Preliminary Report on a Survey of Magnetic Declination near the Royal Alfred Observatory, Mauritius.

By Thomas Folkes Claxton, Director.

(Communicated by Dr. C. Chree, F.R.S. Received June 22, 1905.)

The accompanying chart is a graphic representation of the results of a survey of magnetic declination over a portion of the grounds of the Royal Alfred Observatory, Mauritius, which originated as follows :—

Absolute determinations of the magnetic elements have been made with instruments of the Kew pattern since the year 1875, and in the year 1903 it was decided to utilise the 12-inch theodolite for more refined observations of declination. For this purpose its vertical pillar was removed and a brass one substituted. Suitable experiments showed that the small steel screws in various parts of the instrument had no sensible effect on the declination magnet when at a distance of 4 feet from the theodolite.

It was considered advisable to mount the new apparatus as near as possible to the old magnetic pavilion, but at a sufficient distance to avoid sensible interaction of the magnets during the observations of dip and horizontal force in the old pavilion.

It was further desirable that the spot selected should command a view of the astronomical mark on Pieter Both, a hill some six miles to the south. The mark formerly used is only 150 yards to the south of the old pavilion. A concrete pillar for the theodolite was accordingly erected 90 feet to the south (magnetic) of the old declinometer pillar, and a pavilion built over it 12 feet long by 7 feet wide and 10 feet high. The magnet was mounted on a solid teak table 6 feet to the south of the theodolite, and it was found that at this spot the declination was 10° 35′ (west), or 1° 20′ greater than on the old declinometer pillar 90 feet to northward.

Observations at intermediate points gave the results shown on p. 508.

On November 4 observations were taken along a line running east-south-east from Station No. 4, at intervals of from 10 to 30 feet, and on November 7 at intervals of 10 feet in a direction south-south-east from the same station.

When plotted on a chart, however, the results showed that observations at much closer intervals were necessary before accurate isogonic lines could be drawn ; the instrument was therefore made to slide along a plank, to the sides of which wooden runners were attached, serving as guides for a grooved support carrying the instrument. Holes were drilled in the plank at

Date, 1904.	Number of station.	Rectangular co-ordinates from old declinometer pillar.		Observed value of declination (west).	Magneto-graph reading.	Comparative values of declination.
		South (astronomical).	East (astronomical).			
d. h. m.		feet.	feet.	° ′	′	° ′
October 24 9 5...	1	+72·7	+9·6	10 1	9	9 52
9 27...	2	+51·4	+6·6	9 30	9	9 21
9 53...	3	+38·9	+5·3	9 19	9	9 10
10 20...	4	+15·8	+3·0	8 24	9	8 15
10 37...	5	+20·0	+3·6	8 16	8	8 8
11 5...	6	+23·1	+3·8	8 19	8	8 11
11 32...	7	+26·4	+3·9	8 32	7	8 25
11 50...	8	+30·0	+4·0	8 43	6	8 37
12 15...	9	+34·4	+4·4	8 59	5	8 54
12 39...	10	+21·8	+3·7	8 14	4	8 10

intervals of 6 inches, and after setting up the plank on trestles, in any desired position, the declinometer was accurately centred over the first hole and its position determined, with plumb line and tape, by triangulation from certain fixed points. After observing over each hole in succession the position of the declinometer was again determined when centred over the last hole, and intermediate positions obtained by interpolation.

Care was taken to keep the magnet as nearly as possible at a constant distance (about 4 feet) from the ground throughout the survey; but the observations tend to show that perfect success in this respect was not obtained, and two or three sets near one of the foci were rejected, as the plotted results indicated that the plank was either too high or too low. Observations at one station gave 12° 40′ (west) as the declination at 4 feet from the ground, and 14° 0′ (west) at 2 feet above the ground.

Plotting the position of the plank on a chart, together with the results of the observations as soon as completed, showed where other observations were necessary, and in this manner the various foci were located without unduly multiplying the observations, the intervals being suited to the declination gradient. At some places it was necessary to observe at the beginning and end of the plank only, while at the first focus discovered the declination was changing so rapidly that the plank was discarded and observations taken at rectangular intervals of 3 inches, on a table ruled and grooved for this purpose.

Thus the survey became extended until sufficient (893) observations were obtained to construct the accompanying chart.

The labour of observation and reduction was lightened by using a subsidiary theodolite, placed in view of the astronomical mark and at a

sufficient distance from the declinometer. The reading on the horizontal circle of the theodolite corresponding to the astronomical meridian was obtained by measuring the distance of the theodolite east or west of the transit instrument, and from observation of the mark, which bears due south from the transit instrument. It was then only necessary to observe the bearing of the middle of the declinometer with the theodolite, and *vice versâ*, to obtain the reading on the declinometer corresponding to the astronomical meridian.

Three well marked foci were detected, as follows :—

Focus.	Phase.	Rectangular co-ordinates from old pillar.		Declination reduced to a constant magneto-graph reading.	Distance between maximum and minimum.	Mean gradient from maximum to minimum.
		South.	East.			
		feet.	feet.	° ′	feet.	1° in
1	Maximum	+16·3	+24·7	10 45	11·4	1·9 feet
	Minimum	+18·3	+13·5	4 56		
2	Maximum	+51·4	−13·7	13 45	8·5	1·1 „
	Minimum	+53·4	−22·0	6 20		
3	Maximum	+34·3	+95·6	12 50	23·5	4·6 „
	Minimum	+38·0	+72·6	7 45		

Notwithstanding the 893 observations from which the accompanying chart has been constructed, the true undisturbed value of the declination at the observatory is by no means evident. About midway between the old and new piers the isogonic line of 9° 30′ forms a triangle, of about 200 square feet area, towards the centre of which the declination decreases to 9° 20′. From the north-west angle of the triangle the declination increases rapidly towards the west, on the south side increases towards the south, and on the east side decreases towards the north-east and increases towards the south-east.

Were this the only "plateau" shown on the map a value between 9° 20′ and 9° 30′ might be assumed as the true declination; but between 30 and 50 feet to the east-north-east of the old pier the isogonic line of 10° forms an ellipse, of about 500 square feet area, over which the declination is nearly constant, except to the north-west of its centre where the declination increases to 10° 10′. Another area of relatively shallow gradients is that immediately to the north-west of the old pier, particularly between the isogonic lines of 9° 30′ and 9° 45′.

It appears, therefore, that the normal declination at the Royal Alfred Observatory, Mauritius, is about 9° 45′, or 30′ greater than the value

obtained on the old pier, used for the values published in the annual volume of meteorological and magnetical observations since the year 1875.

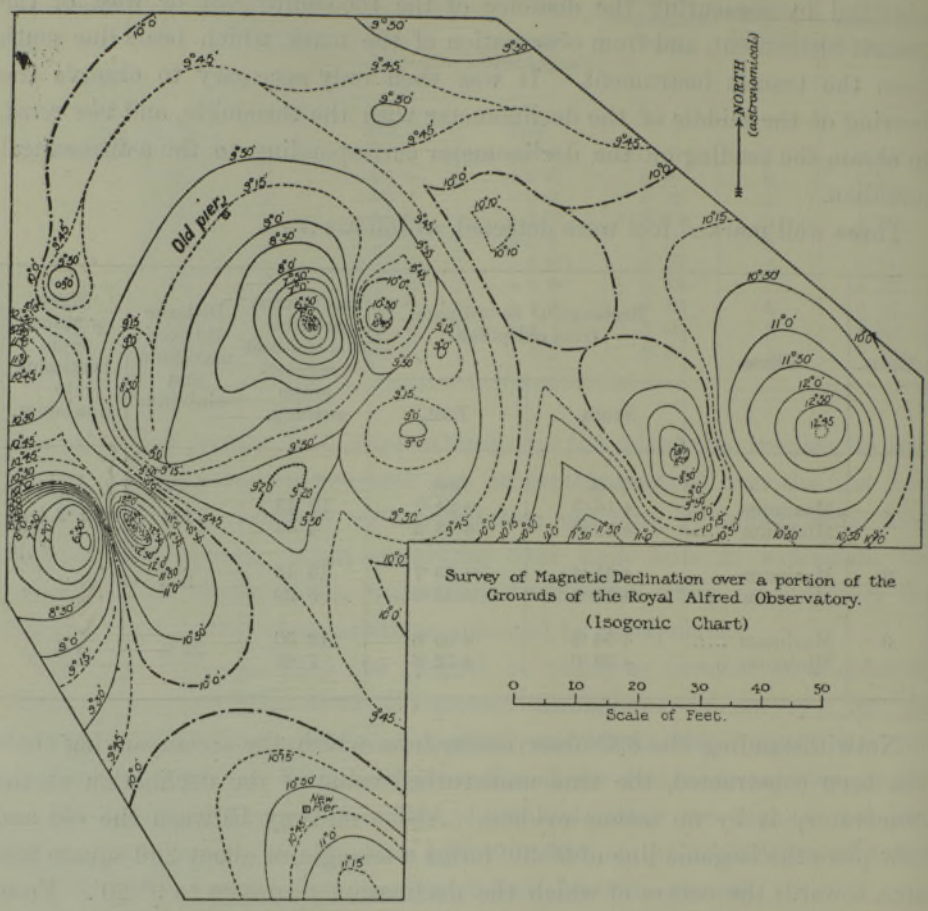

FIG. 1.

In the year 1899 observations of magnetic declination were made at 23 stations in different parts of the island; the two extreme values, 11° 29′ (west) and 7° 30′ (west), were obtained at points separated by only 400 yards, while the mean of the 23 values was 9° 25′. The horizontal force was observed at twelve, and the dip at six of these stations. The mean results were for horizontal force 0·2310 (C.G.S. unit) and for dip 55° 4′ (south).

The horizontal force and dip were observed near the two principal foci detected at the observatory, with the following results:—

Focus.	Station.	Rectangular co-ordinates from old pillar.		Observed.		Resulting.	
		South.	East.	Horizontal force.	Dip (south).	Vertical force.	Total force.
		feet.	feet.	(C.G.S.).	° ′		
1	A	+13·1	+19·2	0·2282	53 26	0·3077	0·3831
	B	+16·7	+19·4	0·2355	52 16	0·3043	0·3848
	C	+21·7	+19·9	0·2439	51 56	0·3114	0·3955
2	D	+54·6	−16·6	0·2400	50 28	0·2908	0·3770
	E	+47·7	−19·6	0·2011	55 37	0·2939	0·3561
	F	+46·7	−20·5	0·1969	57 36	0·3103	0·3675
	G	+46·0	−21·3	0·1993	58 34	0·3261	0·3813
	H	+58·6	−15·2	—	50 47		
	I	+53·4	−16·8	—	50 21		

Station B lies about midway between the positions of maximum and minimum (declination) of Focus No. 1. Stations E to I lie nearly at right angles to a line joining the positions of maximum and minimum (declination) of Focus No. 2.

It will be seen that from D to G, a distance of 9·7 feet, the dip varies 8° 6′, the horizontal force 0·0407 (C.G.S. unit), the vertical force 0·0353 (C.G.S. unit), and the total force 0·0043 (C.G.S. unit).