6	+6	+6	+7	+8	+6	+3	−2	−7	−12	−12	−9	−7	−5	−3	0	+1	+1	+3	+3	+3	+3	+3
August . .	+2	+2	+1	+1	0	+2	+2	−2	−3	−4	−4	−1	0	0	0	+3	+2	0	−2	+1	+1	+2	+2	+2	+3
September . .	+3	+3	+3	+3	+3	+4	+5	+6	+2	−2	−7	−10	−8	−5	−3	0	0	0	0	+1	+2	+3	+4	+4	+4
Means . .	+4	+4	+3	+4	+4	+5	+6	+4	0	−4	−8	−9	−9	−7	−5	−2	−1	0	0	+1	+2	+3	+3	+3	+3

N. B.—When the sign is + the Vertical force is more, and when — it is less than the mean.

Hourly Means of the Dip as determined at Barrackpore from the selected quiet days in 1908.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.	Means.
Winter. Dip. 30° +																										
Months.	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
January .	32·5	32·4	32·4	32·3	32·4	32·3	32·4	32·2	32·1	31·7	31·4	31·2	31·1	31·1	31·2	31·4	31·8	31·3	31·9	32·2	32·2	32·2	32·4	32·3	32·3	32·0
February .	33·7	33·7	33·7	33·6	33·7	33·7	33·6	33·6	33·2	32·6	32·0	31·5	30·9	31·1	31·5	32·0	32·5	33·0	33·3	33·4	33·5	33·7	33·7	33·7	33·6	33·0
March .	33·8	33·9	33·8	33·8	33·8	33·7	33·7	33·6	33·2	32·4	31·4	30·8	30·5	30·9	31·6	32·3	32·9	33·2	33·3	33·4	33·6	33·7	33·7	33·7	33·5	32·9
October .	36·7	36·7	36·7	36·7	36·7	36·6	36·7	36·7	36·3	35·4	34·6	33·9	33·7	34·1	34·8	35·2	35·6	35·9	36·0	36·0	36·1	36·3	36·2	36·2	36·2	35·8
November .	37·0	37·0	36·9	36·9	36·9	36·8	36·8	36·7	36·5	35·9	35·5	35·1	35·1	35·5	35·7	36·0	36·3	36·5	36·7	36·7	36·7	36·8	36·8	36·8	36·8	36·4
December	36·8	36·7	36·8	36·8	36·8	36·7	36·7	36·6	36·4	35·9	35·5	35·2	35·2	35·3	35·7	36·0	36·2	36·5	36·7	36·7	36·7	36·7	36·7	36·6	36·7	36·3
Means .	35·1	35·1	35·1	35·0	35·1	35·0	35·0	34·9	34·6	34·0	33·4	33·0	32·8	33·0	33·4	33·8	34·2	34·5	34·7	34·7	34·8	34·9	34·9	34·9	34·9	34·4
Summer.																										
April .	35·5	35·5	35·4	35·5	35·4	35·3	35·5	35·2	34·4	33·3	32·4	32·1	32·2	32·7	33·4	34·1	34·6	34·9	35·1	35·3	35·5	35·4	35·3	35·3	35·2	34·6
May .	35·2	35·1	35·1	35·0	35·0	35·0	35·1	34·6	33·9	33·2	32·5	32·3	32·3	32·8	33·2	33·7	34·1	34·4	34·6	34·7	34·8	35·0	35·1	34·9	34·9	34·2
June . .	35·2	35·2	35·1	35·1	35·2	35·2	35·2	35·0	34·5	33·9	33·3	33·0	32·7	32·7	33·0	33·7	34·2	34·8	35·1	35·3	35·3	35·3	35·2	35·3	35·3	34·5
July . .	35·2	35·1	35·1	35·1	35·1	35·1	35·0	34·6	34·2	33·6	33·0	32·5	32·4	32·7	33·1	33·5	34·0	34·5	34·8	34·8	34·9	34·9	34·9	34·9	34·9	34·3
August .	35·7	35·7	35·5	35·6	35·6	35·6	35·6	35·2	34·9	34·4	34·0	33·9	34·0	34·0	34·2	34·8	35·1	35·2	35·2	35·4	35·5	35·5	35·6	35·7	35·6	35·1
September .	36·6	36·5	36·5	36·6	36·5	36·6	36·6	36·9	36·8	36·3	35·5	34·9	34·6	34·7	34·9	35·5	35·8	36·0	36·0	36·2	36·4	36·6	36·5	36·5	36·5	36·1
Means .	35·6	35·5	35·5	35·5	35·5	35·5	35·5	35·3	34·8	34·1	33·5	33·1	33·0	33·3	33·6	34·2	34·6	35·0	35·1	35·3	35·4	35·5	35·4	35·4	35·4	34·8

Diurnal Inequality of the Dip at Barrackpore as deduced from the preceding Table.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.
Winter.																									
Months.	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
January . .	+0·5	+0·4	+0·4	+0·3	+0·4	+0·3	+0·4	+0·2	+0·1	-0·3	-0·6	-0·8	-0·9	-0·9	-0·8	-0·6	-0·2	-0·2	-0·1	+0·2	+0·2	+0·2	+0·4	+0·3	+0·3
February . .	+0·7	+0·7	+0·7	+0·6	+0·7	+0·7	+0·6	+0·6	+0·2	-0·4	-1·0	-1·5	-2·1	-1·9	-1·5	-1·0	-0·5	0·0	+0·3	+0·4	+0·5	+0·7	+0·7	+0·7	+0·6
March . .	+0·9	+1·0	+0·9	+0·9	+0·9	+0·8	+0·8	+0·7	+0·3	-0·5	-1·5	-2·1	-2·4	-2·0	-1·3	-0·6	+0·0	+0·3	+0·4	+0·5	+0·7	+0·8	+0·8	+0·8	+0·6
October . .	+0·9	+0·9	+0·9	+0·9	+0·9	+0·8	+0·9	+0·9	+0·5	-0·4	-1·2	-1·9	-2·1	-1·7	-1·0	-0·6	-0·2	+0·1	+0·2	+0·2	+0·3	+0·5	+0·4	+0·4	+0·4
November . .	+0·6	+0·6	+0·5	+0·5	+0·5	+0·4	+0·4	+0·3	+0·1	-0·5	-0·9	-1·3	-1·3	-0·9	-0·7	-0·4	-0·1	+0·1	+0·3	+0·3	+0·3	+0·4	+0·4	+0·4	+0·4
December . .	+0·5	+0·4	+0·5	+0·5	+0·5	+0·4	+0·4	+0·3	+0·1	-0·4	-0·8	-1·1	-1·1	-1·0	-0·6	-0·3	-0·1	+0·2	+0·4	+0·4	+0·4	+0·4	+0·4	+0·3	+0·4
Means . .	+0·7	+0·7	+0·7	+0·6	+0·7	+0·6	+0·6	+0·5	+0·2	-0·4	-1·0	-1·4	-1·6	-1·4	-1·0	-0·6	-0·2	+0·1	+0·3	+0·3	+0·4	+0·5	+0·5	+0·5	+0·5
Summer.																									
April . . .	+0·9	+0·9	+0·8	+0·9	+0·8	+0·7	+0·9	+0·6	-0·2	-1·3	-2·2	-2·5	-2·4	-1·9	-1·2	-0·5	0·0	+0·3	+0·5	+0·7	+0·9	+0·8	+0·7	+0·7	+0·6
May . . .	+1·0	+0·9	+0·9	+0·8	+0·8	+0·8	+0·9	+0·4	-0·3	-1·0	-1·7	-1·9	-1·9	-1·4	-1·0	-0·5	-0·1	+0·2	+0·4	+0·5	+0·6	+0·8	+0·9	+0·7	+0·7
June . . .	+0·7	+0·7	+0·6	+0·6	+0·7	+0·7	+0·7	+0·5	-0·0	-0·6	-1·2	-1·5	-1·8	-1·8	-1·5	-0·8	-0·3	+0·3	+0·6	+0·8	+0·0	+0·8	+0·7	+0·8	+0·8
July . . .	+0·9	+0·8	+0·8	+0·8	+0·8	+0·8	+0·7	+0·3	-0·1	-0·7	-1·3	-1·8	-1·9	-1·6	-1·2	-0·8	-0·3	+0·2	+0·5	+0·5	+0·6	+0·6	+0·6	+0·6	+0·6
August . .	+0·6	+0·6	+0·4	+0·5	+0·5	+0·5	+0·5	+0·1	-0·2	-0·7	-1·1	-1·2	-1·1	-1·1	-0·9	-0·3	0·0	+0·1	+0·1	+0·3	+0·4	+0·5	+0·5	+0·6	+0·5
September . .	+0·5	+0·4	+0·4	+0·5	+0·4	+0·5	+0·5	+0·8	+0·7	+0·2	-0·6	-1·2	-1·5	-1·4	-1·2	-0·6	-0·3	-0·1	-0·1	+0·1	+0·3	+0·5	+0·4	+0·4	+0·4
Means . .	+0·8	+0·7	+0·7	+0·7	+0·7	+0·7	+0·7	+0·5	-0·0	-0·7	-1·3	-1·7	-1·8	-1·5	-1·2	-0·6	-0·2	+0·2	+0·3	+0·5	+0·6	+0·7	+0·6	+0·6	+0·6

N.B.—When the sign is + the Dip is more, and when — it is less than the mean.

TOUNGOO OBSERVATORY TABLES.

Hourly Means of the Declination as determined at Toungoo from the selected quiet days in 1908.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.	Means.
Declination E 0° +												Winter.														
Months.	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
January .	36·6	36·5	36·5	36·5	36·5	36·2	36·0	35·8	36·4	37·5	37·9	37·7	37·4	37·2	36·5	36·1	36·3	36·8	36·7	36·8	36·8	36·6	36·7	36·6	36·6	36·7
February .	36·2	36·2	36·1	36·0	35·9	35·6	35·2	35·1	36·1	37·2	38·3	38·6	38·0	37·2	36·2	35·7	35·7	35·8	35·9	36·0	36·1	36·0	36·0	36·0	36·2	36·3
March .	35·9	35·9	35·9	35·7	35·6	35·3	35·2	35·8	36·8	37·5	37·4	36·6	35·6	34·7	34·5	35·0	35·7	36·0	35·7	35·7	35·8	35·8	35·6	35·7	35·7	35·8
October .	32·9	33·0	33·0	32·9	32·9	32·7	32·7	33·6	34·5	34·6	33·8	32·7	31·6	31·5	32·0	32·9	33·4	33·0	32·5	32·8	32·8	32·7	32·7	32·8	32·9	32·9
November .	32·5	32·6	32·5	32·4	32·2	32·2	32·2	32·3	32·9	33·3	33·1	32·5	32·4	32·5	32·6	32·5	32·5	32·5	32·3	32·4	32·4	32·3	32·3	32·4	32·6	32·5
December .	32·6	32·6	32·6	32·5	32·5	32·3	32·1	31·9	32·4	32·9	33·1	32·5	32·3	32·5	32·7	33·1	33·4	32·9	32·7	32·6	32·6	32·5	32·6	32·6	32·6	32·6
Means .	34·5	34·5	34·4	34·3	34·3	34·1	33·9	34·1	34·9	35·5	35·6	35·1	34·6	34·3	34·1	34·2	34·5	34·5	34·3	34·4	34·4	34·3	34·3	34·4	34·4	34·5
													Summer.													
April .	35·3	35·3	35·4	35·3	35·2	35·0	35·9	37·0	36·8	36·2	35·3	34·3	33·2	33·0	33·7	34·3	35·1	35·4	35·4	35·3	35·1	35·0	35·0	35·1	35·2	35·1
May .	35·5	35·5	35·6	35·7	35·6	35·8	37·0	37·9	38·2	37·3	35·6	34·3	33·4	33·4	34·0	34·6	35·2	35·7	35·6	35·0	35·1	35·1	35·2	35·3	35·3	35·5
June .	34·6	34·8	34·8	34·8	34·9	35·0	36·3	36·8	36·6	35·8	34·7	33·4	32·6	32·4	32·6	32·9	33·8	34·6	34·9	34·6	34·5	34·4	34·4	34·6	34·7	34·5
July .	33·9	34·1	34·3	34·3	34·4	34·6	35·8	36·9	37·4	36·5	35·0	33·6	32·5	32·0	32·1	32·6	33·4	34·0	34·3	33·9	33·7	33·7	33·8	34·0	33·9	34·2
August .	33·2	33·2	33·4	33·5	33·7	34·0	35·5	36·4	35·9	34·7	33·3	32·5	31·9	31·7	32·2	33·1	33·9	34·3	33·8	33·1	33·0	32·9	32·9	33·1	33·1	33·6
September .	33·4	33·5	33·6	33·6	33·6	33·6	34·5	36·0	36·3	35·3	34·0	32·8	31·6	31·2	31·6	32·5	33·4	33·8	33·4	33·4	33·3	33·2	33·1	33·2	33·3	33·5
Means .	34·3	34·4	34·5	34·5	34·6	34·7	35·8	36·8	36·9	36·0	34·7	33·5	32·5	32·3	32·7	33·3	34·1	34·6	34·6	34·2	34·1	34·1	34·1	34·2	34·3	34·4

Diurnal Inequality of the Declination at Toungoo as deduced from the preceding Table.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.
Winter.																									
Months.	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
January	−0·1	−0·2	−0·2	−0·2	−0·2	−0·5	−0·7	−0·9	−0·3	+0·8	+1·2	+1·0	+0·7	+0·5	−0·2	−0·6	−0·4	+0·1	0·0	+0·1	+0·1	−0·1	0·0	−0·1	−0·1
February	−0·1	−0·1	−0·2	−0·3	−0·4	−0·7	−1·1	−1·2	−0·2	+0·9	+2·0	+2·3	+1·7	+0·9	−0·1	−0·6	−0·6	−0·5	−0·4	−0·3	−0·2	−0·3	−0·3	−0·3	−0·1
March	+0·1	+0·1	+0·1	−0·1	−0·2	−0·5	−0·6	0·0	+1·0	+1·7	+1·6	+0·8	−0·2	−1·1	−1·3	−0·8	−0·1	+0·2	−0·1	−0·1	0·0	0·0	−0·2	−0·1	−0·1
October	0·0	+0·1	+0·1	0·0	0·0	−0·2	−0·2	+0·7	+1·6	+1·7	+0·9	−0·2	−1·3	−1·4	−0·9	0·0	+0·5	+0·1	−0·4	−0·1	−0·1	−0·2	−0·2	−0·1	0·0
November	0·0	+0·1	0·0	−0·1	−0·3	−0·3	−0·3	−0·2	+0·4	+0·8	+0·6	0·0	−0·1	0·0	+0·1	0·0	0·0	0·0	−0·2	−0·1	−0·1	−0·2	−0·2	−0·1	+0·1
December	0·0	0·0	0·0	−0·1	−0·1	−0·3	−0·5	−0·7	−0·2	+0·3	+0·5	−0·1	−0·3	−0·1	+0·1	+0·5	+0·8	+0·3	+0·1	0·0	0·0	−0·1	0·0	0·0	0·0
Means	0·0	0·0	−0·1	−0·2	−0·2	−0·4	−0·6	−0·4	+0·4	+1·0	+1·1	+0·6	+0·1	−0·2	−0·4	−0·3	0·0	0·0	−0·2	−0·1	−0·1	−0·2	−0·2	−0·1	−0·1
Summer.																									
April	+0·2	+0·2	+0·3	+0·2	+0·1	−0·1	+0·8	+1·9	+1·7	+1·1	+0·2	−0·8	−1·9	−2·1	−1·4	−0·8	0·0	+0·3	+0·3	+0·2	0·0	−0·1	−0·1	0·0	+0·1
May	0·0	0·0	+0·1	+0·2	+0·1	+0·3	+1·5	+2·4	+2·7	+1·8	+0·1	−1·2	−2·1	−2·1	−1·5	−0·9	−0·3	+0·2	+0·1	−0·5	−0·4	−0·4	−0·3	−0·2	−0·2
June	+0·1	+0·3	+0·3	+0·3	+0·4	+0·5	+1·8	+2·3	+2·1	+1·3	+0·2	−1·1	−1·9	−2·1	−1·9	−1·6	−0·7	+0·1	+0·4	+0·1	0·0	−0·1	−0·1	+0·1	+0·2
July	−0·3	−0·1	+0·1	+0·1	+0·2	+0·4	+1·6	+2·7	+3·2	+2·3	+0·8	−0·6	−1·7	−2·2	−2·1	−1·6	−0·8	−0·2	+0·1	−0·3	−0·5	−0·5	−0·4	−0·2	−0·3
August	−0·4	−0·4	−0·2	−0·1	+0·1	+0·4	+1·9	+2·8	+2·3	+1·1	−0·3	−1·1	−1·7	−1·9	−1·4	−0·5	+0·3	+0·7	+0·2	−0·5	−0·6	−0·7	−0·7	−0·5	−0·5
September	−0·1	0·0	+0·1	+0·1	+0·1	+0·1	+1·0	+2·5	+2·8	+1·8	+0·5	−0·7	−1·9	−2·3	−1·9	−1·0	−0·1	+0·3	−0·1	−0·1	−0·2	−0·3	−0·4	−0·3	−0·2
Means	−0·1	0·0	+0·1	+0·1	+0·2	+0·3	+1·4	+2·4	+2·5	+1·6	+0·3	−0·9	−1·9	−2·1	−1·7	−1·1	−0·3	+0·2	+0·2	−0·2	−0·3	−0·3	−0·3	−0·2	−0·1

N.B.—When the sign is + the magnet points to the East and when — to the West of the mean position.

Hourly Means of Horizontal Force in C. G. S. Units (corrected for temperature) at Toungoo from the selected quiet days in 1908.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.	Means.
38,000 +													Winter.													
Months.	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
January .	**757**	759	759	759	760	761	764	766	770	777	781	**786**	781	772	768	765	764	764	764	763	759	759	760	761	762	766
February .	756	**754**	756	757	757	758	759	763	771	781	788	792	**794**	790	783	774	767	761	759	758	758	757	759	758	757	767
March .	753	753	753	755	756	758	761	763	772	785	799	810	**812**	806	790	775	764	758	757	758	755	752	**752**	754	757	769
October .	749	**748**	749	750	749	750	752	754	763	775	791	802	**804**	794	781	770	762	759	759	759	756	754	755	755	756	764
November .	752	752	**751**	753	753	755	757	761	767	776	786	**791**	788	780	769	763	758	756	756	756	754	756	756	756	755	763
December .	755	757	756	757	757	768	761	766	774	781	**786**	786	785	779	771	767	762	756	756	**755**	755	755	756	756	758	764
Means .	**754**	754	754	755	755	757	759	762	770	779	789	**795**	794	787	777	769	763	759	759	758	756	756	756	757	758	766
													Summer.													
April .	**740**	740	741	743	744	748	748	748	761	782	794	**803**	802	793	781	766	755	745	743	743	741	742	743	745	748	758
May .	747	747	749	749	750	752	754	759	772	786	798	**803**	797	790	779	770	759	752	750	751	750	748	**745**	748	749	763
June .	750	751	751	752	752	753	754	757	765	775	787	793	**794**	792	787	775	763	752	**746**	747	748	750	750	753	750	762
July .	753	754	753	755	755	755	758	763	773	783	792	798	797	791	784	772	761	754	**752**	755	755	756	757	757	756	766
August .	**748**	750	750	752	750	749	751	753	764	774	784	790	**790**	786	780	770	760	754	753	755	754	754	752	752	755	762
September .	740	742	741	739	738	737	738	**733**	733	746	762	772	776	**777**	768	759	750	744	745	745	742	740	741	742	742	748
Means .	**746**	747	748	748	748	749	751	752	761	774	786	**793**	793	788	780	769	758	750	748	749	748	749	748	750	750	760

Diurnal Inequality of the Horizontal Force at Toungoo as deduced from the preceding Table.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.
Winter.																									
Months.	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
January . .	−9	−7	−7	−7	−6	−5	−2	0	+4	+11	+15	+20	+15	+6	+2	−1	−2	−2	−2	−3	−7	−7	−6	−5	−4
February . .	−11	−13	−11	−10	−10	−9	−8	−4	+4	+14	+21	+25	+27	+23	+16	+7	0	−6	−8	−9	−9	−10	−8	−9	−10
March . .	−16	−16	−16	−14	−13	−11	−8	−6	+3	+16	+30	+41	+43	+37	+21	+6	−5	−11	−12	−11	−14	−17	−17	−15	−12
October . .	−15	−16	−15	−14	−15	−14	−12	−10	−1	+11	+27	+38	+40	+30	+17	+6	−2	−5	−5	−5	−8	−10	−9	−9	−8
November . .	−11	−11	−12	−10	−10	−8	−6	−2	+4	+13	+23	+28	+25	+17	+6	0	−5	−7	−7	−7	−9	−7	−7	−7	−8
December . .	−9	−7	−8	−7	−7	−6	−3	+2	+10	+17	+22	+22	+21	+15	+7	+3	−2	−8	−8	−9	−9	−9	−8	−8	−6
Means . . .	−12	−12	−12	−11	−11	−9	−7	−4	+4	+13	+23	+29	+28	+21	+11	+3	−3	−7	−7	−8	−10	−10	−10	−9	−8
Summer.																									
April . . .	−18	−18	−17	−15	−14	−10	−10	−10	+3	+24	+36	+45	+44	+35	+23	+8	−3	−13	−15	−15	−17	−16	−15	−13	−10
May . . .	−16	−16	−14	−14	−13	−11	−9	−4	+9	+23	+35	+40	+34	+27	+16	+7	−4	−11	−13	−12	−13	−15	−18	−15	−14
June . .	−12	−11	−11	−10	−10	−9	−8	−5	+3	+13	+25	+31	+32	+30	+25	+13	+1	−10	−16	−15	−14	−12	−12	−9	−12
July . .	−13	−12	−13	−11	−11	−11	−8	−3	+7	+17	+26	+32	+31	+25	+18	+6	−5	−12	−14	−11	−11	−10	−9	−9	−10
August . .	−14	−12	−12	−10	−12	−13	−11	−9	+2	+12	+22	+28	+28	+24	+18	+8	−2	−8	−9	−7	−8	−8	−10	−10	−7
September . .	−8	−6	−7	−9	−10	−11	−10	−15	−15	−2	+14	+24	+28	+29	+20	+11	+2	−4	−3	−3	−6	−8	−7	−6	−6
Means . .	−14	−13	−12	−12	−12	−11	−9	−8	+1	+14	+26	+33	+33	+28	+20	+9	−2	−10	−12	−11	−12	−12	−12	−10	−10

NOTE.—When the sign is + the Horizontal force is greater, and when − it is less than the mean.

Hourly Means of Vertical Force in C. G. S. Units (corrected for temperature) at Toungoo from the selected quiet days in 1908.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.	Means.
·16000 C. G. S. +													Winter.													
Months.	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
January	472	472	471	471	471	471	471	471	474	474	468	464	461	461	463	465	468	470	469	470	471	471	472	473	473	469
February	472	472	472	471	471	471	470	471	471	467	464	459	451	450	452	458	461	464	467	469	471	471	472	473	474	466
March	479	479	479	479	478	478	480	480	478	471	463	459	459	464	471	477	478	476	476	478	479	479	480	481	481	475
October	494	494	494	494	494	494	496	498	493	483	476	474	476	484	491	495	495	490	490	492	493	493	494	494	495	490
November	498	499	499	498	499	499	500	502	499	495	488	486	489	492	494	495	495	495	497	498	498	498	499	500	500	496
December	474	473	473	473	473	473	474	474	475	471	465	464	469	473	475	477	475	474	474	475	476	477	477	477	477	473
Means	482	482	481	481	481	481	482	483	482	477	471	468	468	471	474	478	479	478	477	480	481	482	482	483	483	478
													Summer.													
April	498	498	498	498	498	499	503	499	491	484	479	476	479	486	494	497	497	496	494	493	494	494	495	496	497	493
May	482	482	481	481	481	482	486	485	479	471	467	468	469	471	477	482	485	485	481	480	480	481	482	483	483	479
June	480	480	480	480	479	481	483	481	477	471	470	469	467	472	475	477	481	481	479	476	476	477	478	478	479	477
July	482	481	481	481	481	483	487	485	480	471	464	461	461	467	472	477	479	480	478	477	479	480	480	481	480	477
August	475	476	476	476	476	477	481	477	470	464	463	466	468	473	476	479	480	475	471	471	472	472	474	474	474	473
September	482	483	482	482	482	482	487	487	477	466	459	456	457	465	473	480	482	481	479	479	480	480	481	482	483	477
Means	483	483	483	483	483	484	488	486	479	471	467	466	467	472	478	482	484	483	480	479	480	481	482	482	483	479

Diurnal Inequality of the Vertical Force at Toungoo as deduced from the preceding Table.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.
Winter.																									
Months.	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
January . .	+3	+3	+2	+2	+2	+2	+2	+2	+5	+5	−1	−5	−8	−8	−6	−4	−1	+1	0	+1	+2	+2	+3	+4	+4
February . .	+6	+6	+6	+5	+5	+5	+4	+5	+5	+1	−2	−7	−15	−16	−14	−8	−5	−2	+1	+3	+5	+5	+6	+7	+8
March . .	+4	+4	+4	+4	+3	+3	+5	+5	+3	−4	−12	−16	−16	−11	−4	+2	+3	+1	+1	+3	+4	+4	+5	+6	+6
October . / .	+4	+4	+4	+4	+4	+4	+6	+8	+3	−7	−14	−16	−14	−6	+1	+5	+5	0	0	+2	+3	+3	+4	+4	+5
November . .	+2	+3	+3	+2	+3	+3	+4	+6	+3	−1	−8	−10	−7	−4	−2	−1	−1	−1	+1	+2	+2	+2	+3	+4	+4
December . .	+1	0	0	0	0	0	+1	+1	+2	−2	−8	−9	−4	0	+2	+4	+3	+1	+1	+2	+3	+4	+4	+4	+4
Means . . .	+4	+4	+3	+3	+3	+3	+4	+5	+4	−1	−7	−10	−10	−7	−4	0	+1	0	−1	+2	+3	+4	+4	+5	+5
Summer.																									
April . . .	+5	+5	+5	+5	+5	+6	+10	+6	−2	−9	−14	−17	−14	−7	+1	+4	+4	+3	+1	0	+1	+1	+2	+3	+4
May . . .	+3	+3	+2	+2	+2	+3	+7	+6	0	−8	−12	−11	−10	−8	−2	+3	+6	+6	+2	+1	+1	+2	+3	+4	+4
June . . .	+3	+3	+3	+3	+2	+4	+6	+4	0	−6	−7	−8	−10	−5	−2	0	+4	+4	+2	−1	−1	0	+1	+1	+2
July . . .	+5	+4	+4	+4	+4	+6	+10	+8	+3	−6	−13	−16	−16	−10	−5	0	+2	+3	+1	0	+2	+3	+3	+4	+3
August . .	+2	+3	+3	+3	+3	+4	+8	+4	−3	−9	−10	−7	−5	0	+3	+6	+7	+2	−2	−2	—	−1	+1	+1	+1
September . .	+5	+6	+5	+5	+5	+5	+10	+10	0	−11	−18	−21	−20	−12	−4	+3	+5	+4	+2	+2	+3	+3	+4	+5	+6
Means . . .	+4	+4	+4	+4	+4	+5	+9	+7	0	−8	−12	−13	−12	−7	−1	+3	+5	+4	+1	0	+1	+2	+3	+3	+4

N.B.—When the sign is + the Vertical force is more, and when — it is less than the mean.

Hourly Means of the Dip as determined at Toungoo from the selected quiet days in 1908.

Dip. 22°+

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.	Means.
Winter.																										
Months.	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
January	61·6	61·5	61·4	61·4	61·4	61·3	61·3	61·2	61·3	61·1	60·5	60·0	60·0	60·3	60·5	60·8	61·0	61·2	61·1	61·2	61·4	61·4	61·5	61·5	61·5	61·1
February	61·6	61·7	61·6	61·5	61·5	61·5	61·3	61·3	61·0	60·4	60·0	59·5	58·8	58·9	59·2	60·0	60·4	60·8	61·1	61·3	61·5	61·5	61·5	61·6	61·7	60·8
March	62·2	62·2	62·2	62·1	62·0	62·0	62·0	62·0	61·5	60·6	59·5	58·9	58·8	59·4	60·4	61·4	61·8	61·8	61·9	62·0	62·1	62·3	62·3	62·2	62·2	61·4
October	63·5	63·5	63·5	63·5	63·5	63·5	63·5	63·6	62·9	61·8	60·8	60·3	60·3	61·3	62·2	62·9	63·1	62·9	62·9	63·0	63·2	63·2	63·3	63·3	63·3	62·7
November	63·7	63·8	63·8	63·6	63·7	63·7	63·7	63·7	63·3	62·7	61·8	61·5	61·8	62·3	62·9	63·1	63·3	63·3	63·5	63·5	63·6	63·5	63·6	63·7	63·7	63·2
December	61·8	61·6	61·7	61·6	61·6	61·6	61·6	61·4	61·3	60·7	60·1	60·0	60·5	60·9	61·3	61·6	61·7	61·7	61·7	61·9	61·9	62·0	62·0	62·0	61·9	61·4
Means	62·4	62·4	62·4	62·3	62·3	62·3	62·2	62·2	61·9	61·2	60·5	60·0	60·0	60·5	61·1	61·6	61·9	62·0	62·0	62·2	62·3	62·3	62·4	62·4	62·4	61·8
Summer.																										
April	64·1	64·1	64·0	64·0	63·9	63·9	64·2	63·9	62·9	61·7	60·9	60·4	60·7	61·5	62·5	63·2	63·5	63·7	63·7	63·6	63·7	63·7	63·7	63·7	63·7	63·1
May	62·6	62·6	62·5	62·5	62·5	62·5	62·7	62·5	61·6	60·5	59·9	59·8	60·1	60·4	61·2	61·9	62·6	62·7	62·5	62·4	62·4	62·5	62·7	62·7	62·7	61·9
June	62·4	63·4	62·4	62·3	62·3	62·3	62·5	62·2	61·7	60·9	60·4	60·2	60·0	60·5	60·8	61·4	62·0	62·4	62·4	62·2	62·1	62·2	62·2	62·1	62·3	61·8
July	62·4	62·3	62·3	62·3	62·3	62·5	62·7	62·3	61·7	60·7	59·9	59·4	59·5	60·1	60·7	61·5	61·9	62·3	62·2	62·0	62·1	62·2	62·2	62·2	62·2	61·7
August	62·1	62·1	62·1	62·0	62·1	62·2	62·4	62·1	61·2	60·4	60·0	60·1	60·2	60·7	61·1	61·7	62·1	61·9	61·6	61·5	61·7	61·7	61·9	61·9	61·8	61·5
September	62·9	62·9	62·8	62·9	62·9	62·9	63·3	63·5	62·7	61·5	60·4	59·9	59·8	60·4	61·3	62·1	62·5	62·7	62·5	62·5	62·7	62·7	62·7	62·8	62·9	62·2
Means	62·8	62·7	62·7	62·7	62·7	62·7	63·0	62·8	62·0	61·0	60·3	60·0	60·1	60·6	61·3	62·0	62·4	62·6	62·5	62·4	62·5	62·5	62·6	62·6	62·6	62·0

Diurnal Inequality of the Dip at Toungoo as deduced from the preceding Table.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.
Winter.																									
Months.	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
January	+0·5	+0·4	+0·3	+0·3	+0·3	+0·2	+0·2	+0·1	+0·2	0	−0·6	−1·1	−1·1	−0·8	−0·6	−0·3	−0·1	+0·1	0·0	+0·1	+0·3	+0·3	+0·4	+0·4	+0·4
February	+0·8	+0·9	+0·8	+0·7	+0·7	+0·7	+0·5	+0·5	+0·2	−0·4	−0·8	−1·3	−2·0	−1·9	−1·6	−0·8	−0·4	0·0	+0·3	+0·5	+0·7	+0·7	+0·7	+0·8	+0·9
March	+0·8	+0·8	+0·8	+0·7	+0·6	+0·6	+0·6	+0·6	+0·1	−0·8	−1·9	−2·5	−2·6	−2·0	−1·0	0·0	+0·4	+0·4	+0·5	+0·6	+0·7	+0·9	+0·9	+0·9	+0·8
October	+0·8	+0·8	+0·8	+0·8	+0·8	+0·8	+0·8	+0·9	+0·2	−0·9	−1·9	−2·4	−2·4	−1·4	−0·5	+0·2	+0·4	+0·2	+0·2	+0·3	+0·5	+0·5	+0·6	+0·6	+0·6
November	+0·5	+0·6	+0·6	+0·4	+0·5	+0·5	+0·5	+0·5	+0·1	−0·5	−1·4	−1·7	−1·4	−0·9	−0·3	−0·1	+0·1	+0·1	+0·3	+0·3	+0·4	+0·3	+0·4	+0·5	+0·5
December	+0·4	+0·2	+0·3	+0·2	+0·2	+0·2	+0·2	0·0	−0·1	−0·7	−1·3	−1·4	−0·9	−0·5	−0·1	+0·2	+0·3	+0·3	+0·3	+0·5	+0·5	+0·6	+0·6	+0·6	+0·5
Means	+0·6	+0·6	+0·6	+0·5	+0·5	+0·5	+0·4	+0·4	+0·1	−0·6	−1·3	−1·8	−1·8	−1·3	−0·7	−0·2	+0·1	+0·2	+0·2	+0·4	+0·5	+0·5	+0·6	+0·6	+0·6
Summer.																									
April	+1·0	+1·0	+0·9	+0·9	+0·8	+0·8	+1·1	+0·8	−0·2	−1·4	−2·2	−2·7	−2·4	−1·6	−0·6	+0·1	+0·4	+0·6	+0·6	+0·5	+0·6	+0·6	+0·6	+0·6	+0·6
May	+0·7	+0·7	+0·6	+0·6	+0·6	+0·6	+0·8	+0·6	−0·3	−1·4	−2·0	−2·1	−1·8	−1·5	−0·7	0·0	+0·6	+0·8	+0·6	+0·5	+0·5	+0·6	+0·8	+0·8	+0·8
June	+0·6	+0·6	+0·6	+0·5	+0·5	+0·5	+0·7	+0·4	−0·1	−0·9	−1·4	−1·6	−1·8	−1·3	−1·0	−0·4	+0·2	+0·6	+0·6	+0·4	+0·3	+0·4	+0·4	+0·3	+0·5
July	+0·7	+0·6	+0·6	+0·6	+0·6	+0·8	+1·0	+0·6	0·0	−1·0	−1·8	−2·3	−2·2	−1·6	−1·0	−0·2	−0·2	+0·6	+0·5	+0·3	+0·4	+0·5	+0·5	+0·5	+0·5
August	+0·6	+0·6	+0·6	+0·5	+0·6	+0·7	+0·9	+0·6	−0·3	−1·1	−1·5	−1·4	−1·3	−0·8	−0·4	+0·2	+0·6	+0·4	+0·1	0	+0·2	+0·2	+0·4	+0·4	+0·3
September	+0·7	+0·7	+0·6	+0·7	+0·7	+0·7	+1·1	+1·3	+0·5	−0·7	−1·8	−2·3	−2·4	−1·8	−0·9	−0·1	+0·3	+0·5	+0·3	+0·3	+0·5	+0·5	+0·5	+0·6	+0·7
Means	+0·8	+0·7	+0·7	+0·7	+0·7	+0·7	+1·0	+0·8	0·0	−1·0	−1·7	−2·0	−1·9	−1·4	−0·7	0·0	+0·4	+0·6	+0·5	+0·4	+0·5	+0·5	+0·6	+0·6	+0·6

N. B. - When the sign is + the Dip is more, and when — it is less than the mean.

KODAIKÁNAL OBSERVATORY TABLES.

Hourly Means of the Declination as determined at Kodaikánal from the selected quiet days in 1908.

Declination W 0° +

Winter.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.	Means.
Months.	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
January .	43·3	43·3	43·4	43·5	43·7	43·8	44·0	44·3	43·9	43·4	43·1	43·1	43·2	42·4	42·1	42·4	42·8	42·9	43·1	43·1	43·2	43·2	43·4	43·5	43·4	43·2
February .	43·9	43·9	44·0	44·1	44·1	44·3	44·6	45·1	44·5	43·6	42·8	42·6	42·6	42·5	42·7	43·0	43·3	43·7	43·8	43·7	43·7	43·8	44·0	44·0	43·9	43·7
March .	44·3	44·3	44·4	44·6	44·6	44·8	44·9	44·5	44·0	43·6	43·4	44·1	44·7	44·7	44·7	44·2	44·2	44·3	44·3	44·4	44·5	44·5	44·5	44·4	44·4	44·4
October .	46·3	46·3	46·3	46·3	46·4	46·6	46·8	46·5	46·1	46·0	46·7	47·5	47·9	47·6	47·2	46·4	46·0	46·2	46·5	46·5	46·5	46·5	46·6	46·6	46·4	46·6
November .	47·1	47·1	47·2	47·3	47·4	47·4	47·4	47·6	47·2	47·1	47·4	47·9	47·8	47·2	46·6	46·6	46·9	47·2	47·2	47·1	47·2	47·2	47·3	47·2	47·1	47·2
December .	47·5	47·5	47·5	47·6	47·7	48·0	48·1	48·4	48·3	48·0	47·8	47·9	47·8	47·5	47·5	47·0	46·7	46·8	47·4	47·4	47·4	47·5	47·5	47·5	47·5	47·6
Means .	45·4	45·4	45·5	45·6	45·7	45·8	46·0	46·1	45·7	45·3	45·2	45·5	45·7	45·3	45·1	44·9	45·0	45·2	45·4	45·4	45·4	45·5	45·6	45·5	45·5	45·5

Summer.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.	Means.
April .	44·2	44·1	44·1	44·2	44·3	44·3	43·9	43·1	43·2	43·7	44·4	44·8	45·6	45·7	45·3	44·6	44·0	43·8	44·0	44·3	44·4	44·5	44·3	44·3	44·1	44·3
May .	44·6	44·5	44·4	44·5	44·4	44·4	44·0	43·4	43·3	44·0	45·0	45·5	46·0	46·0	45·3	44·8	44·2	44·2	44·5	44·9	44·9	45·0	44·9	44·7	44·6	44·6
June .	45·2	45·1	45·1	45·1	45·2	45·0	44·3	43·6	43·8	44·8	45·6	46·5	47·2	46·8	46·0	45·8	45·5	45·2	45·0	45·4	45·5	45·5	45·5	45·4	45·3	45·3
July .	45·6	45·4	45·4	45·4	45·2	45·1	44·5	43·5	43·4	44·3	45·2	46·2	46·8	46·6	46·6	45·9	45·5	45·1	45·3	45·8	45·9	45·9	45·8	45·7	45·6	45·4
August .	46·2	46·1	45·9	45·8	45·7	45·5	44·5	43·8	44·5	45·7	46·7	47·7	48·5	48·2	47·6	46·6	45·7	45·1	45·5	46·2	46·4	46·4	46·3	46·3	46·2	46·1
September .	46·5	46·3	46·3	46·2	46·2	46·2	45·4	44·2	44·2	45·1	45·8	47·0	48·0	48·1	47·4	46·6	46·1	46·0	46·1	46·3	46·4	46·5	46·6	46·6	46·4	46·3
Means .	45·4	45·3	45·2	45·2	45·2	45·1	44·4	43·6	43·7	44·6	45·5	46·3	47·0	46·9	46·4	45·7	45·2	44·9	45·1	45·5	45·6	45·6	45·6	45·5	45·4	45·3

Diurnal Inequality of the Declination at Kodaikánal as deduced from the preceding Table.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.
Winter.																									
Months.	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
January	−0·1	−0·1	−0·2	−0·3	−0·5	−0·6	−0·8	−1·1	−0·7	−0·2	+0·1	+0·1	0·0	+0·8	+ ·1	+0·8	+0·4	+0·3	+0·1	+0·1	0·0	0·0	−0·2	−0·3	−0·2
February	−0·2	−0·2	−0·3	−0·4	−0·4	−0·6	−0·9	−1·4	−0·8	+0·1	+0·9	+1·1	+1·1	+1·2	+1·0	+0·7	+0·4	0·0	−0·1	0·0	0·0	−0·1	+0·3	−0·3	−0·2
March	+0·1	+0·1	0·0	−0·2	−0·2	−0·4	−0·5	−0·1	+0·4	+0·8	+1·0	+0·3	−0·3	−0·3	−0·3	+0·2	+0·2	+0·1	+0·1	0·0	−0·1	−0·1	−0·1	0·0	0·0
October	+0·3	+0·3	+0·3	+0·3	+0·2	0·0	−0·2	+0·1	+0·5	+0·6	−0·1	−0·9	−1·3	−1·0	−0·6	+0·2	+0·6	+0·4	+0·1	+0·1	+0·1	+0·1	0·0	0·0	+0·2
November	+0·1	+0·1	0·0	−0·1	−0·2	−0·2	−0·2	−0·4	0·0	+0·1	−0·2	−0·7	−0·6	0·0	+0·6	+0·6	+0·3	0·0	0·0	+0·1	0·0	0·0	−0·1	0·0	+0·1
December	+0·1	+0·1	+0·1	0·0	−0·1	−0·4	−0·5	−0·8	−0·7	−0·4	−0·2	−0·3	−0·2	+0·1	+0·1	+0·6	+0·9	+0·8	+0·2	+0·2	+0·2	+0·1	−0·1	+0·1	+0·1
Means	+0·1	+0·1	0·0	−0·1	−0·2	−0·3	−0·5	−0·6	−0·2	+0·2	+0·3	0·0	−0·2	+0·2	+0·4	+0·6	+0·5	+0·3	+0·1	+0·1	+0·1	0·0	−0·1	0·0	0·0
Summer.																									
April	+0·1	+0·2	+0·2	+0·1	0·0	0·0	+0·4	+1·2	+1·1	+0·6	−0·1	−0·5	−1·3	−1·4	−1·0	−0·3	+0·3	+0·5	+0·3	0·0	−0·1	−0·2	0·0	0·0	+0·2
May	0·0	+0·1	+0·2	+0·1	+0·2	+0·2	+0·6	+1·2	+1·3	+0·6	−0·4	−0·9	−1·4	−1·4	−0·7	−0·2	+0·4	+0·4	+0·1	−0·3	−0·3	−0·4	−0·3	−0·1	0·0
June	+0·1	+0·2	+0·2	+0·2	+0·1	+0·3	+1·0	+1·7	+1·5	+0·5	−0·3	−1·2	−1·9	−1·5	−0·7	−0·5	−0·2	+0·1	+0·3	−0·1	−0·2	−0·2	−0·2	−0·1	0·0
July	−0·2	0·0	0·0	0·0	+0·2	+0·3	+0·9	+1·9	+2·0	+1·1	+0·2	−0·8	−1·4	−1·2	−1·2	−0·5	−0·1	+0·3	+0·1	−0·4	−0·5	−0·5	−0·4	−0·3	−0·2
August	−0·1	0·0	+0·2	+0·3	+0·4	+0·6	+1·6	+2·3	+1·6	+0·4	−0·6	−1·6	−2·4	−2·1	−1·5	−0·5	+0·4	+1·0	+0·6	−0·1	−0·3	−0·3	−0·2	−0·2	−0·1
September	−0·2	0·0	0·0	+0·1	+0·1	+0·1	+0·9	+2·1	+2·1	+1·2	+0·5	−0·7	−1·7	−1·8	−1·1	−0·3	+0·2	+0·3	+0·2	0·0	−0·1	−0·2	−0·3	−0·3	−0·1
Means	−0·1	0·0	+0·1	+0·1	+0·1	+0·2	+0·9	+1·7	+1·6	+0·7	−0·2	−1·0	−1·7	−1·6	−1·1	−0·4	+0·1	+0·4	+0·2	−0·2	−0·3	−0·3	−0·3	−0·2	−0·1

N.B.—When the sign is + the magnet points to the East, and when — to the West of the mean position.

Hourly Means of Horizontal Force in C. G. S. Units (corrected for temperature) at Kodaikánal from the selected quiet days in 1908.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.	Means.
·37000 +													Winter.													
Months.	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
January .	417	418	419	418	420	419	421	426	436	449	465	473	469	466	462	457	448	438	429	425	421	422	421	420	420	436
February .	412	415	415	415	416	416	416	427	439	453	464	476	471	467	461	455	444	435	428	423	421	419	417	415	415	434
March .	411	415	415	415	416	415	413	423	448	483	512	527	519	487	451	425	416	420	424	418	415	413	414	414	415	438
October .	408	408	410	410	410	410	410	421	447	483	512	519	506	477	452	433	426	427	426	421	419	418	416	414	415	437
November .	412	413	413	414	414	414	416	424	437	458	474	476	465	454	444	436	430	427	423	420	420	418	415	413	416	430
December	424	423	423	422	422	422	423	434	454	475	492	497	485	468	448	431	427	428	427	425	424	425	424	425	426	439
Means .	414	415	416	416	416	416	417	426	444	467	487	495	486	470	453	440	432	429	426	422	420	419	418	417	418	436
													Summer.													
April . .	400	403	403	405	405	404	403	419	451	485	511	513	495	469	442	427	422	417	413	410	409	408	409	408	409	430
May . .	411	413	414	413	415	414	417	427	451	482	504	508	499	478	455	429	417	416	419	416	413	410	411	411	414	435
June . .	416	417	418	418	418	416	418	420	431	453	468	477	477	466	448	433	422	416	418	419	418	418	419	418	420	431
July . .	421	422	423	422	422	421	425	430	445	466	488	497	487	470	451	433	422	419	422	423	423	423	423	423	425	438
August .	415	417	417	415	415	416	420	430	446	460	470	466	455	440	430	425	426	429	431	427	425	423	421	422	422	431
September .	401	400	399	399	398	401	396	396	418	460	490	503	494	475	447	425	414	415	414	408	405	404	404	403	402	424
Means .	411	412	412	412	412	412	413	420	440	468	489	494	485	466	446	429	421	419	420	417	416	414	415	414	415	432

Diurnal Inequality of the Horizontal Force at Kodaikánal as deduced from the preceding Table.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.
Winter.																									
Months.	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
January . .	−19	−18	−17	−18	−16	−17	−15	−10	0	+13	+29	+37	+33	+30	+26	+21	+12	+2	−7	−11	−15	−14	−15	−16	−16
February . .	−22	−19	−19	−19	−18	−18	−18	−7	+5	+19	+30	+42	+37	+33	+27	+21	+10	+1	−6	−11	−13	−15	−17	−19	−19
March . .	−27	−23	−23	−23	−22	−23	−25	−15	+10	+45	+74	+89	+81	+49	+13	−13	−22	−18	−14	−20	−23	−25	−24	−24	−23
October . .	−29	−29	−27	−27	−27	−27	−27	−16	+10	+46	+75	+82	+69	+40	+15	−4	−11	−10	−11	−16	−18	−19	−21	−23	−22
November . .	−18	−17	−17	−16	−16	−16	−14	−6	+7	+28	+44	+46	+35	+24	+14	+6	0	−3	−7	−10	−10	−12	−15	−17	−14
December . .	−15	−16	−16	−17	−17	−17	−16	−5	+15	+36	+53	+58	+46	+29	+9	−8	−12	−11	−12	−14	−15	−14	−15	−14	−13
Means . .	−22	−21	−20	−20	−20	−20	−19	−10	+8	+31	+51	+59	+50	+34	+17	+4	−4	−7	−10	−14	−16	−17	−18	−19	−18
Summer.																									
April . . .	−30	−27	−27	−25	−25	−26	−27	−11	+21	+55	+81	+83	+65	+39	+12	−3	−8	−13	−17	−20	−21	−22	−21	−22	−21
May . . .	−24	−22	−21	−22	−20	−21	−18	−8	+16	+47	+69	+73	+64	+43	+20	−6	−18	−19	−16	−19	−22	−25	−24	−24	−21
June . . .	−15	−14	−13	−13	−13	−15	−13	−11	0	+22	+37	+46	+46	+35	+17	+2	−9	−15	−13	−12	−13	−13	−12	−13	−11
July . . .	−17	−16	−15	−16	−16	−17	−13	−8	+7	+28	+50	+59	+49	+32	+13	−5	−16	−19	−16	−15	−15	−15	−15	−15	−13
August . .	−16	−14	−14	−16	−16	−15	−11	−1	+15	+29	+39	+35	+24	+9	−1	−6	−5	−2	0	−4	−6	−8	−10	−9	−9
September . .	−23	−24	−25	−25	−26	−23	−28	−28	−6	+36	+66	+79	+70	+51	+2	+1	−10	−9	−10	−16	−19	−20	−20	−21	−22
Means . .	−21	−20	−20	−20	−20	−20	−19	−12	+8	+36	+57	+62	+53	+34	+14	−3	−11	−13	−12	−15	−16	−18	−17	−18	−17

N. B.—When the sign is + the Horizontal force is more, and when — less than the mean value

Hourly Means of Vertical Force in C. G. S. Units (corrected for temperature) at Kodaikánal from the selected quiet days in 1908.

·02000 C. G. S. +

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.	Means.
Winter.																										
Months.	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
January .	299	299	299	298	298	298	299	298	300	301	296	292	290	291	286	284	286	288	290	294	294	295	296	297	297	294
February .	302	303	303	302	302	301	301	303	307	308	307	307	310	301	298	294	289	287	292	296	297	298	299	300	301	300
March .	308	309	309	308	309	308	310	311	310	305	296	287	279	281	287	300	303	303	304	303	304	305	307	308	309	302
October .	340	340	340	340	340	340	342	343	340	332	324	317	318	319	321	325	330	331	333	335	337	337	338	340	341	333
November .	346	347	346	347	347	347	348	346	346	342	338	338	338	340	338	336	338	343	347	349	350	350	351	351	353	345
December .	364	363	363	363	364	364	365	365	362	358	353	349	346	343	345	354	358	456	359	360	360	362	362	363	363	358
Means	327	327	327	326	327	326	328	328	328	324	319	315	314	313	313	316	317	318	321	323	324	325	326	327	327	322
Summer.																										
April .	314	315	314	315	315	316	319	320	314	306	299	291	288	290	293	300	304	305	306	309	310	312	313	314	315	308
May .	311	311	312	312	312	813	315	316	313	303	295	297	295	299	302	312	317	315	313	314	315	317	318	319	319	310
June .	333	333	333	332	333	334	338	339	338	334	331	329	326	329	331	333	333	333	331	329	330	332	332	332	332	332
July .	334	334	335	434	335	335	338	340	337	335	331	321	320	323	327	333	335	334	331	329	331	332	333	333	334	332
August .	335	336	336	436	336	338	340	338	330	325	324	325	330	339	342	346	344	340	334	333	334	335	335	337	338	335
September .	342	342	342	343	343	344	349	348	340	331	327	316	316	318	321	328	334	337	538	339	339	341	343	343	345	336
Means .	328	329	329	329	329	330	333	334	329	322	318	313	313	316	319	325	328	327	326	326	327	328	329	330	331	326

Diurnal Inequality of the Vertical Force at Kodaikánal as deduced from the preceding Table.

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.
Winter.																									
Months.	γ	γ	γ	γ	γ	γ	γ		γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
January . .	+5	+5	+5	+4	+4	+4	+5	+4	+6	+7	+2	−2	−4	−3	−8	−10	−8	−6	−4	0	0	+1	+2	+3	+3
February . .	+2	+3	+3	+2	+2	+1	+1	+3	+7	+8	+7	+7	+10	+1	−2	−6	−11	−13	−8	−4	−3	−2	−1	0	+1
March . .	+6	+7	+7	+6	+7	+6	+8	+9	+8	+3	−6	−15	−23	−21	−15	−2	+1	+1	+2	+1	+2	+3	+5	+6	+7
October . .	+7	+7	+7	+7	+7	+7	+9	+10	+7	−1	−9	−16	−15	−14	−12	−8	−3	−2	0	+2	+4	+4	+5	+7	+8
November . .	+1	+2	+1	+2	+2	+2	+3	+1	+1	−3	−7	−7	−7	−5	−7	−9	−7	−2	+2	+4	+5	+5	+6	+6	+8
December . .	+6	+5	+5	+5	+6	+6	+7	+7	+4	0	−5	−9	−12	−15	−13	−4	0	−2	+1	+2	+2	+4	+4	+5	+5
Means . .	+5	+5	+5	+4	+5	+4	+6	+6	+6	+2	−3	−7	−8	−9	−9	−6	−5	−4	−1	+1	+2	+3	+4	+5	+5
Summer.																									
April . . .	+6	+7	+6	+7	+7	+8	+11	+12	+6	−2	−9	−17	−20	−18	−15	−8	−4	−3	−2	+1	+2	+4	+5	+6	+7
May . . .	+1	+1	+2	+2	+2	+3	+5	+6	+3	−7	−15	−13	−15	−11	−8	+2	+7	+5	+3	+4	+5	+7	+8	+9	+9
June . . .	+1	+1	+1	0	+1	+2	+6	+7	+6	+2	−1	−3	−6	−3	−1	+1	+1	+1	−1	−3	−2	0	0	0	0
July . . .	+2	+2	+3	+2	+3	+3	+6	+8	+5	+3	−1	−11	−12	−9	−5	+1	+3	+2	−1	−3	−1	0	+1	+1	+2
August . .	0	+1	+1	+1	+1	+3	+5	+3	−5	−10	−11	−10	−5	+4	+7	+11	+9	+5	−1	−2	−1	0	0	+2	+3
September . .	+6	+6	+6	+7	+7	+8	+13	+12	+4	−5	−9	−20	−20	−18	−15	−8	−2	+1	+2	+3	+3	+5	+7	+7	+9
Means . .	+2	+3	+3	+3	+3	+4	+7	+8	+3	−4	−8	−13	−13	−10	−7	−1	+2	+1	0	0	+1	+2	+3	+4	+5

N. B.- When the sign is + the Vertical Force is more, and when — it is less than the mean.

Hourly Means of the Dip as determined at Kodaikánal from the selected quiet days in 1908.

Dip 3°+

Hours.	Mid.	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.	Means.
													Winter.													
Months.	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′
January .	31.0	31.0	31.0	30.9	30.9	30.9	30.9	30.8	31.0	**31.0**	30.4	30.0	29.9	30.0	29.5	**29.4**	29.6	29.8	30.1	30.5	30.5	30.6	30.7	30.8	30.8	30.5
February .	31.3	31.3	31.3	31.3	31.2	31.2	31.2	31.3	31.6	31.6	31.4	31.4	**31.7**	30.9	30.6	30.3	29.9	**29.8**	30.3	30.7	30.8	30.9	31.0	31.1	31.2	31.0
March .	31.8	31.9	31.9	31.8	31.9	31.8	32.0	**32.0**	31.8	31.1	30.2	29.3	**28.6**	28.9	29.7	31.0	31.3	31.3	31.4	31.3	31.4	31.5	31.7	31.8	31.9	31.1
October .	34.4	34.8	34.8	34.8	34.8	34.8	34.9	**35.0**	34.5	33.6	32.7	**32.0**	32.2	32.5	32.8	33.3	33.8	33.8	34.0	34.2	34.4	34.4	34.5	34.7	34.8	34.0
November .	35.3	35.4	35.3	35.8	35.4	35.4	35.5	35.2	35.2	34.7	34.2	**34.2**	34.3	34.5	34.4	34.2	34.5	34.9	35.3	35.5	35.6	35.6	35.7	35.7	**35.9**	35.1
December .	36.9	36.8	36.8	36.8	36.9	36.9	**37.0**	36.9	36.5	36.0	35.5	35.1	34.9	**34.7**	35.0	35.9	36.3	36.1	36.4	36.5	36.5	36.7	36.7	36.8	36.8	36.3
Means .	33.5	33.5	33.5	33.5	33.5	33.5	**33.6**	33.5	33.4	33.0	32.4	32.0	31.9	**31.9**	32.0	32.4	32.6	32.6	32.9	33.1	33.2	33.3	33.4	33.5	33.6	33.0
													Summer.													
April . .	32.4	32.5	32.4	32.5	**32.5**	32.6	**32.9**	32.9	32.1	31.2	30.4	29.7	**29.5**	29.9	30.3	31.0	31.4	31.5	31.6	31.9	32.0	32.2	32.3	32.4	32.5	31.7
May . .	32.1	32.1	32.2	32.2	32.2	32.3	32.4	32.5	32.1	31.0	30.1	30.3	30.1	30.6	31.0	32.1	32.6	32.4	32.2	32.3	32.5	32.7	32.7	**32.8**	**32.8**	31.9
June . .	34.1	34.1	34.1	34.0	34.1	34.2	34.5	**34.6**	3 .5	34.0	33.6	33.4	**33.1**	33.4	33.7	34.0	34.0	34.1	33.9	33.7	33.8	34.0	34.0	34.0	34.0	34.0
July . .	34.1	34.1	34.2	34.1	34.2	34.2	34.5	**34.6**	34.3	34.0	33.5	32.5	**32.5**	32.9	33.3	34.0	34.2	34.2	33.9	33.7	33.9	34.0	34.0	34.0	34.1	33.9
August .	34.3	34.4	34.4	34.4	34.4	34.5	34.7	34.5	33.6	33.1	33.0	33.1	33.6	34.5	34.8	**35.2**	35.0	34.7	34.1	34.0	34.1	34.2	34.2	34.4	34.5	34.2
September .	35.0	35.0	35.0	35.1	35.1	35.2	**35.7**	35.6	34.7	33.6	33.1	**32.0**	32.1	32.4	32.8	33.6	34.2	34.5	34.6	34.7	34.7	34.9	35.1	35.1	35.3	34.3
Means .	33.7	33.7	33.7	33.7	33.8	33.8	**34.1**	34.1	33.6	32.8	32.3	31.8	31.8	32.3	32.7	33.3	33.6	33.6	33.4	33.4	33.5	33.7	33.7	33.8	33.9	33.3

Diurnal Inequality of the Dip at Kodaikánal as deduced from the preceding Table.

Winter.

Hours.	Mid	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.
Months.	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ	γ
January	+0·5	+0·5	+0·5	+0·4	+0·4	+0·4	+0·4	+0·3	+0·5	+0·5	−0·1	−0·5	−0·6	−0·5	−1·0	−1·1	−0·9	−0·7	−0·4	0·0	0·0	+0·1	+0·2	+0·3	+0·3
February	+0·3	+0·3	+0·3	+0·3	+0·2	+0·2	+0·2	+0·3	+0·6	+0·6	+0·4	+0·4	+0·7	−0·1	−0·4	−0·7	−1·1	−1·2	−0·7	−0·3	−0·2	−0·1	0·0	+0·1	+0·2
March	+0·7	+0·8	+0·8	+0·7	+0·8	+0·7	+0·9	+0·9	+0·7	0·0	−0·9	−1·8	−2·5	−2·2	−1·4	−0·1	+0·2	+0·2	+0·3	+0·2	+0·3	+0·4	+0·6	+0·7	+0·8
October	+0·8	+0·8	+0·8	+0·8	+0·8	+0·8	+0·9	+1·0	+0·5	−0·4	−1·3	−2·0	−1·8	−1·5	−1·2	−0·7	−0·2	−0·2	0·0	+0·2	+0·4	+0·4	+0·5	+0·7	+0·8
November	+0·2	+0·3	+0·2	+0·3	+0·3	+0·3	+0·4	+0·1	+0·1	−0·4	−0·9	−0·9	−0·8	−0·6	−0·7	−0·9	−0·6	−0·2	+0·2	+0·4	+0·5	+0·5	+0·6	+0·6	+0·8
December	+0·6	+0·5	+0·5	+0·5	+0·6	+0·6	+0·7	+0·6	+0·2	−0·3	−0·8	−1·2	−1·4	−1·6	−1·3	−0·4	0·0	−0·2	+0·1	+0·2	+0·2	+0·4	+0·4	+0·5	+0·5
Means	+0·5	+0·5	+0·5	+0·5	+0·5	+0·5	+0·6	+0·5	+0·4	0·0	−0·6	−1·0	−1·1	−1·1	−1·0	−0·6	+0·4	−0·4	−0·1	+0·1	+0·2	+0·3	+0·4	+0·5	+0·6

Summer.

Hours.	Mid	1	2	3	4	5	6	7	8	9	10	11	Noon.	13	14	15	16	17	18	19	20	21	22	23	Mid.
April	+0·7	+0·8	+0·7	+0·8	+0·8	+0·9	+1·2	+1·2	+0·4	−0·5	−1·3	−2·0	−2·2	−1·8	−1·4	−0·7	−0·3	−0·2	−0·1	+0·2	+0·3	+0·5	+0·6	+0·7	+0·8
May	+0·2	+0·2	+0·3	+0·3	+0·3	+0·4	+0·5	+0·6	+0·2	−0·9	−1·8	−1·6	−1·8	−1·3	−0·9	+0·2	+0·7	+0·5	+0·3	+0·4	+0·6	+0·8	+0·8	+0·9	+0·9
June	+0·1	+0·1	+0·1	+0·0	+0·1	+0·2	+0·5	+0·6	+0·5	0·0	−0·4	−0·6	−0·9	−0·6	−0·3	0·0	0·0	+0·1	−0·1	−0·3	−0·2	0·0	0·0	0·0	0·0
July	+0·2	+0·2	+0·3	+0·2	+0·3	+0·3	+0·6	+0·7	+0·4	+0·1	−0·4	−1·4	−1·4	−1·0	−0·6	+0·1	+0·3	+0·3	0·0	−0·2	0·0	+0·1	+0·1	+0·1	+0·2
August	+0·1	+0·2	+0·2	+0·2	+0·2	+0·3	+0·5	+0·3	+0·6	−1·1	−1·2	−1·1	−0·6	+0·3	+0·6	+1·0	+0·8	+0·5	−0·1	−0·2	−0·1	0·0	0·0	+0·2	+0·3
September	+0·7	+0·7	+0·7	+0·8	+0·8	+0·9	+1·4	+1·3	+0·4	−0·7	−1·2	−2·3	−2·2	−1·9	−1·5	−0·7	−0·1	+0·2	+0·3	+0·4	+0·4	+0·6	+0·8	+0·8	+1·0
Means	+0·4	+0·4	+0·4	+0·4	+0·5	+0·5	+0·8	+0·8	+0·3	−0·5	−1·0	−1·5	−1·5	−1·0	−0·6	0·0	+0·3	+0·3	+0·1	+0·1	+0·2	+0·4	+0·4	+0·5	+0·6

N. B.—When the sign is + the Dip is more, and when — it is less than the mean.

II.

TIDAL AND LEVELLING OPERATIONS.

Extracted from Narrative Report of Mr. C. F. Erskine, in charge No. 25 Party (Tidal and Levelling Operations), for Season 1908-09.

Personnel.

Imperial Officer.

Mr. C. F. Erskine.

Provincial Officers.

Messrs. J. P. Barker, H. G. Shaw, E. H. Corridon, Syed Zille Hasnain, A. M. Talati, O. N. Pushong, P. N. Sur, D. H. Luxa, T. F. Kitchen, H. St. J. Kenny.

Subordinate Establishment.

1 Surveyor, 24 Computers and Recorders, 2 Artificers, 3 Observatory Clerks.

1. The personnel of the party during the year under report was as shown in the margin. Mr. C. F. Erskine held charge of the party throughout the year.

TIDAL OPERATIONS.

2. *Work of the year.*—During the past year tidal registrations by self-registering tide-gauges, were taken at the ports of Aden, Karáchi, Apollo Bandar (Bombay), Prince's Dock (Bombay), Madras, Kidderpore, Rangoon, Moulmein, and Port Blair. In addition, tide-pole readings of high and low water were taken during daylight at the ports of Bhávnagar, Akyab, and Chittagong, with the object of comparing the actual times and heights with the predictions; the observations were made under the direction of this department, and the immediate control of the Port Officers concerned. The reduction by harmonic analysis of the observations for 1908 of eight stations named above, excluding Moulmein which was not working in that year, has been completed. The tide-tables for 1910 have arrived in India, and have been distributed. The work of publication of tide-tables for 40 ports for the years 1911 and 1912 is in progress in England. Data for these predictions were despatched from the office in Dehra Dún in July 1908; for the tide-tables for 1913 they are in preparation.

3. *List of Tidal stations.*—The following table gives a list of the 42 ports at which tidal observations have been registered, together with the periods of observations from 1874 when tidal operations were begun, up to the present time. The permanent stations are shown in italics; the others are minor stations which were closed on the completion of the requisite observations:—

Serial No.	Stations.	Automatic or personal observations.	Date of commencement of observations.	Date of closing of observations.	Number of years of observations.	REMARKS.
1	Suez	Automatic .	1897	1903	7	
2	Perím . . .	Ditto .	1898	1902	5	
3	*Aden* . . .	Ditto .	1879	Still working.	29	
4	Muscat . . .	Ditto .	1893	1898	5	
5	Bushire . .	Ditto .	1892	1901	8	

Serial No.	Stations.	Automatic or personal observations.	Date of commencement of observations.	Date of closing of observations.	Number of years of observations.	REMARKS.
6	*Karáchi* . .	Automatic .	1868 1881	1880 Still working.	13* 28 } 41	* Small Tide-Gauge working.
7	Hanstal . . .	Ditto .	1874	1875	1	Tide-Tables not published.
8	Navánar . .	Ditto .	1874	1875	1	
9	Okha Point . .	Ditto .	1874 Re-started 1904	1875 1906	1 1 } 2	Year 1904-05 is excluded.
10	Porbandar . .	Personal .	1893	1894	2	
10 A	Porbandar . .	Automatic .	1898	1902	5	With certain interruptions.
11	Port Albert Victor (Káthiáwár).	Personal	1881	1882	1	
11 A	Port Albert Victor (Káthiáwár).	Automatic .	1900	1903	4	
12	Bhávnagar . .	Ditto .	1889	1894	5	Tide-pole readings taken.
13	*Bombay (Apollo Bandar).*	Ditto .	1878	Still working.	31	
14	*Bombay (Prince's Dock).*	Ditto .	1888	"	21	Property of Port Trust.
15	Mormugao (Goa) .	Ditto .	1884	1889	5	
16	Kárwár . . .	Ditto .	1878	1883	5	
17	Beypore . .	Ditto .	1878	1884	6	
18	Cochin . . .	Ditto .	1886	1892	6	
19	Tuticorin . .	Ditto .	1888	1893	5	
20	Minicoy . . .	Ditto .	1891	1896	5	
21	Galle . . .	Ditto .	1884	1890	6	
22	Colombo . .	Ditto .	1884	1890	6	
23	Trincomalee . .	Ditto .	1890	1896	6	
24	Pámban Pass . .	Ditto .	1878	1882	4	
25	Negapatam . .	Ditto .	1881	1888	6	Year 1884-85 is excluded.
26	*Madras* . . .	Ditto .	1880 Re-started 1895	1890 Still working.	10 14 } 24	
27	Cocanáda . .	Ditto .	1886	1891	5	

Serial No.	Stations.	Automatic or personal observations.	Date of commencement of observations.	Date of closing of observations.	Number of years of observations.	REMARKS.
28	Vizagapatam	Automatic	1879	1885	6	
29	False Point	Ditto	1881	1885	4	
30	Dublat (Ságar Island)	Ditto	1881	1886	5	
31	Diamond Harbour	Ditto	1881	1886	5	
32	*Kidderpore*	Ditto	1881	Still working.	28	
33	Chittagong	Ditto	1886	1891	5	Tide-pole readings taken.
34	Akyab	Ditto	1887	1892	5	Ditto.
35	Diamond Island	Ditto	1895	1899	5	
36	Bassein (Burma)	Ditto	1902	1903	2	
37	Elephant Point	Ditto	1880 Re-started 1884	1881 1888	1 5 } 6	
38	*Rangoon*	Ditto	1880	Still working.	29	
39	Amherst	Ditto	1880	1886	6	
40	*Moulmein*	Ditto	1880 Re-started 1909	1886 Still working.	6	
41	Mergui	Ditto	1889	1894	5	
42	*Port Blair*	Ditto	1880	Still working.	29	

4. ***Inspection of Observatories.***—The nine tidal observatories now working were inspected during the year.

5. ***Working of Observatories.***—The following account contains a detailed description of the working of the several tidal observatories during the year. It has been taken from reports of inspecting officers, from information furnished by port officers and from the registrations themselves.

6. ***Aden.***—This observatory was inspected by Mr. Shaw in December 1908. During the past year, there were several interruptions in the tidal registrations, due either to the band sticking, the pencil failing to mark or the driving clock stopping, otherwise the gauge has worked satisfactorily.

7. ***Karáchi.***—This observatory was inspected by Mr. C. F. Erskine in January 1909. All the instruments were cleaned and left in perfect adjustment. The tide-gauge was found in good working order but in need of cleaning. The bed-plate of the tide-gauge had settled 0·04 of a foot owing to the settlement of the new observatory. No break has occurred in the tidal registrations during the past year.

8. ***Apollo Bandar (Bombay).***—This observatory was inspected by Mr. Erskine in January 1909. The tide-gauge was cleaned and left in adjustment.

There have been no interruptions in the tidal registrations during the past year.

9. *Prince's Dock* (*Bombay*).—This observatory was inspected by Mr. Erskine in January 1909. The gauge was found to be working satisfactorily. During the past year there have been a few interruptions in the tidal registrations, due either to the driving clock stopping, or to the breaking of the hair spring which supports the pencil weight.

10. *Madras.*—This observatory was inspected by Mr. Shaw in December 1908. The tide-gauge was found to be working well but in need of cleaning. No breaks in the tidal registrations have occurred during the past year.

11. *Kidderpore.*—This observatory was inspected by Mr. Erskine in November and December 1908. The tide-gauge was found clean and in good working order, it was thoroughly overhauled and has been left in adjustment. The registrations of the tide-gauge are complete, there having been no interruptions during the past year.

12. *Rangoon.*—This observatory was inspected by Mr. Erskine in November 1908. During the past year the tide-gauge has worked well; there have been no interruptions in the registrations. The tide-gauge was cleaned and left in adjustment.

13. *Moulmein.*—This is a new observatory erected by the Public Works Department on a site close to the old one dismantled in 1886. The tide-gauge was installed and started by Mr. Erskine assisted by Mr. Shaw on January 1st, 1909, since which date, with the exception of a few unimportant breaks in its registrations due to the driving clock stopping, it has worked well during the year.

14. *Port Blair.*—This observatory was inspected by Mr. Erskine in December 1908. No interruptions in the tidal registrations have occurred during the past year. The tide-gauge was thoroughly cleaned at the time of inspection and left in good working order.

15. *New observatory opened.*—After a lapse of close on 23 years, a new observatory was erected at Moulmein by the Public Works Department, near the site of the old observatory erected in 1880 and closed in 1886 after six years' observations had been obtained. The principal reason for reopening this observatory was that the Port Officer, Moulmein, considered that personal observations taken to a tide-pole were unreliable. The results derived from the observations which will now be obtained will serve as a check on the accuracy of the predictions and will be of benefit to both science and commerce.

This observatory will be a permanent one. It is situated immediately south of the main wharf, where there is sufficient depth of water at all times for direct communication between the river and the cylinder, and as it is isolated from the wharf, no vibration is felt from vessels mooring at the pontoon which is attached to this wharf. Had there been screw piles under the corners of the verandah in addition to those under the corners of the cabin there is no doubt that the observatory would have been more rigid, and vibration from other causes lessened to a minimum. As at present constructed, the observatory vibrates considerably at certain tide rips, to remedy this the Port Officer has been asked to have the cabin stayed up with wire ropes if this is possible. It is, however, satisfactory to note that notwithstanding this drawback, the tide-gauge has worked very well since it was started on January 1st, 1909.

The cabin is 12 feet square. The iron cylinder is 27 feet 3 inches in length, having in its bottom plate one hole of 2 inches in diameter, and six holes of one inch in diameter. As the water of this river is very muddy, this arrangement will, it is hoped, prevent mud from accumlating in the bottom of the cylinder.

The true zero of the gauge has been set to 24·295 feet below bench-mark G. T. S. □ B. M. 1880 A., the bench-mark of reference, which is cut on a block of Portland cement let into the flooring of the Port Office verandah. This zero is identical with that determined when the gauge was first started in 1880. The gauge is now working on the $\frac{1}{8}$th scale, but at the next inspection will be altered to the $\frac{1}{4}$th scale, that being the scale formerly adopted. Of the two bench-marks "A" and "B" erected in 1880, bench-mark "A" the bench-mark of reference was found intact and in good preservation; bench-mark "B" situated in the verandah of the Telegraph Office (old Post Office) had evidently been disturbed since the closing of the observatory in 1886, as the letter "B" was missing, and the relative values between the two bench-marks differed by 0·027 of a foot from the old values obtained when the observatory was working.

16. *Registrations of Auxiliary Instruments discontinued.*—With the sanction of the Superintendent, Trigonometrical Surveys, and the consent of the Port Officials concerned, all registrations of Mercurial and self-registering Aneroid Barometers, Thermometers and self-registering Anemometers have been discontinued since last inspection at ports where tide-gauges were working, as the Meteorological Department keep such registers at their observatories at such ports. An exception has been made at Karâchi, where at the special request of the Chief Engineer, Karâchi Port Trust, they are still in use. All these meteorological instruments were returned to the Mathematical Instrument Office, Calcutta.

17. *Tidal diagrams and daily reports.*—The tidal diagrams and daily reports have been submitted regularly to the office at Dehra Dûn.

18. *Tidal Constants.*—The tidal observations for a year at 8 stations have been reduced and the tabulated values of the tidal constants thus derived are appended. There are no arrears.

VALUES OF THE TIDAL CONSTANTS, ADEN, 1908.

The following are the amplitudes (R) and epochs (ζ) deduced from the 1908 observations at Aden; and also the *mean* values of the amplitudes (H) and of the epochs (κ) for each particular tide evaluated from the 1908 observations :

Short Period Tides.

A_0 = 5·820 feet.

S_1	H = R =	·108	M_6	R =	·008	Q_1	R =	·176	T_2	R =	·069
S_1	κ = ζ =	177°·08	M_6	ζ =	176°·03	Q_1	ζ =	107°·38	T_2	ζ =	213°·06
S_2	H = R =	·668	M_6	H =	·008	Q_1	H =	·175	T_2	H =	·069
S_2	κ = ζ =	244°·38	M_6	κ =	346°·06	Q_1	κ =	36°·97	T_2	κ =	214°·80
S_4	H = R =	·006	M_8	R =	·003	L_2	R =	·042	$(MS)_4$	R =	·005
S_4	κ = ζ =	288°·14	M_8	ζ =	255°·96	L_2	ζ =	35°·84	$(MS)_4$	ζ =	59°·42
S_6	H = R =	·006	M_8	H =	·003	L_2	H =	·039	$(MS)_4$	H =	·005
S_6	κ = ζ =	225°·00	M_8	κ =	122°·68	L_2	κ =	236°·42	$(MS)_4$	κ =	116°·10
S_8	H = R =	·002	O_1	R =	·661	N_2	R =	·435	$(2SM)_2$	R =	·023
S_8	κ = ζ =	240°·26	O_1	ζ =	156°·85	N_2	ζ =	114°·98	$(2SM)_2$	ζ =	178°·22
			O_1	H =	·656	N_2	H =	·434	$(2SM)_2$	H =	·023
			O_1	κ =	36°·83	N_2	κ =	221°·27	$(2SM)_2$	κ =	121°·54
M_1	R =	·110	K_1	R =	1·323	λ_2	R =	...	$2N_2$	R =	·101
M_1	ζ =	115°·77	K_1	ζ =	214°·01	λ_2	ζ =	...	$2N_2$	ζ =	38°·83
M_1	H =	·074	K_1	H =	1·316	λ_2	H =	...	$2N_2$	H =	·100
M_1	κ =	21°·99	K_1	κ =	34°·75	λ_2	κ =	...	$2N_2$	κ =	194°·74

Short Period Tides—contd.

M_2	R =	1·584	K_2	R =	·176	ν_2	R =	·118	$(M_2N)_4$	R =	·011
	ζ =	170°·20		ζ =	57°·74		ζ =	194°·69		ζ =	90°·22
	H =	1·579		H =	·177		H =	·118		H =	·011
	κ =	226°·88		κ =	239°·15		κ =	260°·56		κ =	253°·19
M_3	R =	·017	P_1	R =	·422	μ_2	R =	·074	$(M_2K_1)_3$	R =	·035
	ζ =	117°·03		ζ =	220°·80		ζ =	74°·86		ζ =	80°·26
	H =	·017		H =	·422		H =	·073		H =	·035
	κ =	202°·05		κ =	31°·18		κ =	188°·21		κ =	317°·69
M_4	R =	·005	J_1	R =	·145	R_2	R =	...	$(2M_2K_1)_3$	R =	·008
	ζ =	171°·70		ζ =	285°·10		ζ =	...		ζ =	80°·88
	H =	·005		H =	·143		H =	...		H =	·008
	κ =	285°·06		κ =	52°·19		κ =	...		κ =	13°·49

Long Period Tides.

	R	ζ	H	κ
Lunar Monthly Tide	·044	88°·50	·044	38°·88
„ Fortnightly „	·046	263°·40	·045	20°·12
Luni-Solar „ „	·016	115°·72	·016	59°·04
Solar-Annual „	·383	68°·06	·383	347°·68
„ Semi-Annual „	·112	280°·75	·112	120°·00

VALUES OF THE TIDAL CONSTANTS, KARÁCHI, 1907-08.

The following are the amplitudes (R) and epochs (ζ) deduced from the 1907-08 observations at Karáchi; and also the ***mean*** values of the amplitudes (H) and of the epochs (κ) for each particular tide evaluated from the 1907-08 observations:—

Short Period Tides.

A_0 = 7·178 feet.

S_1	H = R =	·065	M_6	R =	·047	Q_1	R =	·157	T_2	R =	·073
	κ = ζ =	197°·49		ζ =	299°·61		ζ =	280°·43		ζ =	5°·02
S_2	H = R =	·962		H =	·046		H =	·158		H =	·073
	κ = ζ =	324°·21		κ =	205°·73		κ =	47°·04		κ =	85·66
S_4	H = R =	·012	M_8	R =	·006	L_2	R =	·125	$(MS)_4$	R =	·044
	κ = ζ =	3°·26		ζ =	124°·00		ζ =	272°·04		ζ =	92°·07
S_6	H = R =	·005		H =	·006		H =	·111		H =	·043
	κ = ζ =	293°·20		κ =	238°·82		κ =	295°·98		κ =	300°·77
S_8	H = R =	·000	O_1	R =	·663	N_2	R =	·630	$(2SM)_2$	R =	·009
	κ = ζ =	45°·00		ζ =	295°·89		ζ =	56°·48		ζ =	330°·64
				H =	·667		H =	·626		H =	·009
				κ =	46°·89		κ =	280°·79		κ =	121°·94
M_1	R =	·071	K_1	R =	1·316	λ_2	R =	...	$2N_2$	R =	·120
	ζ =	225°·23		ζ =	304°·69		ζ =	...		ζ =	2°·32
	H =	·055		H =	1·320		H =	...		H =	·119
	κ =	18°·14		κ =	46°·50		κ =	...		κ =	242°·25
M_2	R =	2·635	K_2	R =	·282	ν_2	R =	·200	$(M_2N)_4$	R =	·026
	ζ =	86°·01		ζ =	293°·02		ζ =	216°·46		ζ =	286°·46
	H =	3·619		H =	·290		H =	·199		H =	·026
	κ =	294°·72		κ =	316°·66		κ =	260°·37		κ =	359°·48
M_3	R =	·035	P_1	R =	·379	μ_2	R =	·079	$(M_2K_1)_3$	R =	·048
	ζ =	189°·87		ζ =	158°·02		ζ =	216°·58		ζ =	49°·16
	H =	·035		H =	·379		H =	·078		H =	·048
	κ =	322°·93		κ =	47°·31		κ =	273°·99		κ =	359°·68
M_4	R =	·027	J_1	R =	·125	R_2	R =	...	$(2M_2K_1)_3$	R =	·024
	ζ =	286°·25		ζ =	347°·02		ζ =	...		ζ =	81°·80
	H =	·027		H =	·124		H =	...		H =	·024
	κ =	343°·66		κ =	69°·11		κ =	...		κ =	37°·40

Long Period Tides.

	R	ζ	H	κ
Lunar Monthly Tide	·041	32°·20	·040	16°·59
„ Fortnightly „	·035	146°·46	·036	313°·16
Luni-Solar „ „	·022	6°·49	·022	157°·78
Solar-Annual „	·107	224°·33	·107	65°·05
„ Semi-Annual „	·154	111°·02	·154	152°·45

. VALUES OF THE TIDAL CONSTANTS, BOMBAY (APOLLO BANDAR), 1908.

The following are the amplitudes (R) and epochs (ζ) deduced from the 1908 observations at Bombay (Apollo Bandar); and also the *mean* values of the amplitudes (H) and of the epochs (κ) for each particular tide evaluated from the 1908 observations:—

Short Period Tides.

A_0 = 10·142 feet.

S_1	H = R =	·078
	κ = ζ =	197°·49
S_2	H = R =	1·560
	κ = ζ =	3°·55
S_4	H = R =	·015
	κ = ζ =	200°·42
S_6	H = R =	·003
	κ = ζ =	288°·44
S_8	H = R =	·001
	κ = ζ =	14°·04
M_1	R =	·108
	ζ =	139°·54
	H =	·073
	κ =	46°·69
M_2	R =	4·030
	ζ =	271°·80
	H =	4·017
	κ =	330°·36
M_3	R =	·062
	ζ =	295°·16
	H =	·062
	κ =	23°·01
M_4	R =	·102
	ζ =	200°·18
	H =	·102
	κ =	317°·31
M_6	R =	·019
	ζ =	200°·16
	H =	·019
	κ =	15°·85
M_8	R =	008
	ζ =	145°·31
	H =	·008
	κ =	19°·56
O_1	R =	·664
	ζ =	166°·88
	H =	·659
	κ =	48°·82
K_1	R =	1·399
	ζ =	224°·55
	H =	1·392
	κ =	45°·22
K_2	R =	·385
	ζ =	172°·69
	H =	·388
	κ =	353°·95
P_1	R =	·411
	ζ =	233°·03
	H =	·411
	κ =	43°·48
J_1	R =	·151
	ζ =	299°·55
	H =	·148
	κ =	65°·55
Q_1	R =	·174
	ζ =	123°·87
	H =	·172
	κ =	56°·43
L_2	R =	·075
	ζ =	90°·08
	H =	·071
	κ =	291°·53
N_2	R =	·955
	ζ =	205°·31
	H =	·952
	κ =	314°·50
λ_2	R =	...
	ζ =	...
	H =	...
	κ =	...
ν_2	R =	·252
	ζ =	282°·30
	H =	·251
	κ =	350°·94
μ_2	R =	·218
	ζ =	186°·48
	H =	·216
	κ =	303°·61
R_2	R =	...
	ζ =	...
	H =	...
	κ =	...
T_2	R =	·163
	ζ =	331°·14
	H =	·163
	κ =	332°·96
$(MS)_4$	R =	·099
	ζ =	340°·28
	H =	·099
	κ =	38°·85
$(2SM)_2$	R =	·043
	ζ =	187°·88
	H =	·043
	κ =	129°·32
$2N_2$	R =	·214
	ζ =	118°·37
	H =	·213
	κ =	278°·19
$(M_2N)_4$	R =	·022
	ζ =	149°·74
	H =	·022
	κ =	317°·50
$(M_2K_1)_3$	R =	·047
	ζ =	190°·67
	H =	·046
	κ =	69°·90
$(2M_2K_1)_3$	R =	·063
	ζ =	149°·58
	H =	·062
	κ =	86°·04

Long Period Tides.

	R	ζ	H	κ
Lunar Monthly Tide	·041	9°·05	·041	318°·43
„ Fortnightly „	·013	197°·03	·013	311°·71
Luni-Solar „ „	·014	131°·94	·014	73°·38
Solar-Annual „	·103	58°·17	·103	337°·72
„ Semi-Annual „	·127	26°·70	·127	225°·80

Values of the Tidal Constants, Bombay (Prince's Dock), 1908.

The following are the amplitudes (R) and epochs (ζ) deduced from the 1908 observations at Bombay (Prince's Dock); and also the *mean* values of the amplitudes (H) and of the epochs (κ) for each particular tide evaluated from the 1908 observations:—

Short Period Tides.

A_0 = 8·115 feet.

S_1	H = R =	·089	M_6	R =	·016	Q_1	R =	·176	T_2	R =	·161
	κ = ζ =	197°·72		ζ =	31°·10		ζ =	122°·52		ζ =	337°·69
S_2	H = R =	1·609		H =	·016		H =	·175		H =	·161
	κ = ζ =	4°·86		κ =	206°·79		κ =	55°·09		κ =	339°·50
S_4	H = R =	·019	M_8	R =	·006	L_2	R =	·102	$(MS)_4$	R =	·113
	κ = ζ =	212°·33		ζ =	252°·65		ζ =	100°·51		ζ =	346°·38
S_6	H = R =	·001		H =	·006		H =	·096		H =	·112
	κ = ζ =	169°·70		κ =	126°·90		κ =	301°·96		κ =	44°·94
S_8	H = R =	·001	O_1	R =	·665	N_2	R =	·992	$(2SM)_2$	R =	·040
	κ = ζ =	105°·26		ζ =	166°·58		ζ =	207°·35		ζ =	178°·11
				H =	·660		H =	·989		H =	·040
				κ =	48°·52		κ =	316°·54		κ =	119°·54
M_1	R =	·110	K_1	R =	1·408	λ_2	R =	...	$2N_2$	R =	·233
	ζ =	138°·32		ζ =	224°·69		ζ =	...		ζ =	120°·30
	H =	·074		H =	1·401		H =	...		H =	·232
	κ =	45°·48		κ =	45°·36		κ =	...		κ =	280°·11
M_2	R =	4·121	K_2	R =	·379	ν_2	R =	·234	$(M_2N)_4$	R =	·019
	ζ =	272°·97		ζ =	176°·39		ζ =	283°·93		ζ =	183°·50
	H =	4·107		H =	·382		H =	·233		H =	·019
	κ =	331°·53		κ =	357°·65		κ =	352°·56		κ =	351°·25
M_3	R =	·066	P_1	R =	·411	μ_2	R =	·220	$(M_2K_1)_3$	R =	·053
	ζ =	298°·04		ζ =	233°·33		ζ =	186°·51		ζ =	203°·53
	H =	·066		H =	·411		H =	·219		H =	·053
	κ =	25°·88		κ =	43°·78		κ =	303°·64		κ =	82°·77
M_4	R =	·100	J_1	R =	·150	R_2	R =	...	$(2M_2K_1)_3$	R =	·072
	ζ =	214°·87		ζ =	300°·83		ζ =	...		ζ =	161°·54
	H =	·099		H =	·148		H =	...		H =	·071
	κ =	332°·00		κ =	66°·83		κ =	...		κ =	98°·00

Long Period Tides.

	R	ζ	H	κ
Lunar Monthly Tide	·048	19°·43	·048	328°·81
„ Fortnightly „	·019	211°·06	·019	325·75
Luni-Solar „ „	·030	107°·39	·030	48·63
Solar-Annual „	·116	58°·83	·116	338·38
„ Semi-Annual „	·135	18°·58	·135	217·68

Values of the Tidal Constants, Madras, 1908.

The following are the amplitudes (R) and epochs (ζ) deduced from the 1908 observations at Madras; and also the *mean* values of the amplitudes (H) and of the epochs (κ) for each particular tide evaluated from the 1908 observations:—

Short Period Tides.

A_0 = 2·144 feet.

S_1	H = R =	·027	M_6	R =	·005	Q_1	R =	·001	T_2	R =	·049
	κ = ζ =	97°·02		ζ =	284°·04		ζ =	172°·88		ζ =	220°·11
S_2	H = R =	·457		H =	·005		H =	·001		H =	·049
	κ = ζ =	267°·74		κ =	101°·23		κ =	106°·23		κ =	221°·94
S_4	H = R =	·003	M_8	R =	·001	L_2	R =	·023	$(MS)_4$	R =	·002
	κ = ζ =	205°·20		ζ =	201°·80		ζ =	69°·20		ζ =	102°·53
S_6	H = R =	·001		H =	·001		H =	·021		H =	·002
	κ = ζ =	135°·00		κ =	78°·07		κ =	270°·88		κ =	161°·60

Short Period Tides—contd.

S_8	H = R =	·001	O_1	R =	·099	N_2	R =	·251	$(2SM)_2$	R =	·019
	κ = ζ =	243°·44		ζ =	81°·56		ζ =	124°·18		ζ =	269°·06
				H =	·098		H =	·251		H =	·018
				κ =	324°·02		κ =	234°·14		κ =	210°·00
M_1	R =	·019	K_1	R =	·297	λ_2	R =	...	$2N_2$	R =	·051
	ζ =	116°·83		ζ =	155°·45		ζ =	...		ζ =	60°·05
	H =	·013		H =	·295		H =	...		H =	·051
	κ =	24°·24		κ =	336°·10		κ =	...		κ =	220°·90
M_2	R =	1·100	K_2	R =	·116	ν_2	R =	·074	$(M_2N)_4$	R =	·004
	ζ =	180°·04		ζ =	84°·50		ζ =	200°·65		ζ =	40°·16
	H =	1·097		H =	·117		H =	·074		H =	·004
	κ =	239°·11		κ =	265°·72		κ =	270°·01		κ =	209°·18
M_3	R =	·003	P_1	R =	·100	μ_2	R =	·036	$(M_2K_1)_3$	R =	·016
	ζ =	295°·71		ζ =	169°·86		ζ =	62°·07		ζ =	78°·19
	H =	·003		H =	·100		H =	·036		H =	·016
	κ =	24°·31		κ =	340°·33		κ =	180°·20		κ =	317°·90
M_4	R =	·007	J_1	R =	·026	R_2	R =	...	$(2M_2K_1)_3$	R =	·002
	ζ =	61°·88		ζ =	202°·65		ζ =	...		ζ =	296°·57
	H =	·007		H =	·026		H =	...		H =	·002
	κ =	180°·01		κ =	328°·36		κ =	...		κ =	234°·05

Long Period Tides.

	R	ζ	H	κ
Lunar Monthly Tide	·059	42°·93	·058	352°·04
„ Fortnightly „	·048	246°·95	·047	1°·09
Luni-Solar „ „	·023	34°·88	·023	335°·82
Solar-Annual „	·339	291°·90	·339	211°·43
„ Semi-Annual „	·238	260°·53	·238	99°·59

VALUES OF THE TIDAL CONSTANTS, KIDDERPORE, 1908.

The following are the amplitudes (R) and epochs (ζ) deduced from the 1908 observations at Kidderpore; and also the *mean* values of the amplitudes (H) and of the epochs (κ) for each particular tide evaluated from the 1908 observations :—

Short Period Tides.

A_0 = 10·397 feet.

S_1	H = R =	·104	M_6	R =	·172	Q_1	R =	·036	T_2	R =	·053
	κ = ζ =	199°·76		ζ =	137°·27		ζ =	65°·99		ζ =	114°·12
S_2	H = R =	1·572		H =	·171		H =	·036		H =	·053
	κ = ζ =	95°·40		κ =	316°·11		κ =	0°·21		κ =	115°·97
S_4	H = R =	·098	M_8	R =	·090	L_2	R =	·140	$(MS)_4$	R =	·700
	κ = ζ =	101°·38		ζ =	43°·48		ζ =	229°·26		ζ =	10°·66
S_6	H = R =	·005		H =	·089		H =	·132		H =	·698
	κ = ζ =	2°·29		κ =	281°·93		κ =	71°·20		κ =	70°·27
S_8	H = R =	·003	O_1	R =	·224	N_2	R =	·670	$(2SM)_2$	R =	·076
	κ = ζ =	357°·88		ζ =	141°·75		ζ =	290°·08		ζ =	57°·54
				H =	·222		H =	·668		H =	·076
				κ =	24°·78		κ =	40°·88		κ =	357°·92
M_1	R =	·025	K_1	R =	·422	λ_2	R =	...	$2N_2$	R =	·197
	ζ =	214°·08		ζ =	231°·98		ζ =	...		ζ =	247°·60
	H =	·017		H =	·420		H =	...		H =	·196
	κ =	121°·75		κ =	52°·60		κ =	...		κ =	49°·59
M_2	R =	3·823	K_2	R =	·446	ν_2	R =	·233	$(M_2N)_4$	R =	·313
	ζ =	355°·17		ζ =	264°·94		ζ =	332°·62		ζ =	207°·46
	H =	3·810		H =	·450		H =	·232		H =	·310
	κ =	54°·78		κ =	86°·12		κ =	42°·79		κ =	17°·87

Short Period Tides—contd.

Tide			Tide			Tide			Tide		
M_3	R =	·022	P_1	R =	·154	μ_2	R =	·250	$(M_2K_1)_3$	R =	·130
	ζ =	219°·97		ζ =	234°·87		ζ =	57°·20		ζ =	164°·06
	H =	·022		H =	·154		H =	·249		H =	·129
	κ =	309°·39		κ =	45°·37		κ =	176°·51		κ =	44°·30
M_4	R =	·786	J_1	R =	·027	R_2	R =	...	$(2M_2K_1)_3$	R =	·040
	ζ =	271°·57		ζ =	281°·10		ζ =	...		ζ =	22°·46
	H =	·781		H =	·026		H =	...		H =	·039
	κ =	30°·80		κ =	46°·49		κ =	...		κ =	321°·06

Long Period Tides.

	R	ζ	H	κ
Lunar Monthly Tide . .	·396	67°·56	·392	16°·37
„ Fortnightly „	·258	275°·72	·255	29°·27
Luni Solar „ „	·903	96°·16	·900	36°·54
Solar-Annual „	2·440	225°·69	2·440	145°·19
„ Semi-Annual „	·834	125°·34	·834	324°·35

Values of the Tidal Constants, Rangoon, 1908.

The following are the amplitudes (R) and epochs (ζ) deduced from the 1908 observations at Rangoon; and also the *mean* values of the amplitudes (H) and of the epochs (κ) for each particular tide evaluated from the 1908 observations :—

Short Period Tides.

A_0 = 10·130 feet.

Tide			Tide			Tide			Tide		
S_1	H = R =	·127	M_6	R =	·270	Q_1	R =	·029	T_2	R =	·260
	κ = ζ =	134°·52		ζ =	267°·76		ζ =	77°·56		ζ =	120°·12
S_2	H = R =	2·136		H =	·267		H =	·029		H =	·260
	κ = ζ =	168°·51		κ =	88°·19		κ =	12°·61		κ =	122°·00
S_4	H = R =	·082	M_8	R =	·096	L_2	R =	·333	$(MS)_4$	R =	·448
	κ = ζ =	267°·84		ζ =	230°·59		ζ =	328°·07		ζ =	153°·67
S_6	H = R =	·008		H =	·094		H =	·314		H =	·447
	κ = ζ =	45°·48		κ =	111°·17		κ =	170°·85		κ =	213°·81
S_8	H = R =	·002	O_1	R =	·281	N_2	R =	1·041	$(2SM)_2$	R =	·161
	κ = ζ =	99°·46		ζ =	146°·96		ζ =	2°·71		ζ =	108°·00
				H =	·279		H =	1·037		H =	·160
				κ =	30°·55		κ =	114°·32		κ =	47°·86
M_1	R =	·037	K_1	R =	·678	λ_2	R =	...	$2N_2$	R =	·273
	ζ =	266°·26		ζ =	213°·91		ζ =	...		ζ =	341°·32
	H =	·025		H =	·674		H =	...		H =	·272
	κ =	174°·20		κ =	34°·52		κ =	...		κ =	144°·41
M_2	R =	5·922	K_2	R =	·596	ν_2	R =	·354	$(M_2N)_4$	R =	·187
	ζ =	70°·86		ζ =	349°·88		ζ =	69°·29		ζ =	345°·80
	H =	5·903		H =	·601		H =	·353		H =	·186
	κ =	131°·00		κ =	171°·01		κ =	140°·24		κ =	157°·56
M_3	R =	·013	P_1	R =	·193	μ_2	R =	·534	$(M_2K_1)_3$	R =	·116
	ζ =	66°·27		ζ =	243°·05		ζ =	170°·74		ζ =	215°·17
	H =	·013		H =	·193		H =	·530		H =	·115
	κ =	156°·48		κ =	53°·56		κ =	291°·02		κ =	95°·92
M_4	R =	·466	J_1	R =	·073	R_2	R =	...	$(2M_2K_1)_3$	R =	·115
	ζ =	45°·83		ζ =	300°·84		ζ =	...		ζ =	106°·80
	H =	·463		H =	·072		H =	...		H =	·114
	κ =	166°·12		κ =	65°·93		κ =	...		κ =	46°·48

Long Period Tides.

	R	ζ	H	κ
Lunar Monthly Tide	·167	60°·28	·165	8°·81
„ Fortnightly „	·116	272°·19	·115	25°·17
Luni-Sola. „ „	·420	105°·78	·419	45°·63
Solar-Annual „	1·095	226°·03	1·095	145°·51
„ Semi-Annual „	·132	181°·38	·132	20°·35

Values of the Tidal Constants, Port Blair, 1908.

The following are the amplitudes (R) and epochs (ζ) deduced from the 1908 observations at Port Blair; and also the *mean* values of the amplitudes (H) and of the epochs (κ) for each particular tide evaluated from the 1908 observations :—

Short Period Tides.

A_0 = 4·709 feet.

Tide		Value
S_1	H = R =	·015
	κ = ζ =	100°·93
S_2	H = R =	·955
	κ = ζ =	312°·24
S_4	H = R =	·007
	κ = ζ =	266°·48
S_6	H = R =	·003
	κ = ζ =	294°·91
S_8	H = R =	·004
	κ = ζ =	142°·52
M_1	R =	·016
	ζ =	91°·82
	H =	·011
	κ =	359°·65
M_2	R =	2·006
	ζ =	218°·82
	H =	2·000
	κ =	278°·73
M_3	R =	·006
	ζ =	283°·07
	H =	·006
	κ =	12°·94
M_4	R =	·007
	ζ =	22°·48
	H =	·007
	κ =	142°·30

Tide		Value
M_6	R =	·002
	ζ =	156°·04
	H =	·002
	κ =	335°·77
M_8	R =	·002
	ζ =	213°·69
	H =	·002
	κ =	93°·34
O_1	R =	·155
	ζ =	59°·28
	H =	·154
	κ =	302°·63
K_1	R =	·401
	ζ =	146°·27
	H =	·399
	κ =	326°·88
K_2	R =	·246
	ζ =	123°·23
	H =	·248
	κ =	304°·38
P_1	R =	·134
	ζ =	154°·72
	H =	·134
	κ =	325°·23
J_1	R =	·039
	ζ =	194°·32
	H =	·039
	κ =	319°·54

Tide		Value
Q_1	R =	·019
	ζ =	314°·79
	H =	·019
	κ =	249°·48
L_2	R =	·058
	ζ =	89°·10
	H =	·055
	κ =	291°·18
N_2	R =	·392
	ζ =	161°·65
	H =	·391
	κ =	272°·91
λ_2	R =	...
	ζ =	...
	H =	...
	κ =	...
ν_2	R =	·097
	ζ =	234°·10
	H =	·097
	κ =	304°·71
μ_2	R =	·076
	ζ =	173°·49
	H =	·075
	κ =	293°·32
R_2	R =	...
	ζ =	...
	H =	...
	κ =	...

Tide		Value
T_2	R =	·092
	ζ =	270°·82
	H =	·092
	κ =	272°·69
$(MS)_4$	R =	·016
	ζ =	177°·75
	H =	·016
	κ =	237°·67
$(2SM)_2$	R =	·022
	ζ =	216°·30
	H =	·022
	κ =	156°·38
$2N_2$	R =	·099
	ζ =	92°·46
	H =	·099
	κ =	255°·07
$(M_2N)_4$	R =	·004
	ζ =	198°·89
	H =	·004
	κ =	10°·06
$(M_2K_1)_3$	R =	·027
	ζ =	101°·61
	H =	·026
	κ =	342°·14
$(2M_2K_1)_3$	R =	·011
	ζ =	253°·52
	H =	·010
	κ =	192°·72

Long Period Tides.

	R	ζ	H	κ
Lunar Monthly Tide	·019	53°·38	·019	2°·03
„ Fortnightly „ . . .	·052	235°·27	·051	348°·50
Luni-Solar „ „	·003	236°·68	·003	176°·77
Solar-Annual „	·110	219°·21	·110	138°·71
„ Semi-Annual „	·099	329°·98	·099	168°·97

19. *Other Computations.*—The actual times and heights of high and low water for 1908 at 12 ports have been compared with the predicted values published in the tide-tables and the results tabulated.

20. *Auxiliary Reports.*—Reports on the operations carried on in the Bombay Presidency and in Burma were prepared and submitted, the former to the Government of Bombay, and the latter to the Principal Port Officer in Burma, Rangoon.

21. *Receipt and issue of tide-tables.*—The tide-tables for 1909 and 1910 were received in the office and were duly distributed.

22. *Datum of tide-tables.*—The datum for the tide-tables is the datum of soundings in the most recent Admiralty Charts, with the exception of Bassein, the datum for which port is "Indian spring low water mark" which has not been connected with the Admiralty datum.

23. *Sale of tide-tables.*—The amount realised on the sale of tide-tables during the financial year ending 30th September 1909 is R2,578-12-0.

24. *Data forwarded to England.*—The following data were supplied to the Tidal Assistant, National Physical Laboratory, Teddington, England :—

(i) Actual values during 1907 of every high and low water measured in duplicate from the tidal diagrams at 8 stations, and of tide-pole observations taken during daylight at 4 closed stations, the latter under the supervision of the Port Officers, and supplied by them to this office.

(ii) Comparisons of the above with predicted values for 1907, the errors being tabulated in such form as to be of aid in improving the predictions.

25. *Errors in Predictions.*—The 5 tabular statements which are appended show the percentage and amount of errors in the predicted times and heights of high and low water for the year 1908 at 12 stations, as determined by comparisons of the predictions given in the tide-tables with actual values measured from the tidal diagrams at 8 stations, and from tide-poles at 4 stations, the former are made in this office, and the latter by the Port Officials.

No. 1.

Statement showing the percentage and the amount of the errors in the predicted times of high waters at the various Tidal Stations for the year 1908.

Stations.	Automatic or Tide-pole observations.	Number of comparisons between actual and predicted values.	Errors of 5 minutes and under.	Errors over 5 minutes and under 15 minutes.	Errors over 15 minutes and under 20 minutes.	Errors over 20 minutes and under 30 minutes.	Errors over 30 minutes.
			Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Aden	Auto.	689	44	42	6	6	2
Karáchi	Auto.	707	34	46	12	6	2
Bhávnagar	T. P.	366	52	48	0	0	0
Bombay { Apollo Bandar	Auto.	707	42	43	6	7	2
Bombay { Prince's Dock	Auto.	703	39	45	8	6	2
Madras	Auto.	706	39	45	9	7	0
Kidderpore	Auto.	707	16	28	15	25	16
Chittagong	T. P.	366	28	36	13	11	12
Akyab	T. P.	331	96	3	1	0	0
Rangoon	Auto.	707	29	42	13	13	3
Moulmein	T. P.	394	24	44	12	13	7
Port Blair	Auto.	704	49	38	6	5	2

No. 2.

Statement showing the percentage and the amount of the errors in the predicted times of low water at the various Tidal Stations for the year 1908.

Stations.	Automatic or Tide-pole observations.	Number of comparisons between actual and predicted values.	Errors of 5 minutes and under.	Errors over 5 minutes and under 15 minutes.	Errors over 15 minutes and under 20 minutes.	Errors over 20 minutes and under 30 minutes.	Errors over 30 minutes.
			Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Aden	Auto.	684	34	46	9	7	4
Karáchi	Auto.	707	37	41	10	9	3
Bhávnagar . . .	T. P.	366	53	47	0	0	0
Bombay { Apollo Bandar .	Auto.	707	42	47	5	4	2
Bombay { Prince's Dock .	Auto.	703	36	44	9	8	3
Madras . . .	Auto.	706	43	45	7	4	1
Kidderpore . . .	Auto.	706	14	27	14	20	25
Chittagong . . .	T. P.	366	25	32	10	16	17
Akyab	T. P.	331	97	3	0	0	0
Rangoon . . .	Auto.	706	28	34	14	13	11
Moulmein . . .	T. P.	395	24	38	9	18	11
Port Blair . . .	Auto.	706	43	45	7	4	1

No. 3.

Statement showing the percentage and the amount of the errors in the predicted heights of high water at the various Tidal Stations for the year 1908.

Stations.	Automatic or Tide-pole observations.	Number of comparisons between actual and predicted values.	Mean range at springs in feet.	Errors of 4 inches and under.	Errors over 4 inches and under 8 inches.	Errors over 8 inches and under 12 inches.	Errors over 12 inches.
				Per cent.	Per cent.	Per cent.	Per cent.
Aden	Auto.	689	6·7	95	5	0	0
Karáchi . . .	Auto.	707	9·3	81	18	1	0
Bhávnagar . . .	T. P.	366	31·4	57	32	9	2
Bombay { Apollo Bandar .	Auto.	707	13·9	73	22	5	0
Bombay { Prince's Dock .	Auto.	703	13·9	74	22	4	0
Madras . . .	Auto.	706	3·5	94	5	1	0
Kidderpore . . .	Auto.	707	11·7	47	27	14	12
Chittagong . . .	T. P.	366	13·3	46	27	16	11
Akyab	T. P.	331	8·3	81	18	0	1
Rangoon . . .	Auto.	707	16·4	50	29	17	4
Moulmein . . .	T. P.	394	12·7	30	24	22	24
Port Blair . . .	Auto.	704	6·6	99	1	0	0

No. 4.

Statement showing the percentage and the amount of the errors in the predicted heights of low water at the various Tidal Stations for the year 1908.

Stations.	Automatic or Tide-pole observations.	Number of comparisons between actual and predicted values.	Mean range at springs in feet.	Errors of 4 inches and under.	Errors over 4 inches and under 8 inches.	Errors over 8 inches and under 12 inches.	Errors over 12 inches.
				Per cent.	Per cent.	Per cent.	Per cent.
Aden	Auto.	684	6·7	95	5	0	0
Karáchi	Auto.	707	9·3	77	21	2	0
Bhávnagar	T. P.	366	31·4	61	28	9	2
Bombay { Apollo Bandar	Auto.	707	13·9	69	26	5	0
Bombay { Prince's Dock	Auto.	703	13·9	63	26	9	2
Madras	Auto.	706	3·5	93	7	0	0
Kidderpore	Auto.	706	11·7	44	25	14	17
Chittagong	T. P.	366	13·3	48	22	15	15
Akyab	T. P.	331	8·3	78	20	2	0
Rangoon	Auto.	706	16·4	28	23	21	28
Moulmein	T. P.	395	12·7	32	22	20	26
Port Blair	Auto.	706	6·6	98	2	0	0

No. 5.

Tables of average errors in the predicted times and heights of high and low water at the several Tidal Stations for the year 1908.

Stations.	Automatic or Tide-pole observations.	Mean range at springs in feet.	Average Errors. Of Time in Minutes.		Of Height in terms of the range.		Of Height in inches.	
			H. W.	L. W.	H. W.	L. W.	H. W.	L. W.
Open Coast.								
Aden	Auto.	6·7	9	10	·025	·025	2	2
Karáchi	Auto.	9·3	10	10	·027	·027	3	3
Bhávnagar	T. P.	31·4	6	6	·013	·013	5	5
Bombay { Apollo Bandar	Auto.	13·9	9	8	·018	·018	3	3
Bombay { Prince's Dock	Auto.	13·9	9	10	·018	·024	3	4
Madras	Auto.	3·5	9	8	·048	·048	2	2
Akyab	T. P.	8·3	1	1	·030	·030	3	3
Port Blair	Auto.	6·6	8	8	·013	·013	1	1
General Mean			8	8	·024	·025	...	...
Riverain.								
Kidderpore	Auto.	11·7	18	22	·043	·050	6	7
Chittagong	T. P.	13·3	14	17	·038	·038	6	6
Rangoon	Auto.	16·4	12	14	·025	·046	5	9
Moulmein	T. P.	12·7	13	15	·059	·059	9	9
General Mean			14	17	·041	·048	...	...

The foregoing statement for the year 1908 may be thus summarised :—

Percentage of time predictions within 15 minutes of actuals.

		High water per cent.	Low water per cent.
Open Coast Stations.	6 at which predictions were tested by S. R. Tide-gauge .	84	84
	2 „ „ „ Tide-pole . .	100	100
Riverain Stations.	2 „ „ „ S. R. Tide-gauge .	58	52
	2 „ „ „ Tide-pole . .	66	60

Percentage of height predictions within 8 inches of actuals.

		High water per cent.	Low water per cent.
Open Coast Stations.	6 at which predictions were tested by S. R. Tide-gauge .	98	97
	2 „ „ „ Tide-pole . .	94	94
Riverain Stations.	2 „ „ „ S. R. Tide-gauge .	77	60
	2 „ „ „ Tide-pole . .	64	62

Percentage of height predictions within one-tenth of mean range at springs.

		High water per cent.	Low water per cent.
Open Coast Stations.	6 at which predictions were tested by S. R. Tide-gauge .	99	99
	2 „ „ „ Tide-pole . .	100	100
Riverain Stations.	2 „ „ „ S. R. Tide-gauge .	97	92
	2 „ „ „ Tide-pole . .	92	89

26. *Comparisons of the predictions at Riverain Stations.*—The predictions for the riverain stations for the year 1908, were compared with those for the year before, with the following results :—

At Kidderpore they are about the same for high water times, but better for low water times. For the high and low water heights they are better. At Chittagong they are about the same for high and low water times and for the low water heights, and better for the high water heights. At Rangoon they are better for the high water and low water times, and practically the same for the high and low water heights. At Moulmein they are worse for the high and low water times, they are better for the high water heights, but worse for the low water heights.

At Kidderpore the greatest difference between the actual and predicted heights of low water for 1908 was 2 feet 5 inches on 24th June, the actual being higher than the predicted. At Chittagong it was 3 feet, on 8th July, the actual being higher. At Rangoon it was 2 feet 2 inches on 29th October, the actual being lower. At Moulmein it was 2 feet 1 inch on 10th and 14th July and 23rd September, the actuals in each case being lower.

LEVELLING OPERATIONS.

27. *Strength of Levelling sections.*—During the past year three detachments were engaged on spirit-levelling operations.

The strength of the levelling detachments in the field was as detailed below :—

No. 1 detachment.—Three levellers : Mr. E. H. Corridon, 1st leveller; Mr. O. N. Pushong, 2nd leveller; Mr. H. St. J. Kenny, under training; 3 recorders.

No. 2 detachment.—Three levellers; Mr. Syed Zille Hasnain, 1st leveller; Mr. D. H. Luxa, 2nd leveller; Mr. T. F. Kitchen, under training; 3 recorders.

No. 3 detachment.—Two levellers: Mr. A. M. Talati, 1st leveller; Mr. P. N. Sur, 2nd leveller; 3 recorders.

In each case the 1st leveller had charge of the detachment.

28. *Programme for past field season.*—The following programme of work was allotted to the detachments :—

No. 1 detachment—

(i) To connect the standard bench-marks at Sátára, Belgaum, Bangalore, Salem, Trichinopoly, Negapatam, Madura, Tinnevelly, Calicut, Bijápur, and Akola with the adjacent lines of levels.

(ii) To level from Secunderábád *viá* the metre gauge section of H. H. the Nizám's Guaranteed State Railway as far as Dichpali Railway station, thence by road *viá* Nirmal and Edlábád to Warora, connecting the standard bench-marks at Secunderábád, Trimulgherry and Bolárum.

The connection of Náchangaon hill station was subsequently added to this programme at the request of the officer in charge of No. 2 Party (Berár.)

No. 2 detachment—

(i) To continue the main line of levels from Nágaur to Ahmadábád along the Jodhpur-Bíkaner Railway and the Rájputána-Malwa Railway, connecting *en route* the standard bench-marks at Jodhpur and Ahmadábád.

(ii) To run a branch line of levels from Pálanpur to Deesa, connecting the standard bench-mark at Deesa.

On completion of the work at Ahmadábád the detachment was instructed to connect the standard bench-mark at Roorkee, and to carry a line of levels from Hardwár to Dehra Dún.

No. 3 detachment—

(i) To level from Katni along the East Indian Railway line to Jubbulpore and thence along the road *viá* Seoni to Nágpur, connecting the standard bench-marks at Jubbulpore and Nágpur.

(ii) To level from Wardha to Warora along the Great Indian Peninsula Railway line, connecting the standard bench-mark at Hinganghát.

(iii) To connect the standard bench-marks at Saugor, Raipur, Biláspur, and Sambalpur.

Subsequently at the request of the officer in charge of No. 2 Party (Berár) the connection of Keljhar hill station and Esamba hill station of the great trigonometrical survey, and Hinganghát station and Karwa hill station of the minor triangulation was added to the above programme.

29. *Duration of field season and work performed.*

No. 1 detachment.—This detachment left Dehra Dún for Sátára on the 8th October 1908 arriving there on the 16th idem. After preliminary arrangements were completed, work was started on standard bench-mark connections on the 18th October and closed at Bijápur on the 20th December. The detachment then proceeded to Secunderábád, to take up the main part of the programme, work being resumed at that place on 23rd idem, and closed at Warora on the 7th April 1909. The connection of Náchangaon hill station and the Akola standard bench-mark was next taken up in succession, all operations being finally closed at Akola on the 13th April 1909. The detachment then returned to Dehra Dún arriving there on the 15th idem.

30. *No. 2 detachment.*—The detachment left Dehra Dún for the field on the 3rd October 1908 and commenced work at Nágaur on the 11th idem, in continuation of the previous season's operations. Pálanpur was reached on the 31st January 1909; from this place a branch line of levels was run to Deesa to connect the standard bench-mark erected there. Work was resumed on the main line at Pálanpur on the 9th February and closed at Ahmadábád on the 13th March 1909. The detachment then proceeded to Roorkee to connect the standard bench-mark there with the line of levels executed by Lieutenant Morshead, R.E., from Nojli *viâ* Roorkee to Hardwár during the previous season. This work was finished on the 24th March and next day the detachment moved to Hardwár and commenced work from there towards Dehra Dún. The levelling was carried out partly along the railway line and partly along the road and the operations for the season were finally closed at Dehra Dún on the 9th April 1909.

31. *No. 3 detachment.*—The detachment left Dehra Dún on the 14th October 1908 and arrived at Katni on the 18th idem. After making preliminary arrangements for the field work, the detachment proceeded to connect the standard bench-mark at Saugor and on completion of that work returned to Katni and commenced work on the main line, from there *viâ* Jubbulpore to Nágpur which was reached on the 4th March 1909, the standard bench-marks at Jubbulpore and Nágpur having been duly connected in the course of the work. The line Wardha to Warora and the connection of the remaining standard bench-marks, and the trigonometrical survey stations mentioned in the programme were next taken in hand, and the field work was finally closed on the 10th April 1909. The detachment then returned to Dehra Dún reaching there on the 16th April 1909.

32. *Outturn.*—The total outturn of work completed by the three detachments amounted to 1,085 miles of double levelling of precision, in the course of which observations were taken at 13,528 stations, the total rises and falls amounting to 33,584 feet. The bench-marks determined were 25 standard, 90 embedded, 625 inscribed and 34 belonging to other departments. The heights of three principal and eight secondary great trigonometrical survey stations and two topographical survey stations were also determined by levelling, as a check on the heights deduced by triangulation.

During the past field season three important lines of levels which were undertaken principally to break up the larger level circuits have been completed, *viz.*, (1) from Ferozepore across Rájputána to Ahmadábád, (2) from Katni *viâ* Jubbulpore and Seoni to Nágpur, (3) from Wardha *viâ* Warora and Nirmal to Secunderábád.

Tabular statements showing the details of the work performed by each detachment separately are appended.

No. 1 Levelling Detachment.

Tabular statement of outturn of work—season 1908-09.

Section.	Month.	No. of miles double levelling. Main Line. Ms. chs. lks.	No. of miles double levelling. Branch Line. Ms. chs. lks.	No. of miles double levelling. Total. Ms. chs. lks.	Total No. of feet. Rise.	Total No. of feet. Fall.	No. of stations at which instrument was set up.	No. of bench-marks connected. Old. Embedded.	No. of bench-marks connected. Old. Inscribed.	No. of bench-marks connected. Standard.	No. of bench-marks connected. Embedded.	No. of bench-marks connected. Inscribed.	No. of bench-marks connected. G. T. Survey.	No. of bench-marks connected. P. W. D. and other departments.	Remarks.
Connection of Standard Bench-marks at Sátára, Belgaum, Bangalore, Salem, Trichinopoly, Negapatam, Madura, Tinnevelly, Calicut and Bijápur.	October 1908	......	14 73 78	14 73 78	141·242	129·666	249	4	6	3	...	12	...	6	
	November „	......	39 19 94	39 19 94	229·133	310·404	461	4	13	5	...	23	...	1	
	December „	......	19 43 36	19 43 36	87·075	96·655	225	3	5	2	...	6	...	3	
	Total	......	73 57 08	73 57 08	457·450	536·725	935	11	24	10	...	41	...	10	
Secunderábád to Warora	December 1908	8 52 10	5 69 86	14 41 96	347·426	113·336	197	1	6	3	1	12	...	...	
	January 1909	79 20 58	6 77 26	86 17 84	880·509	1,429·021	982	...	...	...	8	57	1	3	
	February „	64 32 70	0 29 08	64 61 78	2,196·085	2,224·181	982	...	...	...	7	31	...	1	
	March „	68 03 80	0 39 68	68 43 48	1,771·693	2,489·004	1,039	...	...	...	6	32	...	6	
	April „	16 30 90	0 26 70	16 57 60	386·086	368·178	222	...	...	...	3	10	...	5	
	Total	236 60 08	14 02 58	250 62 66	5,581·889	6,623·720	3,422	1	6	3	25	142	1	15	
Connection of Náchangaon, h. s. and Standard bench-mark at Akola.	April 1909	......	7 55 84	7 55 84	349·552	44·899	112	2	6	1	...	2	1	...	
	Grand Total	236 60 08	95 35 50	332 15 58	6,388·891	7,205·344	4,469	14	36	14	25	185	2	25	

No. 2 Levelling Detachment.

Tabular statement of outturn of work—season 1908-09.

Section.	Month.	No. of miles double levelling. Main Line. Ms. chs. lks.	Branch Line. Ms. chs. lks.	Total. Ms. chs. lks.	Total No. of feet. Rise.	Fall.	No. of stations at which instrument was set up.	No. of bench-marks connected. Old. Standard.	Old. Embedded.	Old. Inscribed.	Standard.	Embedded.	Inscribed.	G. T. Survey.	P. W. Dept. Irrigation.	Railway.	Remarks.
Nágaur to Ahmadábád	October 1908	42 75 36	0 3 0	42 78 36	360·064	224·897	461	...	1	1	...	4	19	...	...	...	
	November ,,	71 61 40	6 59 56	78 40 96	268·563	761·673	900	...	...	...	1	6	36	1	...	...	
	December ,,	86 69 92	0 32 24	87 22 16	694·212	394·866	826	...	...	...	...	11	54	...	...	...	
	January 1909	101 42 66	1 18 30	102 60 96	853·922	1099·050	975	...	...	...	...	11	84	2	...	...	
	February ,,	53 34 32	21 15 98	74 50 30	232·438	631·225	769	...	...	...	1	7	59	2	...	...	
	March ,,	26 47 56	2 41 88	29 09 44	69·601	173·029	305	...	1	1	1	2	26	...	...	1	
	Total	383 11 22	32 10 96	415 22 18	2478·800	3284·740	4236	...	2	2	3	41	278	5	...	1	
Connection of G. T. S. standard bench-mark at Roorkee.	March 1909	... ...	2 20 78	2 20 78	12·618	8·478	24	...	...	2	1	...	2	...	1	...	
	Total	... ...	2 20 78	2 20 78	12·618	8·478	24	...	...	2	1	...	2	...	1	...	
Hardwár to Dehra Dún	March 1909	11 51 16	0 3 62	11 54 78	458·773	116·645	149	...	...	2	...	...	8	...	...	...	
	April ,,	21 17 34	0 1 32	21 18 66	1075·757	134·124	259	1	...	3	...	...	9	...	...	...	
	Total	32 68 50	0 4 94	32 73 44	1534·530	250·769	408	1	...	5	...	...	17	...	...	...	
	Grand Total	415 79 72	34 36 68	450 36 40	4025·948	3543·9°7	4668	1	2	9	4	41	297	5	1	1	

No. 3 Levelling Detachment.

Tabular statement of outturn of work—season 1908-09.

Section.	Month.	No. of Miles Double Levelling. Main Line. Ms.	chs.	lks.	Branch Line. Ms.	chs.	lks.	Total. Ms.	chs.	lks.	Total No. of Feet. Rise.	Fall.	No. of stations at which instrument was set up.	No. of Bench-Marks Connected. Old. Embedded.	Old. Inscribed.	Standard.	Embedded.	Inscribed.	G. T. Survey.	P. W. Dept.	Remarks.
Connection of standard bench-mark at Saugor.	October 1908	...	...	...	1	43	72*	1	43	72	26·553	0·807	26	...	4	1	...	1	...	...	Ms. chs. lks. *Includes 1 02 50 of check levelling.
	Total	...	...	...	1	43	72	1	43	72	26·553	0·807	26	...	4	1	...	1	...	...	
Katni to Nágpur	October 1908	6	59	50	1	21	14†	8	0	64	109·719	18·779	111	1	8	...	...	2	...	...	†Includes 1 12 70 of check levelling.
	November 1908	40	78	66	2	42	92	43	41	58	224·347	301·932	629	...	...	...	4	26	1	...	
	December 1908	30	12	30	3	21	28	39	33	58	1336·339	843·545	727	...	...	1	3	26	1	3	
	January 1909	70	57	48	0	31	92	71	09	40	2308·244	1982·847	1,018	...	...	...	7	32	...	4	
	February 1909	60	76	40	0	47	32	61	43	72	1120·047	2239·510	866	1	4	...	5	27	...	...	
	March 1909	6	06	24	2	03	14	8	09	38	131·179	84·358	121	1	7	1	1	3	...	...	
	Total	221	50	58	10	07	72	231	58	30	5229·875	5470·971	3,472	3	19	2	20	116	2	7	
Wardha to Warora	March 1909	46	33	52	9	42	40‡	55	75	92	415·343	612·860	685	1	8	1	4	24	3	...	‡Includes 4 31 68 of check levelling.
	Total	46	33	52	9	42	40	55	75	92	415·343	612·860	685	1	8	1	4	24	3	...	
Connection of Keljhar G. T. Survey station and standard bench-marks at Raipur, Biláspur and Sambalpur.	March 1909	...	...	...	1	53	94§	1	53	94	...	...	18	...	4	...	...	...	...	...	§All check levelling.
	April 1909	...	...	...	11	32	06¶	11	32	06	496·806	166·885	190	3	14	3	...	2	1	...	Ms. chs. lks. ¶Includes 0 39 10 of check levelling.
	Total	...	...	...	13	06	0	13	06	0	496·806	166·885	208	3	18	3	...	2	1	...	
	GRAND TOTAL	268	04	10	34	19	84	302	23	94	6168·577	6251·523	4,391	7	49	7	24	143	6	7	

No. 1 Levelling Detachment.

List of great trigonometrical survey stations connected by spirit levelling in season 1908-09.

Name of Station.	Height in feet above Mean Sea Level.		Difference in height by triangulation in feet.	Remarks.
	By spirit levelling.	By triangulation.		
Bora Gattu H. S., Bídar longitudinal series.	2073·222	2080	+6·778	Upper mark-stone.

No. 3 Levelling Detachment.

List of great trigonometrical survey stations connected by spirit levelling in season 1908-09.

Name of Station.	Height in feet above Mean Sea Level.		Difference in height by triangulation in feet.	Remarks.
	By spirit levelling.	By triangulation.		
Lora H. S., of Calcutta longitudinal series.	1929·357	1923	—6·357	Upper mark-stone.
Lapeta H. S., of Jubbulpore meridional series.	1901·240	1895	—6·240	Do. do.

33. *Difference between Levellers (First—Second).*

No. 1 detachment:—

Section Warora to Secunderábád.

at 50th mile	+0·084
„ 100th „	+0·143
„ 150th „	+0·128
„ 200th „	+0·142
„ 237th „	+0·103

No. 2 detachment:—

Section Nágaur to Ahmadábád.

at 50th mile	+0·095
„ 100th „	+0·147
„ 150th „	+0·170
„ 200th „	+0·088
„ 250th „	+0·076
„ 300th „	+0·108
„ 350th „	+0·137
„ 383rd „	+0·195

Section Hardwár to Dehra Dún.

at 33rd mile	+0·023

No. 3 detachment :—

Section Katni to Nágpur.

at 50th mile	—0·026
„ 100th „	—0·137
„ 150th „	—0·124
„ 200th „	—0·105
„ 222nd „	—0·090

Section Wardha to Warora.

at 46th mile	—0·128

34. *Levels and staves used in the field.*— No. 1 detachment used cylindrical levels Nos. 4 and 1 on all the main and principal branch lines, and Cushing's reversible level No. 8522 and Bolton's reversible level No. 82 on branch lines to G. T. Survey stations ; Mr. Corridon worked with the first named level of each pair and Mr. Pushong with the other. Mr. Kenny worked with the first or second levels according as he acted for the first or second leveller. The staves used were Nos. 01, 03, 04 and 05 of the modified Cowie pattern.

No. 2 detachment used American binocular precise levels throughout the season's work :—Mr. Syed Zille Hasnain worked with level No. 2697, and Mr. Luxa with level No. 2626 and Mr. Kitchen with level No. 2698. The staves used by the detachment were single faced, Nos. 16 A, 16 B, 20 A and 20 B, of the Committee's pattern.

No. 3 detachment. The levels used by this detachment on the main lines and most of the branch lines were cylindrical level No 3 by Mr. Talati and cylindrical level No. 2 by Mr. Sur ; on branch lines to G. T. Survey stations the levels used were Dumpy level No 734 by Mr. Talati and Cushing's reversible level No. 8574 by Mr. Sur. The old G. T. pattern staves Nos. B 1, B 2, IIII and 4, were employed throughout the season.

35. *Unit Correction for staves.*—During the progress of the work the staves were compared with portable 10 foot standard steel bars almost every week, with the object of determining the correction for difference in unit of pairs of staves, to be applied to the observed heights in order to obtain the absolute heights.

Tables of these comparisons are appended.

No. 1 Levelling Detachment.

Results of comparison of staves—season 1908-09.

Place and date of comparison.		Number of Staff.				Remarks.
		04	05	01	03	
		Plain faces only.				
Sátára,	17th October 1908.	+·0004974	+·0007038	—·0033994	—·0037744	Cloudy for past 3 days.
Belgaum,	24th „ „ .	—·0000976	+·0000024	—·0041976	—·0048450	Cloudy. Rain 4 days ago.
Bangalore,	1st November „ .	—·0001518	+·0005700	—·0037614	—·0040082	Cloudy. Occasional showers for 3 or 4 days.

Results of comparison of staves—season 1908-09.

Place and date of comparison.		No. of Staff.				Remarks.
		04	05	01	03	
Trichinopoly	10th November 1908	+·0003746	+·0008746	—·0034504	—·0036568	Heavy rain last week.
Tinnevelly,	19th " " .	+·0001976	+·0006976	—·0039274	—·0049370	No rain since last comparisons. Clear.
Maniyáchi,	28th " " .	+·0003452	+·0005202	—·0037112	—·0048548	Dull heavy clouds for 3 or 4 days.
Calicut,	11th December " .	—·0005730	+·0001712	—·0043980	—·0056544	Clear.
Secunderábád,	24th " " .	—·0001370	+·0002444	—·0039922	—·0054236	Cloudy for last 2 days.
Médcharla,	2nd January 1909 .	—·0007634	—·0001384	—·0043948	—·0055884	Cloudy for last 3 days.
Narsingpet,	14th " " .	—·0003808	—·0000270	—·0038270	—·0056898	Rain during interval.
Upalvái,	25th " " .	—·0006072	+·0000210	—·0044444	—·0060630	Clear and dry.
Dichpali,	2nd February " .	—·0019306	—·0015524	—·0063928	—·0077492	"
Dúdhgaon,	11th " " .	—·0010988	—·0008738	—·0053988	—·0069520	Light scattered clouds, dry.
Dúngarpur,	19th " " .	—·0017374	—·0016002	—·0062194	—·0072572	Clouds gathering.
Kumári, *	27th " " .	—·0021062	—·0021812	—·0065626	—·0081036	Occasionally cloudy since 19th Feb.
Mawala,	10th March " .	—·0022870	—·0020152	—·0069748	—·0085562	Dry and clear.
Dhánura,	20th " " .	—·0027030	—·0019908	—·0074408	—·0092722	Very light clouds on 19th and 20th Mar.
Káyar,	29th " " .	—·0029490	—·0029612	—·0076464	—·0097470	Thunder-storms with rain during week.
Warora,	6th April " .	—·0033676	—·0036586	—·0085278	—·0103932	"
Akola,	13th " " .	—·0031438	—·0032592	—·0083060	—·0100464	"

* *Red Faces only.*

Narsingpet,	14th January 1909 .	+·0036914	+·0032446	—·0028150	—·0032900	Remarks as given above on specified dates.
Warora	6th April " .	—·0022028	—·0000432	—·0059342	—·0074214	
Akola	13th " " .	—·0020028	+·0002472	—·0055342	—·0070714	

* Owing to smaller levels with single wires having to be used on Triangulation station connections, comparisons of red faces were made of staves at Narsingpet, Warora and Akola as both faces of the staves had to be used.

No. 2 Levelling Detachment.

Results of comparison of staves—season 1908-09.

Place and date of comparison.		Number of Staff.				Remarks.
		20 A.	20 B.	16 A.	16 B.	
Nágaur,	11th October 1908 .	−0·0015031	−0·0008712	−0·0016987	−0·0009174	Clear and dry, cool breeze.
Khajwána,	21st ,, ,, .	−0·0023525	−0·0017346	−0·0026367	−0·0019300	Clear and dry.
Gotan,	1st November ,, .	−0·0037053	−0·0033416	−0·0040527	−0·0029028	,,
Pípár Road,	9th ,, ,, .	−0·0032425	−0·0029080	−0·0034451	−0·0026164	,,
Jodhpur,	19th ,, ,, .	−0·0036603	−0·0037740	−0·0040679	−0·0030860	,,
Lúni Junction,	2nd December ,, .	−0·0044673	−0·0041354	−0·0049219	−0·0033564	,,
Márwár Páli,	11th ,, ,, .	−0·0034945	−0·0033254	−0·0042779	−0·0031514	,,
Bhinwália,	22nd ,, ,, .	−0·0039025	−0·0041122	−0·0051275	−0·0034776	,,
Ráni,	30th ,, ,, .	−0·0043587	−0·0049666	−0·0051791	−0·0039658	,,
Nána,	8th January 1909 .	−0·0047433	−0·0044890	−0·0052851	−0·0039202	,,
Rohira,	15th ,, ,, .	−0·0043763	−0·0040056	−0·0043973	−0·0034678	Scattered clouds, cool breeze.
Chitrasani,	29th ,, ,, .	−0·0044091	−0·0041574	−0·0047737	−0·0038094	Clear and dry.
Chhápi,	12th February ,, .	−0·0047855	−0·0045302	−0·0050763	−0·0040130	,,
Mehsána,	23rd ,, ,, .	−0·0051565	−0·0049144	−0·0057313	−0·0044750	Scattered clouds.
Kálol,	3rd March ,, .	−0·0051349	−0·0048818	−0·0054333	−0·0043536	Clear and dry.
Sábarmati,	13th ,, ,, .	−0·0053853	−0·0054252	−0·0059809	−0·0046724	,,
Hardwár,	26th ,, ,, .	−0·0061469	−0·0060172	−0·0064623	−0·0050028	Light clouds.
Doíwála,	2nd April ,, .	−0·0068111	−0·0063894	−0·0073207	−0·0054118	Light scattered clouds.
Dehra Dún,	10th ,, ,, .	−0·0061717	−0·0060218	−0·0061749	−0·0050468	Scattered clouds, cool breeze.

No. 3 Levelling Detachment.

Results of comparison of staves—season 1908-09.

Place and date of comparison.		Number of Staff. (White face.)				Remarks.
		B 1.	B 2.	IIII.	4	
Katni,	21st October 1908	+0·0040661	+0·0018726	+0·0037612	+0·0013212	Clear (dew).
Katni,	29th ,, ,, .	+0·0037778	+0·0018217	+0·0026760	+0·0009379	,,
Sleemanábád Road, 6th November 1908.		+0·0033625	+0·0014251	+0·0028747	+0·0004328	Light rain.
Mahangwan,	13th November 1908 .	+0·0038121	+0·0017663	+0·0033251	+0·0007653	Clear (dew).
Sihora Road,	20th ,, ,,	+0·0035397	+0·0012712	+0·0030647	+0·0005729	,,
		+0·0032430*	+0·0008282*	+0·0027236*	+0·0011402*	
Deori,	27th ,, ,, .	+0·0036372	+0·0017187	+0·0031541	+0·0009562	Clear (dew and haze).
Jubbulpore,	8th December ,, .	+0·0028865	+0·0010738	+0·0027017	+0·0005354	,,
Jubbulpore,	14th ,, ,, .	+0·0026692	+0·0008960	+0·0024882	−0·0001098	Clear.
Nigri,	21st ,, ,, .	+0·0031911	+0·0012502	+0·0026392	−0·0000591	,,

* Mean of both white and black faces. Owing to smaller levels with single wires having to be used on triangulation station connections both faces of staves were used.

Results of comparison of staves—season 1908-09—contd.

Place and date of comparison.		Number of Staff. (*White face*).				Remarks.
		B 1.	B 2.	IIII.	4	
Hulki,	30th December 1908	+0·0031917	+0·0013108	+0·0025814	+0·0003310	Scattered clouds, light rain (frost).
		+0·0029951*	+0·0006134*	+0·0020438*	+0·0010295*	
Dhuma,	6th January 1909	+0·0029201	+0·0017020	+0·0033224	+0·0007088	Scattered clouds, rain twice.
Ganeshganj,	14th „ „	+0·0034628	+0·0013589	+0·0030639	+0·0000394	Scattered clouds, rain once.
Bandol,	22nd „ „	+0·0038057	+0·0017247	+0·0033552	+0·0004487	Light clouds.
Suktalao,	29th „ „	+0·0030787	+0·0015830	+0·0030606	+0·0009752	Scattered clouds, rain twice.
Khawása,	6th February „	+0·0028956	+0·0017553	+0·0028162	—0·0000859	Scattered clouds, rain once.
Chorebaoli,	13th „ „	+0·0031004	+0·0006052	+0·0018085	—0·0002851	Clear.
Mansar,	21st „ „	+0·0029175	+0·0007267	+0·0024777	—0·0003729	Light clouds.
Nágpur,	1st March „	+0·0027970	+0·0009274	+0·0021352	+0·0002407	Scattered clouds.
Wardha,	8th „ „	+0·0025334	+0·0005833	+0·0005546	—0·0003849	Scattered clouds.
Sonegaon,	15th „ „	+0·0022396	+0·0003059	+0·0002586	—0·0012181	Clear.
Nágri,	23rd „ „	+0·0026964	+0·0004361	+0·0004324	+0·0000723	Light clouds.
		+0·0025211*	+0·0003171*	+0·0003269*	+0·0009149*	
Warora,	29th „ „	+0·0015498	—0·0005859	—0·0000762	—0·0021417	Cloudy.
Biláspur,	7th April 1909	+0·0016208	—0·0005015	+0·0005758	—0·0019567	Scattered clouds.
		+0·0015497*	—0·0008984*	+0·0001100*	—0·0006877*	

* Mean of both white and black faces. Owing to smaller levels with single wires having to be used on triangulation station connections both faces of staves were used.

36. *Change in the system of levelling.*—Binocular precise levels have been used by No. 2 levelling detachment since 1906-07. Some modifications were made in the G. T. Survey levelling system consequent on the use of the above levels. These modifications were fully described in the narrative report for season 1907-08. The principal change was that three readings were taken on one face only of the staff in place of one reading on each of the two faces. This change in the system resulted in an appreciable saving of time and labour, and a corresponding increase in the outturn of work. It was therefore decided to introduce the modified system of observations in all first class levelling operations conducted by the Survey of India. At the commencement of the past field season the number of Binocular precise levels in stock with the party was not sufficient for the use of all the levelling detachments. The existing cylindrical levels were therefore provided with three horizontal wires and these were successfully used under the modified system by detachments Nos. 1 and 3. During the past field season, all the main lines and most of the branch lines have been executed by the modified system of levelling. On branch lines to some of the G. T. Survey hill stations, the cylindrical levels fitted with three horizontal wires could not be used on account of the steep nature of the ground, hence smaller levels containing single horizontal wires were used. In such cases the old system of observation was employed.

A sufficient number of Binocular precise levels has now been obtained and it will be possible to equip all the three detachments with levels of this description during the coming field season, and the old system of observations will no longer be resorted to.

37. *Levelling in the Himalayas.*—At the instance of the Director, Geological Survey, instructions were received to carry out lines of precise levelling to certain Himalayan stations during 1909-10. An opportunity was therefore taken towards the close of the year under report, to supplement the bench-marks fixed between Rájpur and Mussoore in 1905, by specially selected and protected rock-cut bench-marks, as a model for the above lines. Fifteen bench-marks were fixed on ground rock and protected by masonry pillars 2 feet square and about 9 inches high with an aperture in the centre 6 inches square. On the top of the protecting pillar a stone slab 9 inches square and 2 inches thick has been fixed bearing the following inscription :—

G. T. SURVEY

O

UPPER MARK.

In fixing this slab care was taken to put the circle vertically above the mark cut on rock and the height of the upper mark above the lower was carefully measured. In addition to the above bench-marks one standard and 3 inscribed bench-marks were also built at Mussooree. All the new bench-marks were duly connected by levelling.

38. *Standard Bench-marks.*—During the past year 16 standard bench-marks were erected and 26 connected, 32 are under construction and 39 have been proposed for erection.

The following is a complete list of standard bench-marks as they stood at the close of year 1908-09 :—

Nos.	Completed and connected.	Completed not yet connected.	Under construction.
1	1 in Calcutta (old).	1 in Sukkur.	1 in Berhampur.
2	2 in Bombay (old).	1 in Hyderábád (Sind).	1 in Vizagapatam.
3	1 in Madras (old).	1 in Karáchi.	1 in Cocanáda.
4	1 in Karáchi (old).	1 in Mhow.	1 in Bezwáda.
5	1 in Rangoon (old).	1 in Jacobábád.	1 in Nellore.
6	2 in Dehra Dún.	1 in Surat.	1 in Motíhári.
7	1 in Sahāranpur.	1 in Godhra.	1 in Bankipore.
8	1 in Muzaffarnagar.	1 in Dhúlia.	1 in Bhágalpur.
9	2 in Meerut.	1 in Baháwalpur.	1 in Burdwán.
10	1 in Alígarh.	1 in Rájkot.	1 in Purnea.
11	1 in Bareilly.	1 in Khánpur.	1 in Dinájpur.
12	1 in Sháhjahánpur.	1 in Sadikganj.	1 in Cuttack.
13	1 in Lucknow.	1 in Baroda.	1 in Balasore.
14	2 in Sítápur.	1 in Muzaffarpur.	1 in Dhubri.
15	1 in Fyzábád.	1 in Rewah.	1 in Gauháti.

Nos.	Completed and connected.	Completed not yet connected.	Under construction.
16	2 in Allahábád.		1 in Rangoon.
17	1 in Mirzápur.		1 in Pegu.
18	1 in Benares.		1 in Toungoo.
19	1 in Gházípur.		1 in Mandalay.
20	1 in Gorakhpur.		1 in Shwebo.
21	1 in Muttra.		1 in Meiktila.
22	1 in Agra.		1 in Magwe.
23	1 in Gwalior.		1 in Myitkyina.
24	1 in Lahore.		1 in Wuntho.
25	1 in Ráwalpindi.		2 in Bhopál.
26	1 in Jhánsi.		1 in Barisál.
27	1 in Delhi.		1 in Comilla.
28	1 in Ambála.		1 in Chittagong.
29	1 in Ludhiána.		1 in Dacca.
30	1 in Ferozepore.		1 in Mymensingh.
31	1 in Jhelum.		

Nos.	Completed and connected.	Proposed for erection.
32	1 in Attock.	Silchar.
33	1 in Peshawár.	Sylhet.
34	1 in Deoláli.	Dibrugarh.
35	1 in Ahmadnagar.	Bhamo.
36	1 in Kirkee.	Thabeitkyin.
37	2 in Poona.	Sagaing.
38	1 in Sholápur.	Maymyo.
39	1 in Multán.	Hsípaw.
40	1 in Dera Ismail Khán.	Lashio.
41	1 in Raichúr.	Akyab.
42	1 in Bellary.	Tavoy.
43	1 in Cuddapah.	Mergui.
44	1 in Madras.	Sandoway.
45	1 in Bíkaner.	Yamethin.
46	1 in Sátára.	Thazi.
47	1 in Belgaum.	Kyaukse.

Nos.	Completed and connected.	Proposed for erection.
48	1 in Saugor.	Myingyan.
49	1 in Bangalore.	Pakôkku.
50	1 in Jodhpur.	Monywa.
51	1 in Calicut.	Thayetmyo.
52	1 in Jubbulpore.	Thaton.
53	1 in Negapatam.	Pa-an.
54	1 in Madura.	Kyaikto.
55	1 in Trichinopoly.	Moulmein.
56	3 in Secunderábád.	Kalaw.
57	1 in Salem.	Taunggyi.
58	1 in Tinnevelly.	Loilen.
59	1 in Bijápur.	Insein.
60	1 in Deesa.	Taikkyi.
61	1 in Nágpur.	Kyauktan.
62	1 in Hinganghát.	Twante.
63	1 in Akola.	Tharrawaddy.
64	1 in Raipur.	Zígon.
65	1 in Bilåspur.	Prome.
66	1 in Sambalpur.	Henzada.
67	1 in Ahmadábád.	Myanaung.
68	1 in Roorkee.	Danubyu.
69	1 in Mussooree.	Myaungmya.
		Ma-ubin.

Most of the following standard bench-marks, completed and under construction, will it is hoped be connected during the field season 1909-10:—

Nos.	Completed.	Under construction.	Remarks.
1	1 in Sukkur.	1 in Berhampur.	
2	1 in Hyderábád.	1 in Vizagapatam.	
3	1 in Karáchi.	1 in Cocanáda.	
4	1 in Mhow.	1 in Bezwáda.	
5	1 in Jacobábád.	1 in Nellore.	
6	1 in Surat.	1 in Motíhári.	
7	1 in Godhra.	1 in Bankipore.	

Nos.	Completed.	Under construction.	Remarks.
8	1 in Dhúlia.	1 in Bhágalpur.	
9	1 in Baháwalpur.	1 in Burdwán.	
10	1 in Rájkot.	1 in Purnea.	
11	1 in Khánpur.	1 in Dinájpur.	
12	1 in Sadikganj.	1 in Cuttack.	
13	1 in Baroda.	1 in Balasore.	
14	1 in Muzaffarpur.	1 in Barisál.	
15	1 in Rewah.	1 in Comilla.	
		1 in Chittagong.	
		1 in Dacca.	
		1 in Mymensingh.	
		1 in Dhubri.	
		1 in Gauháti.	
		1 in Rangoon.	
		1 in Pegu.	
		1 in Toungoo.	
		1 in Mandalay.	
		1 in Shwebo.	
		1 in Meiktila.	
		1 in Magwe.	
		1 in Myitkyina.	
		1 in Wuntho.	
		2 in Bhopál.	

39. *Destruction of bench-marks.*—During the past year 65 bench-marks were reported as lost or destroyed.

40. *Recess duties.*—The levelling computations have been completed and manuscript pamphlets of heights have been brought up to date.

41. *Health of levelling detachments.*—The health of the members of the levelling detachments was generally far from good at the commencement of the field season, a large percentage of the establishment suffered from malarial fever. But later on the health of the men improved and in the latter portion of the season was on the whole good.

42. *Inspection of the party.*—The Superintendent, Trigonometrical Surveys, inspected the party in May 1909.

43. *Programme for field season, 1909-10.*—The levelling operations to be performed during the coming field season are :—

No. 1 Levelling detachment.—

(i) New levelling from Wuntho to Myitkyina.

(ii) Revision levelling from Pyinmana to Rangoon.

(iii) The connection of standard bench-marks at Rangoon, Pegu, Toungoo, Mandalay, Shwebo, Meiktila, Magwe, Wuntho and Myitkyina.

No. 2 Levelling detachment—

(i) Levelling from Síliguri to Tindhária.

(ii) Levelling from Bareilly to Naini Tál.

(iii) Levelling from Hardwár to Lansdowne.

(iv) „ „ Ambála to Solon.

(v) The connection of standard bench-marks at Nellore, Bezwáda, Cocanáda, Vizagapatam, Berhampur, Cuttack, Balasore, Burdwán, Gauháti, Dhubri, Dinájpur, Purnea, Bhágalpur, Patna (Bankipore), Muzaffarpur, Motíhári, Rewah and Lucknow (new).

No. 3 Levelling detachment—

(i) Levelling from Laluwali T. S. near Khánpur to Rohri.

(ii) Levelling from Shikárpur to Jacobábád.

(iii) Levelling from Pali H. S. to Godhra.

(iv) „ „ Lahore to Dharmkot.

(v) The connection of standard bench-marks at Sadikganj, Baháwalpur, Khánpur, Sukkur, Jacobábád, Hyderábád (Sind), Karáchi, Godhra, Baroda, Rájkot, Surat, Dhúlia, Mhow, and Bhopál.

III.

THE PENDULUM OPERATIONS.

Extracted from the Narrative Report of Captain H. McC. Cowie, R.E., in charge No. 23 Party (Pendulums), for the Season 1908-09.

1. During the winter of 1908-09, pendulum operations were carried out in the western portion of Central India, the stations visited, lying, for the most part, in the Sátpura and Vindhyan hill tracts. Latitude operations executed in peninsular India had revealed deflections of the plumb-line which pointed to the existence, in the material forming the earth's crust, of a belt of great density, the southern edge of which runs from about Bhusáwal towards Hinganghát and thence north-westwards, to a little to the north of Biláspur. Plumb-line deflections had also indicated the existence of a tract, stretching from west of Ahmadábád to Indore and Mhow and perhaps a little further eastwards, where the subjacent matter was of low density and which, lying within the belt of high density, appeared by reason of its relatively small area as an intrusive feature. One of the objects of this season's work was the more precise location of the lines of demarcation between the regions of high and low density. Besides this, the operations were expected to add materially to the data gradually being collected for the purposes of future discussions of the larger questions of the compensation of visible masses and the investigation of the constitution of the earth's crust.

2. The examination of the variation of gravity in Central India embraces an array of conditions somewhat different to those prevailing in extra-peninsular regions. In the former, the geological formations comprise the oldest rock strata of India. They cover enormous areas and show that from early geological times the crust, here, has not been subjected to great pressures. The beds are little disturbed and the present configuration is mainly due to denudation. The hill masses have not been produced by folding nor by upheaval of the crust, but are merely the remnants of the extensive plateaux existing in earlier times. The relations of the crust to the internal magma are, here, perhaps, more uniform than in extra-peninsular India. The crust has not, it would appear, been subjected to great lateral thrust. The stresses which portions of it have had to withstand have been caused, rather, by overloading by volcanic ejecta and the material has yielded to the forces in operation not by folding but more probably by faulting. On the other side of the Gangetic plain the case is entirely different. Here the geological formations are much contorted; everywhere there are signs of great crustal disturbance; strata, much folded and crushed, have been thrust upwards, forming mountain masses. It cannot be supposed that the enormous pressures, which have produced this condition, have been operative only on the surface of the crust. It seems reasonable to infer that the relations of the crust to the interior have been similarly disturbed; that the mountain masses on the surface are but incidental features of the thickening of the crust below, portions of which have been forced downwards into the magma. The characters of the two regions are, thus, very dissimilar. In the one case, it is that of a portion of the crust, stable and quiescent through

long ages, while that of the other is appropriate to the scene of much orogenic disturbance. This variety of character in the peninsular and extra-peninsular areas constitutes one of the most attractive features of gravimetric research in India, giving rise to problems of much interest as to whether the crust in peninsular India has arrived at a condition of isostasy; whether this condition has been affected by great denudation of the surface; whether the attaining of such a condition in the extra-peninsular area has been assisted or retarded by the great crustal movements which have taken place there.

3. The stations visited were—

Station.	Latitude.	Longitude.	Height.
	° ′ ″	° ′ ″	feet.
Ujjain	23 11 0	75 47 0	1,612
Mhow	22 33 10	75 45 40	1,903
Mukhtiara	22 23 40	75 58 40	926
Mortakka	22 13 20	76 2 50	576
Khandwa	21 49 30	76 21 30	1,014
Asírgarh	21 28 10	76 17 50	2,077
Jálgaon	21 0 0	75 33 50	760
Amraoti	20 55 50	77 45 40	1,123
Ellichpur	21 18 20	77 30 40	1,314
Badnúr	21 54 10	77 54 10	2,103
Shahpur	22 11 30	77 54 10	1,286
Hoshangábád	22 45 0	77 43 50	1,002

Both Ujjain and Mhow are on the gentle northern slope of the Vindhyan plateau, Mhow being close to the crest of the southern scarp. Mukhtiara and Mortakka are in the Narbada valley. The former is 12 miles north of the river and some 8 miles from the Vindhya crest which here runs up, in places, to about 2,500 feet above sea-level, and the latter place is immediately on the south bank. Khandwa lies between the Narbada and Tapti rivers, in the gap of the Sátpura hills. Asírgarh is on one of the high peaks defining the crest of the Sátpurás, a prominent feature of the locality, of the type common in Western India, flat-topped with precipitous sides. From the southern foot of the hill, the ground slopes gently to the Tapti. On the north, after a belt of irregular hill masses, relatively lower in height, the ground slopes to the Narbada. To the west of Asírgarh, the Sátpurás are represented by a mountainous region with occasional high peaks, while immediately to the east, occurs the noticeable break in the system, some 25 miles wide. Jálgaon is situated in the Tapti valley about 7 miles south of the river. Amraoti and Ellichpur lie in the Berár plains south of the Sátpurás. Badnúr aud Shahpur are over the centre of the Sátpura mass and Hoshangábád is on the south bank of the Narbada. For the greater part, these stations lie upon, or very close to the edge of, the Deccan trap. Hoshangábád is on the alluvium of the upper reaches of the Narbada, while Jálgaon is close to the edge of the alluvium of the Tapti valley. Generally speaking, the trap to the north of the Narbada, overlies Vindhyan beds, while to the south the gneiss of peninsular India, presumably, lies at the base of the basalt.

4. At all these places, thanks to the kindness of local officials, the pendulum observatory could be installed in masonry buildings. At most of them the means of easily controlling the temperature within the room were sufficient. The exceptions were Ellichpur and Badnúr, where the rooms were small and isolated, with little protection from the sun, and Asírgarh, where the control was somewhat difficult by reason of the prevailing high wind and an indifferently weather-proof building.

5. The temperature changes will be found summarised in table I. The value of the mean hourly change of temperature was comparatively large at Ellichpur, Amraoti and Mhow. No corrections for lag in temperature have, however, been applied to the times of vibration.

TABLE I.

Average temperatures during the observations.

Station.	Night.		Day.		Mean.	
	Average temp. C.	Hourly change.	Average temp. C.	Hourly change.	Average temp. C.	Hourly change.
	°	°	°	°	°	°
Dehra Dún, December, 1908	15·74	+0·13	15·23	+0·19	15·48	+0·16
Ujjain	21·61	+0·07	20·82	+0·09	21·22	+0·08
Mhow	19·84	+0·09	19·28	+0·33	19·56	+0·21
Mukhtiara	24·55	0·00	23·04	+0·10	23·80	+0·05
Mortakka	25·10	+0·05	24·36	+0·21	24·73	+0·13
Khandwa	19·64	+0·04	17·36	+0·26	18·50	+0·15
Asírgarh	22·14	+0·15	21·68	+0·21	21·91	+0·18
Jálgaon	28·36	−0·08	27·75	+0·16	28·06	+0·04
Amraoti	29·37	+0·09	28·07	+0·36	28·72	+0·22
Ellichpur	30·67	−0·10	28·50	+0·60	29·59	+0·25
Hoshangábád	28·92	+0·02	28·51	+0·12	28·71	+0·07
Shahpur	29·92	+0·04	29·08	+0·22	29·50	+0·13
Badnúr	26·95	+0·07	27·02	+0·20	26·99	+0·13
Dehra Dún, May, 1909	25·33	+0·14	25·31	+0·16	25·32	+0·15

6. Determinations of the flexure of the pendulum support were made both before and after the series of observations of the time of vibration of the pendulums. On each occasion at least two sets of flexure determinations were made. The results are exhibited in table II. As will be seen there, the flexure

correction remained very steady at each place and varied during the season from $37^s \times 10^{-7}$ to $67^s \times 10^{-7}$.

TABLE II.

The flexure correction.

Station.	Date.	Observed Flexure correction.	Adopted Flexure correction.
Dehra Dún	1908, December 2nd .	43·9 45·4 46·8 45·0 44·8	
	" 18th .	44·7 44·2	45·0
Ujjain	1908, December 31st .	51·0 51·4 51·6	
	1909, January 4th .	50·3 51·1 51·1	51·1
Mhow	1909, January 8th .	36·7 37·1 36·9	
	" 12th .	37·0 38·2 37·9	37·3
Mukhtíara	1909, January 15th .	46·5 47·8 46·6	
	" 19th .	46·6 44·2 44·0	46·0
Mortakka	1909, January 22nd .	69·2 68·4 68·6	
	" 26th .	64·4 67·4 66·7	67·5
Khandwa	1909, January 29th .	51·5 51·6 53·1	
	1909, February 2nd .	51·6 52·5 51·5	52·0

TABLE II—*contd.*

Station.	Date.	Observed Flexure correction.	Adopted Flexure correction.
Asírgarh	1909, February 7th .	46·1 45·7 46·8	
	" 13th .	46·3 45·9 45·3	46·0
Jálgaon	1909, February 18th .	39·4 39·1	
	" 24th .	38·1 38·9	38·9
Amraoti	1909, March 1st .	44·7 45·1	
	" 7th .	44·0 45·1	44·7
Ellichpur	1909, March 13th .	50·4 50·2	
	" 16th .	49·7 50·0	50·1
Hoshangábád	1909, March 26th .	55·5 53·4 53·4	
	" 30th .	52·4 51·0	53·1
Shahpur	1909, April 4th .	52·6 52·6	
	" 7th .	51·4 52·2	52·2
Badnúr	1909, April 11th .	44·6 44·0	
	" 14th	42·9 42·4	43·5
Dehra Dún	1909, April 29th .	38·3 38·5	
	1909, May 3rd .	37·3 37·2	37·8

The unit in table II is the seventh decimal place of a second.

7. Throughout the season, the clock rate was determined by Mr. Hanuman Prasad with the Bent Transit Instrument made by Messrs. Troughton and Simms. The results of his observations were thoroughly satisfactory, the mean p. e. of a clock rate determined by observations on two successive nights being ± 0ˢ·012 and the mean p. e. of a value of the rate derived from observations of one star on two successive nights ± 0ˢ·042.

8. In table III are given the observed times of vibration of the four pendulums in December 1908 and April-May 1909, at Dehra Dún, and the value of the time of vibration of the mean pendulum adopted for the season.

TABLE III.

Times of vibration of the several pendulums.

Date.	No. 137.	No. 138.	No. 139.	No. 140.	Mean.
1908, Dec. 14—15	0·5072567	0·5075001	0·5071583	0·5070864	0·5072504
15—16	2570	4988	1567	0855	2495
16—17	2565	4988	1573	0865	2498
17—18	2570	5001	1558	0859	2497
Means . .	0·5072568	0·5074995	0·5071570	0·5070861	0·5072499
1909, April 29—30	0·5072560	0·5074990	0·5071587	0·5070862	0·5072500
April 30 May 1	2567	4984	1578	0851	2495
May 1—2	2547	4988	1579	0859	2493
Means . .	0·5072558	0·5074987	0·5071581	0·5070857	0·5072496
General Means adopted for the season .	0·5072563	0·5074991	0·5071576	0·5070859	0·5072497
Differences, May—Dec. .	−10	−8	+11	−4	−3

It is interesting to note the gradual change that has been taking place in the times of vibration of the pendulums since January 1904. The following is a summary of the values of the times of vibration at different dates.

TABLE IV.

Times of vibration of the pendulums at Dehra Dún at different times between January 1904 and May 1909.

Date.	No. 137.	No. 138.	No. 139.	No. 140.	Mean.
1904, January . . .	0·5072599	0·5075016	0·5071626	0·5070869	0·5072528
„ May	2589	5015	1613	0859	2519
„ November . . .	2599	5016	1623	0849	2522
1905, May	2581	5001	1588	0868	2509
„ November . . .	2583	4990	1598	0854	2506
1906, April	2598	5001	1599	0860	2515
„ November . . .	2598	5005	1599	0866	2517
1907, April	2560	5002	1590	0867	2505
1908, January . . .	2566	5011	1596	0865	2510
„ April	2574	5004	1595	0874	2512
„ November . . .	2572	5002	1589	0866	2507
„ December . . .	2568	4995	1570	0861	2499
1909, May	2558	4987	1581	0857	2496

The accompanying diagram, on which the changes in the times of vibration have been plotted, shews at a glance the nature of the behaviour of each pendulum. The black traces have been drawn through the points representing the observed values of the times of vibration. The red lines exhibit the most probable linear equations representing the black traces. The assumptions made here are that the change in each pendulum is a linear function of the interval of time and that the discrepancies between the black trace and the red line are accidental. With regard to the former, it would be more correct, if it be admitted that the alteration of the length of the pendulum is due to molecular change, to represent the variation of the time of vibration by an equation of a degree other than the first. For it is reasonable to suppose that, with the increasing age of the pendulum, the intensity of the molecular forces producing change would become weaker and that the curve exemplifying the effects of molecular change would be such that, if the co-ordinate y represent the effect the axis of x would be an asymptote.

At present, however, the data are insufficient to indicate the most suitable equation. An examination of the diagram shows that the changes in the pendulums are practically as great now as they were five years ago, that we are, as it were, still occupied with a portion of the curve where the angle between the tangent and the axis of reference, though comparatively large, varies but slowly. The diagram, it should be noticed, shows only the changes that have taken place, not the absolute values. The traces for the different pendulums have been so placed on the diagram as to interfere as little as possible with one another, confusion of lines being thus avoided. The three pendulums Nos. 137, 138, 139 appear to have changed in much the same way, all show a decrease of length. No. 140, on the other hand, shows only a small change and that seems to incline towards an increase of length. This slow decrease of length is not an unusual phenomenon in pendulum operations.

Professional Paper No. 10, pages 160, 161 should be referred to regarding the change that took place in pendulum No. 137 between November 1906 and April 1907.

9. It may be of interest to examine the changes that have taken place from time to time, during the periods of rest and work respectively. These changes are tabulated below.

TABLE V.

Changes in the times of vibration of the several pendulums during periods of work and rest respectively.

Changes during periods of work.

Period.	No. 137.	No. 138.	No. 139.	No. 140.	Mean pendulum.
January 1904 to May 1904 . .	−10	−1	−13	−10	−9
November „ to „ 1905 .	−18	−15	−35	+19	−13
„ 1905 to April 1906 . .	+15	+11	+1	+6	+9
„ 1906 to „ 1907 . .	−38	−3	−9	+1	−12
January 1908 to „ 1908 . .	+8	−7	−1	+9	+2
November „ to May 1909 . .	−14	−15	−8	−9	−11
Changes during periods of rest.					
May 1904 to November 1904 . .	+10	+1	+10	−10	+3
„ 1905 to „ 1905 . .	+2	−11	+10	−14	−3
April 1906 to „ 1906 . .	0	+4	0	+6	+2
„ 1907 to January 1908 . .	+6	+9	+6	−2	+5
„ 1908 to November 1908 . .	−2	−2	−6	−8	−5

The unit in the statement above is the seventh decimal place of a second. Here it is seen that the changes that take place during the field season are somewhat greater than the similar quantities for the periods of rest, though the duration of the intervals of time is practically the same in the two cases.

10. Table VI shews for each station the time of vibration of the mean pendulum, the differences of these quantities from the corresponding quantity for Dehra Dún, and the values of gravity deduced from these differences, using for g at Dehra the value 979·063 dynes. The *p. e.* of one determination of the time of vibration of the mean pendulum, as derived from the differences between the several values of the time of vibration of the mean pendulum and the respective station mean, is

$$\pm 3{\cdot}42 \times 10^{-7}$$

This quantity corresponds to about ± 0·0009 dynes for the values given in the last column of table VI.

TABLE VI.

Table giving for each station, the mean observed times of vibration and the values of g deduced therefrom.

Station.	Time of vibration.	Difference from Dehra.	Observed value of g dynes.
Dehra Dún	0·5072497	...	979·063
Ujjain	3498	1001	978·677
Mhow	3646	1149	978·620
Mukhtiara	3531	1034	978·664
Mortakka	3429	932	978·703
Khandwa	3457	960	978·692
Asírgarh	3737	1240	978·584
Jálgaon	3612	1115	978·633
Amraoti	3674	1177	978·609
Ellichpur	3651	1154	978·618
Hoshangábád	3388	891	978·719
Shahpur	3534	1037	978·663
Badnúr	0·5073679	1182	978·607

11. Table VII gives for each station, the observed value of gravity g, the corrections for height, mass and uneven terrain and the resulting value g_0'' of gravity at sea level, the theoretical value γ_0 and the differences $g_0''-\gamma_0$ and $g_0-\gamma_0$.

In computing the theoretical values, use has been made of Helmert's 1884 formula

$$\gamma_0=978{\cdot}00\{1+0{\cdot}005310 \text{ Sin}^2\phi\}$$

and in reducing the observed values to sea level, the density of surface masses has been assumed to be 2·8.

TABLE VII.

Station.	Latitude.			Longitude.			Height above M. S. L.	Observed value of gravity $=g$.	Corrections: for height.	Corrections: for mass.	Corrections: Orographical.	Value of gravity at Sea level. $=g_0''$.	γ_0	$g_0''-\gamma_0$.	$g_0-\gamma_0$.
	°	′	″	°	′	″	feet.	dynes.				dynes.	dynes.	dynes.	dynes.
Ujjain	23	11	0	75	47	0	1,612	978·677	+0·150	−0·056	0	978·771	978·802	−0·031	+0·025
Mhow	22	33	10	75	45	40	1,903	978·620	+0·177	−0·067	0	978·730	978·763	−0·033	+0·034
Mukhtiara	22	23	40	75	58	40	926	978·664	+0·086	−0·032	0	978·718	978·753	−0·035	−0·003
Mortakka	22	13	20	76	2	50	576	978·703	+0·054	−0·020	0	978·737	978·743	−0·006	+0·014
Khandwa	21	49	30	76	21	30	1,014	978·692	+0·095	−0·035	0	978·752	978·714	+0·038	+0·073
Asírgarh	21	28	10	76	17	50	2,077	978·584	+0·194	−0·073	+0·006	978·711	978·694	+0·017	+0·084
Jálgaon	21	0	0	75	33	50	760	978·633	+0·071	−0·027	0	978·677	978·665	+0·012	+0·039
Amraoti	20	55	50	77	45	40	1,123	978·609	+0·105	−0·039	0	978·675	978·665	+0·010	+0·049
Ellichpur	21	18	20	77	30	40	1,314	978·618	+0·122	−0·046	0	978·694	978·685	+0·009	+0·055
Hoshangábád	22	45	0	77	43	50	1,002	978·719	+0·093	−0·035	0	978·777	978·773	+0·004	+0·039
Shahpur	22	11	30	77	54	10	1,286	978·663	+0·120	−0·045	0	978·738	978·743	−0·005	+0·040
Badnúr	21	54	10	77	54	10	2,103	978·607	+0·196	−0·073	0	978·730	978·724	+0·006	+0·079

At the first three stations, Ujjain, Mhow and Mukhtiara, on the scarp and plateau of the Vindhyas, the force of gravity varies but little and is in defect by about 0·033 dynes, on an average. Between Mukhtiara and Mortakka on the bank of the Narbada, the intensity of the force increases, until at the latter place it is only slightly in defect. Further still to the south, at Khandwa and Asírgarh in the Sátpura tract and at Jálgaon, south of the Sátpurás, gravity is found to be in excess, the maximum, so far as the stations visited are concerned occurring at Khandwa, where the observed value, reduced to sea level, exceeds the theoretical by 0·038 dynes.

Generally, then, at the stations visited in the Vindhyas, gravity is found to be in defect, while in the Sátpurás it is in excess. The coincidence, however, of the line of demarcation between the areas of excessive and defective gravity with the natural boundary between the Sátpurás and the Vindhyas may be only accidental and further investigation is necessary before we can apply the generalization made above to these hill systems as a whole. At Amraoti and Ellichpur, in the plains of Berár, south of the Sátpurás, gravity is in excess by about the same amount as at Jálgaon, at the same latitude but 2° further west. As we move northwards, across the Sátpurás, to Hoshangábád, on the Narbada, the force of gravity, we see, decreases somewhat. It is to be noticed that at Shahpur gravity is in slight defect, whereas the results obtained at Badnúr and Hoshangábád would point to a small excess. An interesting feature of the results tabulated above lies in the fact that whereas in previous years excess of gravity had been found only at low-lying places, under 750 feet above sea level, we have here seven stations at altitudes of from 760 to 2,100 feet, at which gravity is in excess.

12. The following is a brief comparison of the season's results with values of $g''_0-\gamma_0$ determined at places in extra-peninsular India, lying at approximately the same height as the Central Indian stations :—

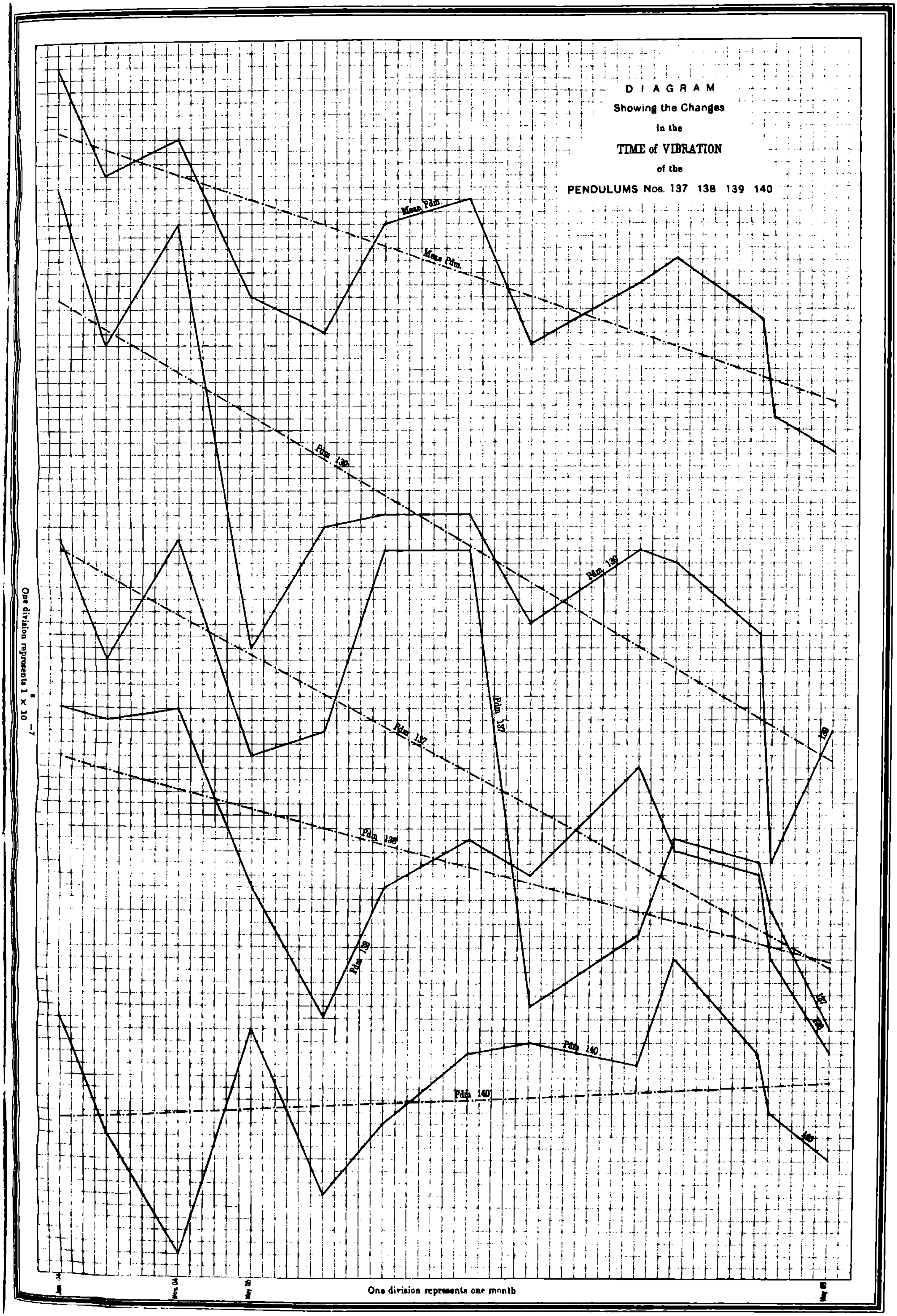
Station.	Height in feet.	$g_0''-\gamma_0$ dynes.
Mortakka, Central India	576	−0·006
Montgomery	557	+0·003
Ferozepore	647	+0·006
Jálgaon, Central India.	760	+0·012
Mián Mir	708	+0·004
Meerut	734	−0·027
Kaliána	810	−0·058
Mukhtiara, Central India	926	−0·035
Nojli	879	−0·095
Hardwár	949	−0·114
Hoshangábád, Central India	1,002	+0·004
Khandwa, Central India	1,014	+0·038
Pathánkot	1,088	−0·179

Station.	Height in feet.	$g_0'-\gamma_0$ dynes.
Amraoti, Central India	1,123	+0·010
Shahpur, ditto	1,286	−0·005
Ellichpur, ditto	1,314	+0·009
Fatehpur	1,434	−0·100
Ujjain, Central India	1,612	−0·031
Mohan	1,660	−0·104
Kalsi	1,684	−0·098
Mhow, Central India	1,903	−0·033
Asírgarh, ditto	2,077	+0·017
Badnúr, ditto	2,103	+0·006
Kálka	2,202	−0·085
Dehra Dún	2,239	−0·126

Along the meridian of 76° between Jálgaon and Ujjain, the variations of gravity show that a greater amount of matter is present to the south of the Narbada than to the north. This is not revealed by the actual configuration of the terrain. The summits of the Vindhyas to the north are just as high as those of the Sátpurás to the south. Indeed, the visible masses to the north and south of the river would lead one to suppose, rather, that there was a preponderance of mass to the north. Latitude observations made at Thikri in the Narbada valley showed that this supposition was incorrect and this indication has now been corroborated by the pendulum operations. The latitude observations, however, pointed to an excess of matter to the south without giving its definite situation. The pendulum has now located the position of the excess of mass.

In the above, when gravity is said to be in excess or defect, it is meant that the force is in excess or defect of what it would be, were the whole of the subjacent mass, above sea-level and in the crust, of a density of 2·8.

13. In reducing the observed value g at the height of the station, to g''_0 at sea level, the average crustal density has been assumed to be 2·8. The reliance that can be placed on the quantities $g''_0-\gamma_0$ depends to some extent on the correctness of this value, and it is subject to this assumption that they show the variations of gravity from normal, allowance having been made for the effects of surface masses. It may, perhaps, be more instructive to compare with the theoretical values, the observed values corrected only for height of station; to form the differences, that is to say, $g_0-\gamma_0$. These differences show the actual abnormal effects of the subjacent masses, and these we can compare with the computed effects of visible masses, basing the latter upon any assumption of density we choose.



Reg. No. 38D Jan. 1910 S. 1.—400.

Heliozincographed at the Office of the Trigonometrical Branch, Survey of India, Dehra Dún.

This comparison is made in the following table :—

Comparison of $g_0 - {}_0\gamma$ with the calculated effects of surface masses.

Station.	$g_o - \gamma_o$ dynes.	Calculated effect of surface masses.
Ujjain	+0·025	+0·056
Mhow	+0·034	+0·067
Mukhtiara	−0·003	+0·032
Mortakka	+0·014	+0·020
Khandwa	+0·073	+0·035
Asírgarh	+0·084	+0·067
Jálgaon	+0·039	+0·027
Amraoti	+0·049	+0·039
Ellichpur	+0·055	+0·046
Badnúr	+0·079	+0·073
Shahpur	+0·040	+0·045
Hoshangábád	+0·039	+0·035

Now, wherever the theory of compensation holds good, we ought to find the actual effect of mass to be *nil*, the effect of visible masses above sea level being compensated by underlying deficiencies; in other words, when the total amount of mass in a vertical column is normal, whatever the surface configuration, we should find the force of gravity to be normal, that is to say, equal to γ_0 after making due allowance for the height above sea level. Now the quantity γ_0 implies a normal amount of mass in the crust, so that $g_0 - \gamma_0$ indicates the actual abnormal mass in excess or defect. When considering these indications, we can compare them with the conclusions that we would have been led to form from a consideration of the masses visible above sea level. At Mukhtiara, $g_0 - \gamma_0$, a very small negative quantity, shows that here there is an approach to normal crust; to a normal amount of matter, although this matter is so disposed and its density is such that it occupies more space than the normal crust, its upper surface lying 900 feet above the sea. Had all this mass above sea level been in excess of that in the normal crust, we would have found gravity in excess by about 0·032 dynes. At all the other stations visited $g_0 - \gamma_0$ points to an abnormal excess of matter. Comparing these quantities with the calcuated effects of surface masses, we see that at Hoshangábád, Shahpur and Badnúr these masses, if their density were 2·8, are almost equal to the abnormal mass indicated by $g_0 - \gamma_0$; consequently there is here scarcely any approach to compensation. At Hoshangábád and Badnúr, the visible masses are slightly less than the indicated excess; at Shahpur they are slightly greater. At Khandwa we see that the visible mass above sea level will account for not quite half the abnormal excess. At Ujjain and Mhow, the visible masses are twice as great as is necessary to produce the observed variation from γ_0

The stations visited lie in an area about 144 miles square. If we can suppose that the mean value of $g_0 - \gamma_0$ and the mean calculated mass effect for these places represent the whole area, we get a mean $g_0 - \gamma_0 = 0·044$ and a mean calculated effect of 0·045. If we are justified in assuming that these figures represent the region, they would indicate that here, in this portion of Central India, there was no compensation of visible masses.

IV.

TRIANGULATION IN INDIA.

Extracted from the Narrative Report of Captain C. M. Browne, D.S.O., R.E., in charge No. 24 Party (Triangulation) for Seasons 1907-08 and 1908-09.

1. The report covers the work done in the two last seasons which comprises:—

(*a*) The completion of the Kalát Longitudinal series.
(*b*) The commencement of the North Baluchistán and Kashmír series.
(*c*) The continuation of the Great Salween series.
(*d*) The carrying out of an accurate traverse in the Punjab.
(*e*) The inauguration of a programme of secondary triangulation.

2. (*a*) Completion of the Kalát Longitudinal series. Season 1907-08. The detachment under Captain Browne assembled at Nushki on the 27th October and after spending a few days in collecting the necessary supplies and escorts left for Padag. Here Messrs. Tresham and Norman were sent ahead to build the stations west of the line Tuzgi-Shuri (where Captain Browne had left off work the previous year) and Captain Browne proceeded to Kopadhar H. S. and Pulchotau H. S. and re-observed the angles which had been observed in 1904-05, as these had given an abnormal triangular error.

The error was thereby considerably reduced and the whole series west of the line Kopadhar-Pulchotau has been recomputed.

The regular work of the series was then resumed, new stations being fixed at Garuki Gori, Borghar, Maland Koh, Kacha Koh, Lar Koh, and Koh-i-Malik Siah (the trijunction of India, Afghánistán and Persia.) Astronomical azimuths were observed at Tuzgi and at Koh-i-Malik Siah and the difference between the values so obtained and those computed from the triangulation are given in the outturn statement the sign of the difference was in both cases positive, and that obtained at Koh-i-Malik Siah ($+13''\cdot24$) is the largest positive value yet obtained in India.

Mr. Tresham having in the meantime connected Robat with the principal series by a triangulation with a 6″ micrometer theodolite, an astronomical latitude determination was made by circum-meridian altitudes. Field work was then closed with the permission of the Superintendent, Trigonometrical Surveys, and the detachment began its long march back to Nushki arriving there on the 10th May.

3. At the end of this report will be found a table of the values now obtained for the latitude, longitude, height and azimuth of some of the main points compared with those hitherto accepted. It will be noticed that the error of azimuth accumulated at the end is considerable; this has often been found the case when a secondary series is carried a long distance and would appear to be caused by some systematic error which would tend to accumulate and not to accidental errors.

4. When the Kalát detachment returned to Nushki it was joined by Lieutenant Oakes, R.E., and Mr. Wainwright; the party was then railed to Mastung road where the detachment for work on the North Baluchistán series in the summer was formed from the men enlisted by Mr. Wainwright with a

nucleus of old men. Captain Browne handed over charge of the detachment to Lieutenant Oakes and proceeded himself to Quetta to interview Sir H. McMahon about the programme of triangulation in Baluchistán and from thence returned to Mussooree.

5. Lieutenant Oakes observed at Zawa, and Zibra stations of the Kalát Longitudinal series and then fixed the following new stations of the North Baluchistán series, Koi Maran, Rastari Taing, Mashelak, Takatu and Khwája Amran.

An astronomical azimuth was observed at Mashelak (Lat. 30°14′, long. 66°47′) and the difference found between the value so obtained and that computed from the triangulation was 1″·25, the sign of this difference was positive which is in accordance with other values found in that region.

The series was completed as far as the Toba plateau (Lat. 31°) the eight completed triangles have an average error of 0″·41 and contain an area of 3,500 square miles. The side Koi Maran-Takatu is remarkable for its length (over 68 miles) it being the longest side yet employed in the principal triangulation of India.

The work was greatly hindered by the dust haze which is prevalent in the summer, but the height of some of the stations made it impracticable to carry out the work in the winter.

The detachment suffered considerably from malarial fever owing to the unusual amount of rain that fell; work was closed at the end of November, and the detachment recessed at Dehra Dún.

6. In August 1909, Mr. Tresham recommenced the work from where Lieutenant Oakes had left off, and up to date has fixed new stations at:—Padughar, Nari Shela, Gunduk, Kand, Basha, and Sakir.

The work is still in progress and consequently full details cannot be given in this year's report.

7. *N.-W. Frontier Province detachment.*—Lieutenant Cardew, R.E., was the observer and his programme was to start the North Baluchistán series from the east, and to carry it south-west over the Sulaimán range with the intention of joining up with the western part of the North Baluchistán series which had been begun in 1908, and in addition to this a secondary series was to be run in order to fix the positions of Pakkalota, Jinighar, and Darweshta Sar with accuracy so as to co-ordinate the different topographical triangulations in the Tochi and Kurram valleys.

The detachment was formed in the beginning of October 1908 and proceeded to Dera Ismail Khán and from thence to Umar Khel, a station of the Great Indus series, but it was found that the triangulation could not be commenced from there as the station of Maidán had been destroyed.

The series was therefore commenced from the sides Bani-Sakesar, and Sakesar-Umar Khel and a new station, which has been called Maidán II, was built near the site of the former one.

On the hill of Maidán a broken stone with a single dot cut on it was found, there was a cairn over it and Lieutenant Cardew's observations shew that it must have been almost exactly on the site of the former station; the data of the two points are given below, No. 1 represents the data of the stone found by Lieutenant Cardew; No. 2 that of Maidán H. S. of the Great Indus series.

	Latitude.			Longitude.			Height.
	°	′	″	°	′	″	
1.	32	51	5·70	71	10	39·99	4256·7
2.	32	51	5·70	71	10	40·00	4275·0

It is difficult to account for the large difference of height unless it is due to the observations of the old Great Indus series not having been taken at the time of minimum refraction.

Observations were taken by Lieutenant Cardew at the following principal stations:—Bani, Sakesar, Umar Khel, Shistarg, Maidán II, Sheikh Ullah, and Baindarra, the last four being newly constructed stations.

Shistarg is on a lower peak of Sheikh Budin on which was formerly a principal station and a subsidiary station of the Great Indus series.

Owing to the building of the cantonment on Sheikh Budin both these stations have been lost.

Baindarra is near the site of an old station erected by Lieutenant Walker when carrying out the Great Indus series, from this station, and from Shistarg, only the back angles were observed as the station which was intended to be built on Kaisarghar or the Takht-i-Sulaimán could not be built from political reasons.

Stations have been built on Ziárat, Surkund, and Sángéghar, but no observations have been taken; and it is probable that a junction will now have to be made with the Great Indus series in the neighbourhood of Dera Gházi Khán.

The secondary stations mentioned in the programme were also fixed, and a comparative table of old and new values is given below. Work was closed and the detachment returned to recess quarters at Mussooree, in the middle of April.

The health of the men on the whole was good, but on first leaving Dera Ismail Khán many suffered from malarial fever which was very prevalent in the district at that time.

	Latitude. ° ′ ″	Longitude. ° ′ ″	Height.
Pakkalita h. s.—			
(a)	32 58 19·045	70 25 28·936	3150·8
(b)	32 58 18·95	70 25 29·01	3169·3
Jinighar h. s.—			
(a)	33 10 35·637	70 40 12·762	3989·7
(b)	33 10 35·48	70 40 12·70	3997·7
Darweshta Sar h. s.—			
(a)	33 09 41·933	70 20 0·459	5056·3
(b)	33 09 41·48	70 20 0·56	5073·1

(a) Values obtained from Lieutenant Cardew's observations in season 1908-09.
(b) Values obtained from Lieutenant Phillimore's observations in season 1904-05.

8. (c) *The Great Salween series.*—In 1907 it was decided to recommence this series without stopping the work in Baluchistán, so a detachment was formed under Lieutenant Cardew, R.E. The programme for this detachment was to carry on the Great Salween series southward from the stations Loi Hsámhsíp, and Loi Kang Mong, up to which it had been completed from the west in 1902-03; the station Loi Ai-hpang had also to be observed at as one angle had been omitted in 1902-03 on account of bad weather.

The detachment arrived at Lashio in the first week of November, but owing to the equipment being delayed on the railway a start could not be made until the 18th November.

Lieutenant Cardew took observations from the following stations:—Loi Hsámhsip, Loi Ai-hpang, Loi Kang Mong, Loi Taow, Loi Hpa-tan, Loi Maw, and Loi Líng; at Loi Hpa-tan an astronomical azimuth was also observed, and the difference found between the value so obtained and that computed from the triangulation was 8″·01, the sign of this difference was negative which is in accordance with the other values found in that part of Burma. All the above-mentioned stations, and those for continuing the series southward had been built in previous seasons, but as it is now intended to turn the series to the eastwards along the parallel of 22°, Mr. Collins was employed in selecting and building stations on the east side of the Salween river; the stations built by him were Loi Pè-möng, Loi Lung, and Loi Aunglawn. Dust haze delayed the work considerably at Loi Maw and Loi Líng, and as it became denser and as at the next station long rays would have to be observed, no further stations were visited.

The detachment returned to Dehra Dún in April and a small detachment was then formed to complete the programme of triangulation in the Dún begun in 1907.

Lieutenant Gwyn was attached to the party and he and Lieutenant Cardew completed the observations at Doíwála H. S. of the Great Arc series. The dust haze was very dense and the observations were only completed with the greatest difficulty, so it was decided not to attempt to do any more that year.

The health of the detachment both in the Shan States and in the Dún was good.

A detailed statement of the outturn of work is appended to this report.

9. In 1908-09 the Great Salween series was continued from where it had been left off by Lieutenant Cardew the previous year.

Captain C. M. Browne, R.E., was the observer and the detachment assembled at Lashio on the 9th of November, but heavy rain fell continually until almost the end of November and no work was possible until the first week in December.

New stations were fixed at Kiip Ma, Hpa Hpak, Tawn, Paning, Pè-möng Aunglawn, and Wánwa.

An astronomical azimuth was observed at Kiip Ma and the difference found between the value so obtained and that computed from the triangulation was 8"·60 which is in accordance with the other values found in that part of Burma.

In addition to the principal triangulation Captain Browne fixed several of the stations of the topographical triangulation on which No. 11 Party were basing their work.

The dust haze came on very early in the year and work had to be closed on the 2nd March, the detachment arriving at Lashio on the 21st of March.

The country east of the Salween river is very difficult to traverse, the hills being very steep and roads almost non-existent.

The health of the detachment was on the whole good although in the early part of the season fever was very prevalent, and in the district small pox was rife in the villages, care was taken to avoid camping in the villages where there were cases and no case occurred among the survey establishment.

A detailed statement of the outturn of work is given at the end of this report.

10. *Upper Irrawaddy detachment.*—Mr. Smith with a small detachment selected and built the stations for this series from the initial side Loï Song-Tangte of the Great Salween series up to latitude 25° 30′.

Lieutenant Cardew, R.E., will this coming field season observe these stations and continue the selection and building.

The series is intended to turn to the west at its present limit of latitude and running due west up to longitude 96° turn to the south and join on to the Mandalay series in the neighbourhood of Katha.

11. *Kashmír detachment.*—The programme for this detachment was to commence a series from the side Nehr-Khagriána of the North-Western Himalaya series, and to carry it northward to connect up with the existing triangulation in Kashmír.

The detachment was formed in Dehra Dún in the middle of April and proceeded to Ráwalpindi and from thence to Nehr.

The work was much delayed at the start from the fact that no stations had been built in advance and in the months of July and August by the monsoon.

Mr. Wyatt with a small party was detached to inspect and repair the stations of the Kashmír (Montogomerie's) series.

As the detachment is still in the field details of the work will have to be given in next year's report.

12. (*d*) *Secondary Triangulation.*—In the Punjab a traverse was run with the Jaderin apparatus from Búrála T. S. of the Jogi Tíla series to Shorkot H. S. and Doráwála S. in order to co-ordinate the various traverses on which the topographical and revenue work of that district is based. The observers were Messrs. Tresham, Wyatt and McInnes.

The work was carried out with every care to ensure accuracy and it would appear more probable that the large difference found between the values now obtained for Shorkot and Doráwála and those given in the synoptical volume is due to errors of the secondary series by which they were fixed unless the assumed length of "C" wire is largely in error.

The fact that the difference becomes smaller on coming back to Doráwála than it is at Shorkot, seems to indicate that there is some error in the assumed length of "C" wire. Comparative data for these two stations are given below:—

I. Represents values obtained from the traverse;

II. that from the synoptical volume of the Jogi-Tíla Meridional series.

Station.		Latitude.	Longitude.
Shorkot	I.	30° 49′ 57″·80	72° 06′ 42″·30
"	II.	30° 49′ 58″·51	72° 06′ 43″·23
Doráwála	I.	30° 27′ 51″·64	72° 29′ 55″·725
"	II.	30° 27′ 52″·60	72° 29′ 56″·02

The total length of the traverse was 118 miles and as bench-marks have been embedded at about every 6 miles the heights of which were ascertained by spirit levelling during the course of the work, the line should be of permanent utility when the error has been located and distributed.

A detailed statement of the outturn of work is given at the end of this report.

13. (*e*) (1) In Assam Mr. Johnson commenced the selection and building of the stations for the Khási Hills secondary series. His detachment consisted of 22 men and field work was begun from Shillong in the beginning of November.

Some difficulty was experienced in obtaining transport and supplies, and the detachment suffered a good deal from malarial fever.

Twelve stations were selected and built, and Mr. Smith will this field season observe them, and continue the selection and building of the series.

14. (*e*) (2) In Lower Burma the selection and building of stations for the Mawkmai secondary series was carried from the initial side (Letpataung-Suletaung) of the Mandalay Meridional series, up to longitude 98° 15′.

The Mawkmai series will run from the Mandalay Meridional series up to the Mongsat secondary series.

Two observers are to be employed this field season and it is hoped that it will be completed this year.

In the year under report Mr. Collins was in charge of the detachment and 28 stations were selected and built.

15. (*e*) (3) In Upper Burma a small detachment under Babu Mohan Lal Arora was employed on the selection and building of the stations for a secondary series in the Bhamo district, starting from the side Tangte-Taungkalat of the Great Salween series.

The series was intended to run north along the meridian of 97° and Lieutenant Cardew will endeavour to fix the stations already built from his principal stations on the Upper Irrawaddy series.

In recess the computations of the last field season's work were completed, and the recomputation of the Kalát Longitudinal series (necessitated by the re-grinding of the Kopadhar-Pragi figure) carried out.

16. The party was inspected in recess by the Superintendent, Trigonometrical Surveys, on the 30th June.

STATEMENT OF OUTTURN OF WORK.

Kalát Longitudinal Series.

1907-08.

Number of principal stations at which observations were taken	10
Ditto ditto newly fixed	6
Length of new series, in miles	107
Area of triangulation, in square miles	2,375
Average triangular error of 13 triangles	0″·35
Value of Astronomical-Geodetic azimuth at Tuzgi	+ 6″·97
Ditto ditto ditto at Koh-i-Malik Siah	+ 13″·24

Great Salween Series.

1907-08.

Number of principal stations at which observations were taken	7
Ditto ditto newly fixed	5
Length of new series, in miles	55
Area of triangulation, in square miles	1,800
Average triangular error of 14 triangles	0″·64
Value of Astronomical-Geodetic azimuth at Loi Hpa-tan	−08″·01

1908-09.

Number of principal stations at which observations were taken	8
Ditto ditto newly fixed	8
Length of new series, in miles	100
Area of triangulation, in square miles	4,200
Average triangular error of 9 triangles	0″·47
Value of Astronomical-Geodetic azimuth at Kiip Ma	−8″·60

North Baluchistán Series.

1907-08.

Number of principal stations at which observations were taken	8
Ditto ditto newly fixed	6
Length of new series, in miles	100
Area of triangulation, in square miles	3,500
Average triangular error of 9 triangles	0″·41
Value of Astronomical-Geodetic azimuth at Mashelak	+ 1″·25

North Baluchistán Series.

1908-09.

Number of principal stations at which observations were taken	7
Ditto secondary ditto ditto ditto .	4
Ditto principal stations newly fixed	4
Ditto secondary ditto ditto	4
Length of new series in miles, principal	50
Ditto ditto ditto secondary	50
Area of triangulation, in square miles, principal . . .	1,900
Ditto ditto ditto secondary . .	1,200
Average triangular error of 7 triangles of the principal series	0″·60
Ditto ditto of 11 ditto secondary series	3″·58
Value of Astronomical-Geodetic azimuth at Umar Khel .	+7″·66

Jaderin Traverse.

Length of traverse in miles	118
Number of stations at which observations were taken . .	76
Ditto markstones embedded and fixed . . .	22

Comparative of Stations and Intersected Points of the Kalát Longitudinal Series.

Name of Station.	G. T. Values. Latitude.	G. T. Values. Longitude.	G. T. Values. Height.	Mr. Tate's Values. Latitude.	Mr. Tate's Values. Longitude.	Mr. Tate's Values. Height.	Error. Latitude.	Error. Longitude.	Error. Height.	Remarks.
	° ′ ″	° ′ ″	Feet.	° ′ ″	° ′ ″	Feet.	″	″	Feet.	
Amalaf Speak	29 8 57·7	61 42 57·2	4387·2	29 8 59·7	61 43 2·7	4,372	+2·0	+5·5	+13·8	
Borghar	29 10 41·34	61 56 41·83	...	29 10 43·5	61 56 47·3	4,029	+2·16	+5·47	...	
Garuki Gori	29 27 25·465	61 47 57·798	2374·3	29 27 27·5	61 48 2·9	2,387	+2·035	+5·102	+12·7	G. T. S.
Padagi	29 28 41·44	61 06 48·88	7016·8	29 28 43·1	61 06 54·0	7,033	+1·66	+5·12	+16·2	
Buzaf	29 21 52·04	60 44 06·54	8439·6	29 21 53·5	60 44 11·3	8,453	+1·46	+4·76	+13·4	
Jikuli	29 21 54·85	60 49 17·79	6758·9	29 21 56·7	60 49 23·3	6,773	+1·85	+5·51	+14·1	
Lar Koh	29 43 13·844	60 55 05·553	7772·1	29 43 25·2	60 55 11·5	7,766	+11·356	+5·947	+ 6·0	G. T. S.
Koh-i-Malik Siah	29 51 32·043	60 54 46·630	5392·5	29 51 33·9	60 54 51·4	5,392	+1·857	+4·770	— ·5	G. T. S.

Errors in azimuth.

Stations.	G. T. Azimuth.	Mr. Tate's Azimuth.	Difference.	G. T. reverse Azimuth.	Mr. Tate's reverse Azimuth.	Difference.
	° ′ ″	° ′ ″	″	° ′ ″	° ′ ″	″
Gharibo H. S. and Koh-i-Sultán H. S.	34 02 26·273	34 02 15·40	—10·873	213 57 37·299	213 57 17·0	—20·299
Garuki Gori H. S. and Koh-i-Malik Siah H. S.	117 38 57·47	117 38 31·0	—26·47	297 12 38·378	297 12 11·7	—26·678
Koh-i-Malik Siah and Buzaf	17 29 17·2	17 28 59·0	—18·2	197 24 0·9	197 23 45·0	—15·9
Koh-i-Malik Siah and Jikuli	9 12 23·0	9 11 42·0	—41·0	189 09 40·50	189 09 01·8	—38·70

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EXTRACTS

FROM

NARRATIVE REPORTS

OF OFFICERS OF THE

Survey of India

FOR THE SEASON

1908-09

PREPARED UNDER THE DIRECTION OF

COLONEL F. B. LONGE, R.E., C.B., A.-D.-C.
SURVEYOR GENERAL OF INDIA

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