

IV. *A Contribution to Terrestrial Magnetism; being the Record of Observations of the Magnetic Inclination, or Dip, made during the Voyage of H.M.S. 'Iron Duke' to China and Japan, &c., 1871-75. By Vice-Admiral Sir CHARLES SHADWELL, K.C.B., F.R.S.*

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IN the following paper I propose to place on record, and submit for the information of the Royal Society, the observations made by me for the determination of the magnetic inclination, or dip of the magnetic needle, during the recent voyages of H.M.S. 'Iron Duke' in the Eastern Seas, when visiting China, Japan, and places adjacent, between October 1871 and April 1875.

The instrument employed was a six-inch dip-circle by ROBINSON, furnished with two needles, and graduated to ten minutes, which was formerly the property of the late Capt. FRANCIS P. BLACKWOOD, R.N., and which was used by me during that officer's survey of the N.E. coast of Australia in H.M.S. 'Fly,' 1842-46.

This instrument was subsequently lent to me while I was in command of H.M.S. 'Highflyer,' employed on the China Station, 1857-59, and has since passed into my possession by gift from the son of my former Captain.

I have thus had the opportunity of repeating, with the same circle and needles, the observations made at various places in China and elsewhere after the lapse of some years, and have thus obtained data for the approximate deduction of the values of the secular changes in this element at some of the stations visited, which may perhaps give to these observations a greater value than they would otherwise possess.

Moreover, in some instances, I have not only had the opportunity of observing the dip at stations along the eastern coasts of Asia, but also of obtaining its value at some places in the chain of islands lying to the eastward from Labuan up to Yezo, which will thus afford the means, by aid of a graphic projection, of determining, approximately, the general direction of the "isoclinal lines" in those parts.

The observations were made generally in the manner described in the 'Admiralty Manual of Scientific Inquiry,' with every possible precaution to eliminate accidental errors of observation; the readings were taken both for the lower and upper ends of the needle, on the graduated circle, "face to face" and "face reversed," "face east" and "face west," "poles direct" and "poles reversed," three readings being taken in each position of the instrument, so that the final result for the dip for each needle is the mean of forty-eight readings; and the observations being repeated in like manner with the second needle, the "mean concluded dip" at each station is the mean result of the observations by the two needles.

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In arranging the observations, after first recording in Table I. those taken on the voyages out and home, 1871 and 1875, to and from Singapore, I have given in Table II. those taken in the Eastern Seas, in order of the latitudes of the stations visited; but in all cases where the observations have been subsequently repeated at the same station I have noted all the results obtained at the same place in the Table in succession.

Finally, I have briefly compared the results of some of the observations here given with those made by me at the same stations at former periods, and have added such remarks as the comparisons suggested.

TABLE I.

No.	Date and time.	Station.	No. of needle.	Poles direct and reversed.	Mean dip.	Mean concluded dip.	Remarks.																																																																																														
1.	1871. Oct. 9. 6.30 A.M. 7.20 "	Malta, 35° 53' N., 14° 31' E.	1.	51 50·7 51 34·7	} 51 42·7	} 51 42·5 N.	Taken near Isola Point, south side of the Fortification Wall.																																																																																														
			2.	51 56·4 51 28·4				} 51 42·4	2.	1875. Apr. 10. 5.40 A.M. 6.30 "	Same.	1.	51 38·8 51 40·8	} 51 39·5	} 51 38·9 N.	Ditto.	2.	51 40·4 51 36·4	} 51 38·4	3.	1875. Mar. 31. 3.10 P.M. 4.10 "	Port Said, Egypt, 31° 16' N., 32° 19' E.	1.	42 29·5 42 41	} 42 35·2	} 42 38·3 N.	Taken 200 yards N.W. of the Lighthouse.	2.	42 44·1 42 38·8	} 42 41·4	4.	1871. Oct. 24. 3. 0 P.M. 3.45 "	Suez, Egypt, 29° 57' N., 32° 34' E.	1.	40 52·6 40 56	} 40 54·3	} 40 54·5 N.	Taken at Observation Spot, North Pier of Dock.	2.	40 1·2 40 48·2	} 40 54·8	5.	1875. Mar. 23. 3.40 P.M. 4.30 "	Same.	1.	40 48·4 40 58·2	} 40 53·3	} 40 51·9 N.	Ditto.	2.	40 55·5 40 45·8	} 40 50·6	6.	1871. Nov. 7. 10.20 A.M. 11. 0 "	Aden, 12° 46' N., 45° 5' E.	1.	6 13·3 6 6·9	} 6 10·1	} 6 10 N.	Near a detached Bungalow at the Residency.	2.	6 23·4 5 56·5	} 6 9·9	7.	1875. Mar. 13. 6. 0 A.M. 6.50 "	Same.	1.	6 0·1 6 9·8	} 6 4·9	} 6 8·3 N.	Ditto.	2.	6 16·4 6 7·2	} 6 11·8	8.	1871. Nov. 30. 10.30 A.M. 11.30 "	Point de Galle, 6° 2' N., 80° 13' E.	1.	7 47 7 48·7	} 7 47·8	} 7 44 S.	In the Garden of the Queen's House.	2.	7 35·9 7 44·3	} 7 40·3	9.	1875. Feb. 23. 3. 0 P.M. 3.40 "	Same.	1.	8 0·7 7 39·9	} 7 50·3	} 7 46·8 S.	Same place, now become the property of Messrs. Clark, Spence, and Co.	2.	7 35·8 7 50·9	} 7 43·3	10.	1875. Feb. 17. 10.10 A.M. 11. 0 "	Trincomalee, Ceylon, 8° 34' N., 81° 13' E.	1.	1 59·9 1 49·2
2.	1875. Apr. 10. 5.40 A.M. 6.30 "	Same.	1.	51 38·8 51 40·8	} 51 39·5	} 51 38·9 N.	Ditto.																																																																																														
			2.	51 40·4 51 36·4				} 51 38·4	3.	1875. Mar. 31. 3.10 P.M. 4.10 "	Port Said, Egypt, 31° 16' N., 32° 19' E.	1.	42 29·5 42 41	} 42 35·2	} 42 38·3 N.	Taken 200 yards N.W. of the Lighthouse.	2.	42 44·1 42 38·8	} 42 41·4	4.	1871. Oct. 24. 3. 0 P.M. 3.45 "	Suez, Egypt, 29° 57' N., 32° 34' E.	1.	40 52·6 40 56	} 40 54·3	} 40 54·5 N.	Taken at Observation Spot, North Pier of Dock.	2.	40 1·2 40 48·2	} 40 54·8	5.	1875. Mar. 23. 3.40 P.M. 4.30 "	Same.	1.	40 48·4 40 58·2	} 40 53·3	} 40 51·9 N.	Ditto.	2.	40 55·5 40 45·8	} 40 50·6	6.	1871. Nov. 7. 10.20 A.M. 11. 0 "	Aden, 12° 46' N., 45° 5' E.	1.	6 13·3 6 6·9	} 6 10·1	} 6 10 N.	Near a detached Bungalow at the Residency.	2.	6 23·4 5 56·5	} 6 9·9	7.	1875. Mar. 13. 6. 0 A.M. 6.50 "	Same.	1.	6 0·1 6 9·8	} 6 4·9	} 6 8·3 N.	Ditto.	2.	6 16·4 6 7·2	} 6 11·8	8.	1871. Nov. 30. 10.30 A.M. 11.30 "	Point de Galle, 6° 2' N., 80° 13' E.	1.	7 47 7 48·7	} 7 47·8	} 7 44 S.	In the Garden of the Queen's House.	2.	7 35·9 7 44·3	} 7 40·3	9.	1875. Feb. 23. 3. 0 P.M. 3.40 "	Same.	1.	8 0·7 7 39·9	} 7 50·3	} 7 46·8 S.	Same place, now become the property of Messrs. Clark, Spence, and Co.	2.	7 35·8 7 50·9	} 7 43·3	10.	1875. Feb. 17. 10.10 A.M. 11. 0 "	Trincomalee, Ceylon, 8° 34' N., 81° 13' E.	1.	1 59·9 1 49·2	} 1 54·5	} 1 52·4 S.	Under a Banyan tree, N.E. side of the Admiralty House.	2.	1 44·1 1 56·6	} 1 50·3					
3.	1875. Mar. 31. 3.10 P.M. 4.10 "	Port Said, Egypt, 31° 16' N., 32° 19' E.	1.	42 29·5 42 41	} 42 35·2	} 42 38·3 N.	Taken 200 yards N.W. of the Lighthouse.																																																																																														
			2.	42 44·1 42 38·8				} 42 41·4	4.	1871. Oct. 24. 3. 0 P.M. 3.45 "	Suez, Egypt, 29° 57' N., 32° 34' E.	1.	40 52·6 40 56	} 40 54·3	} 40 54·5 N.	Taken at Observation Spot, North Pier of Dock.	2.	40 1·2 40 48·2	} 40 54·8	5.	1875. Mar. 23. 3.40 P.M. 4.30 "	Same.	1.	40 48·4 40 58·2	} 40 53·3	} 40 51·9 N.	Ditto.	2.	40 55·5 40 45·8	} 40 50·6	6.	1871. Nov. 7. 10.20 A.M. 11. 0 "	Aden, 12° 46' N., 45° 5' E.	1.	6 13·3 6 6·9	} 6 10·1	} 6 10 N.	Near a detached Bungalow at the Residency.	2.	6 23·4 5 56·5	} 6 9·9	7.	1875. Mar. 13. 6. 0 A.M. 6.50 "	Same.	1.	6 0·1 6 9·8	} 6 4·9	} 6 8·3 N.	Ditto.	2.	6 16·4 6 7·2	} 6 11·8	8.	1871. Nov. 30. 10.30 A.M. 11.30 "	Point de Galle, 6° 2' N., 80° 13' E.	1.	7 47 7 48·7	} 7 47·8	} 7 44 S.	In the Garden of the Queen's House.	2.	7 35·9 7 44·3	} 7 40·3	9.	1875. Feb. 23. 3. 0 P.M. 3.40 "	Same.	1.	8 0·7 7 39·9	} 7 50·3	} 7 46·8 S.	Same place, now become the property of Messrs. Clark, Spence, and Co.	2.	7 35·8 7 50·9	} 7 43·3	10.	1875. Feb. 17. 10.10 A.M. 11. 0 "	Trincomalee, Ceylon, 8° 34' N., 81° 13' E.	1.	1 59·9 1 49·2	} 1 54·5	} 1 52·4 S.	Under a Banyan tree, N.E. side of the Admiralty House.	2.	1 44·1 1 56·6	} 1 50·3																
4.	1871. Oct. 24. 3. 0 P.M. 3.45 "	Suez, Egypt, 29° 57' N., 32° 34' E.	1.	40 52·6 40 56	} 40 54·3	} 40 54·5 N.	Taken at Observation Spot, North Pier of Dock.																																																																																														
			2.	40 1·2 40 48·2				} 40 54·8	5.	1875. Mar. 23. 3.40 P.M. 4.30 "	Same.	1.	40 48·4 40 58·2	} 40 53·3	} 40 51·9 N.	Ditto.	2.	40 55·5 40 45·8	} 40 50·6	6.	1871. Nov. 7. 10.20 A.M. 11. 0 "	Aden, 12° 46' N., 45° 5' E.	1.	6 13·3 6 6·9	} 6 10·1	} 6 10 N.	Near a detached Bungalow at the Residency.	2.	6 23·4 5 56·5	} 6 9·9	7.	1875. Mar. 13. 6. 0 A.M. 6.50 "	Same.	1.	6 0·1 6 9·8	} 6 4·9	} 6 8·3 N.	Ditto.	2.	6 16·4 6 7·2	} 6 11·8	8.	1871. Nov. 30. 10.30 A.M. 11.30 "	Point de Galle, 6° 2' N., 80° 13' E.	1.	7 47 7 48·7	} 7 47·8	} 7 44 S.	In the Garden of the Queen's House.	2.	7 35·9 7 44·3	} 7 40·3	9.	1875. Feb. 23. 3. 0 P.M. 3.40 "	Same.	1.	8 0·7 7 39·9	} 7 50·3	} 7 46·8 S.	Same place, now become the property of Messrs. Clark, Spence, and Co.	2.	7 35·8 7 50·9	} 7 43·3	10.	1875. Feb. 17. 10.10 A.M. 11. 0 "	Trincomalee, Ceylon, 8° 34' N., 81° 13' E.	1.	1 59·9 1 49·2	} 1 54·5	} 1 52·4 S.	Under a Banyan tree, N.E. side of the Admiralty House.	2.	1 44·1 1 56·6	} 1 50·3																											
5.	1875. Mar. 23. 3.40 P.M. 4.30 "	Same.	1.	40 48·4 40 58·2	} 40 53·3	} 40 51·9 N.	Ditto.																																																																																														
			2.	40 55·5 40 45·8				} 40 50·6	6.	1871. Nov. 7. 10.20 A.M. 11. 0 "	Aden, 12° 46' N., 45° 5' E.	1.	6 13·3 6 6·9	} 6 10·1	} 6 10 N.	Near a detached Bungalow at the Residency.	2.	6 23·4 5 56·5	} 6 9·9	7.	1875. Mar. 13. 6. 0 A.M. 6.50 "	Same.	1.	6 0·1 6 9·8	} 6 4·9	} 6 8·3 N.	Ditto.	2.	6 16·4 6 7·2	} 6 11·8	8.	1871. Nov. 30. 10.30 A.M. 11.30 "	Point de Galle, 6° 2' N., 80° 13' E.	1.	7 47 7 48·7	} 7 47·8	} 7 44 S.	In the Garden of the Queen's House.	2.	7 35·9 7 44·3	} 7 40·3	9.	1875. Feb. 23. 3. 0 P.M. 3.40 "	Same.	1.	8 0·7 7 39·9	} 7 50·3	} 7 46·8 S.	Same place, now become the property of Messrs. Clark, Spence, and Co.	2.	7 35·8 7 50·9	} 7 43·3	10.	1875. Feb. 17. 10.10 A.M. 11. 0 "	Trincomalee, Ceylon, 8° 34' N., 81° 13' E.	1.	1 59·9 1 49·2	} 1 54·5	} 1 52·4 S.	Under a Banyan tree, N.E. side of the Admiralty House.	2.	1 44·1 1 56·6	} 1 50·3																																						
6.	1871. Nov. 7. 10.20 A.M. 11. 0 "	Aden, 12° 46' N., 45° 5' E.	1.	6 13·3 6 6·9	} 6 10·1	} 6 10 N.	Near a detached Bungalow at the Residency.																																																																																														
			2.	6 23·4 5 56·5				} 6 9·9	7.	1875. Mar. 13. 6. 0 A.M. 6.50 "	Same.	1.	6 0·1 6 9·8	} 6 4·9	} 6 8·3 N.	Ditto.	2.	6 16·4 6 7·2	} 6 11·8	8.	1871. Nov. 30. 10.30 A.M. 11.30 "	Point de Galle, 6° 2' N., 80° 13' E.	1.	7 47 7 48·7	} 7 47·8	} 7 44 S.	In the Garden of the Queen's House.	2.	7 35·9 7 44·3	} 7 40·3	9.	1875. Feb. 23. 3. 0 P.M. 3.40 "	Same.	1.	8 0·7 7 39·9	} 7 50·3	} 7 46·8 S.	Same place, now become the property of Messrs. Clark, Spence, and Co.	2.	7 35·8 7 50·9	} 7 43·3	10.	1875. Feb. 17. 10.10 A.M. 11. 0 "	Trincomalee, Ceylon, 8° 34' N., 81° 13' E.	1.	1 59·9 1 49·2	} 1 54·5	} 1 52·4 S.	Under a Banyan tree, N.E. side of the Admiralty House.	2.	1 44·1 1 56·6	} 1 50·3																																																	
7.	1875. Mar. 13. 6. 0 A.M. 6.50 "	Same.	1.	6 0·1 6 9·8	} 6 4·9	} 6 8·3 N.	Ditto.																																																																																														
			2.	6 16·4 6 7·2				} 6 11·8	8.	1871. Nov. 30. 10.30 A.M. 11.30 "	Point de Galle, 6° 2' N., 80° 13' E.	1.	7 47 7 48·7	} 7 47·8	} 7 44 S.	In the Garden of the Queen's House.	2.	7 35·9 7 44·3	} 7 40·3	9.	1875. Feb. 23. 3. 0 P.M. 3.40 "	Same.	1.	8 0·7 7 39·9	} 7 50·3	} 7 46·8 S.	Same place, now become the property of Messrs. Clark, Spence, and Co.	2.	7 35·8 7 50·9	} 7 43·3	10.	1875. Feb. 17. 10.10 A.M. 11. 0 "	Trincomalee, Ceylon, 8° 34' N., 81° 13' E.	1.	1 59·9 1 49·2	} 1 54·5	} 1 52·4 S.	Under a Banyan tree, N.E. side of the Admiralty House.	2.	1 44·1 1 56·6	} 1 50·3																																																												
8.	1871. Nov. 30. 10.30 A.M. 11.30 "	Point de Galle, 6° 2' N., 80° 13' E.	1.	7 47 7 48·7	} 7 47·8	} 7 44 S.	In the Garden of the Queen's House.																																																																																														
			2.	7 35·9 7 44·3				} 7 40·3	9.	1875. Feb. 23. 3. 0 P.M. 3.40 "	Same.	1.	8 0·7 7 39·9	} 7 50·3	} 7 46·8 S.	Same place, now become the property of Messrs. Clark, Spence, and Co.	2.	7 35·8 7 50·9	} 7 43·3	10.	1875. Feb. 17. 10.10 A.M. 11. 0 "	Trincomalee, Ceylon, 8° 34' N., 81° 13' E.	1.	1 59·9 1 49·2	} 1 54·5	} 1 52·4 S.	Under a Banyan tree, N.E. side of the Admiralty House.	2.	1 44·1 1 56·6	} 1 50·3																																																																							
9.	1875. Feb. 23. 3. 0 P.M. 3.40 "	Same.	1.	8 0·7 7 39·9	} 7 50·3	} 7 46·8 S.	Same place, now become the property of Messrs. Clark, Spence, and Co.																																																																																														
			2.	7 35·8 7 50·9				} 7 43·3	10.	1875. Feb. 17. 10.10 A.M. 11. 0 "	Trincomalee, Ceylon, 8° 34' N., 81° 13' E.	1.	1 59·9 1 49·2	} 1 54·5	} 1 52·4 S.	Under a Banyan tree, N.E. side of the Admiralty House.	2.	1 44·1 1 56·6	} 1 50·3																																																																																		
10.	1875. Feb. 17. 10.10 A.M. 11. 0 "	Trincomalee, Ceylon, 8° 34' N., 81° 13' E.	1.	1 59·9 1 49·2	} 1 54·5	} 1 52·4 S.	Under a Banyan tree, N.E. side of the Admiralty House.																																																																																														
			2.	1 44·1 1 56·6				} 1 50·3																																																																																													

TABLE II.

No.	Date and time.	Station.	No. of needle.	Poles direct and reversed.	Mean dip.	Mean concluded dip.	Remarks.
11.	1874. Feb. 21. 7. 0 A.M. 7.55 „	Singapore, 1° 17' N., 103° 51' E.	1.	13 26.5 13 9	13 17.7	13 15.5 s.	Taken in the Garden on N.E. side of Government House.
			2.	13 0.6 13 25.9	13 13.3		
12.	1874. Feb. 23. 7.30 A.M. 8. 0 „	Same.	1.	13 20.7 13 8.4	13 14.5	13 13.8 s.	Ditto.
			2.	13 5.7 13 20.5	13 13.1		
13.	1875. Jan. 31. 6.45 A.M. 7.30 „	Same.	1.	13 26.9 13 17.9	13 22.4	13 19.6 s.	Taken on the lawn in front of Government House.
			2.	13 10.4 13 23.5	13 16.9		
14.	1872. Jan. 30. 11.30 A.M. 12.15 P.M.	Labuan, 5° 16' N., 115° 15' E.	1.	2 11.9 2 3.8	2 7.8	2 8.7 s.	Taken under some trees on west side of Cemetery near the Flagstaff.
			2.	2 7.6 2 11.8	2 9.7		
15.	1872. Jan. 4. 6.15 A.M. 7.10 „	Island of Penang, Straits of Malacca, 5° 25' N., 100° 14' E.	1.	5 1.2 5 9.6	5 5.4	5 6.9 s.	Taken at the Compound at the Police Station, under a tree at the west end.
			2.	5 4.2 5 12.9	5 8.5		
16.	1874. Feb. 1. 6.10 A.M. 7. 0 „	Same.	1.	5 16.3 5 5.0	5 10.6	5 8.6 s.	Ditto.
			2.	4 59.4 5 13.9	5 6.6		
17.	1874. Mar. 5. 6.30 A.M. 7.15 „	Saigon, Cochin China, 10° 47' N., 106° 42' E.	1.	7 44.6 8 16.6	8 0.6	8 1.9 N.	On east side of Saigon river, opposite the town.
			2.	8 14.8 7 51.9	8 3.3		
18.	1874. Jan. 14. 6.40 A.M. 7.30 „	Bankok, Siam, 13° 45' N., 100° 29' E.	1.	12 56.9 13 16.7	13 6.8	13 7.9 N.	Taken in the Garden of the British Consulate.
			2.	13 21.4 12 56.9	13 9.1		
19.	1872. Feb. 9. 6.50 A.M. 7.40 „	Manilla, Philippine Islands, 14° 36' N., 120° 58' E.	1.	17 54.7 18 20.2	18 7.5	18 8.2 N.	Taken in the Garden of the British Consul's residence in the suburbs.
			2.	18 20.4 17 57.5	18 8.9		
20.	1872. Apr. 12. 9.45 A.M. 10.30 „	Hong Kong, China, 22° 16' N., 114° 10' E.	1.	32 16.4 32 24.5	32 20.4	32 17.9 N.	Taken at the Wellington Battery.
			2.	32 23.4 32 7.7	32 15.5		
21.	1873. Apr. 1. 10. 0 A.M. 10.50 „	Same.	1.	32 13.2 32 25.4	32 19.3	32 19.5 N.	Ditto.
			2.	32 31.2 32 8.5	32 19.8		
22.	1874. Dec. 21. 9.50 A.M. 10.45 „	Same.	1.	32 16.7 32 19.9	32 18.3	32 17.3 N.	Ditto.
			2.	32 16.9 32 16	32 16.4		

TABLE II. (continued).

No.	Date and time.	Station.	No. of needle.	Poles direct and reversed.	Mean dip.	Mean concluded dip.	Remarks.
23.	1873. Apr. 24. 4.20 P.M. 5.10 „	Takau, Island of Formosa, 23° 37' N., 120° 16' E.	1.	32 40.4 32 53.8	} 32 47.1	} 32 45.8 N.	At Messrs. Brown's Garden, inside the Harbour of Takau.
			2.	32 53.8 32 35.2			
24.	1872. Mar. 13. 7.30 A.M. 8.20 „	Canton, China, 23° 8' N., 113° 15' E.	1.	34 16.2 33 22.9 33 33.5	} 33 49.5	} 33 39.9 N.	Taken in the Garden of the Tartar General's Yamen, the residence of Sir Brooke Robertson, C.B., H.M.'s Consul.
			2.	32 27.4			
25.	1872. Mar. 14. 7.20 A.M. 8. 5 „	Same.	1.	33 40.7 33 31.2	} 33 35.9	} 33 36.1 N.	Ditto.
			2.	33 47.6 33 25.2			
26.	1872. Apr. 20. 3. 0 P.M. 3.40 „	Swatow, China, 23° 21' N., 116° 40' E.	1.	33 58.9 34 16.9	} 34 7.9	} 34 9.9 N.	Taken in the Garden of the British Consulate.
			2.	34 22.3 34 1.8			
27.	1873. Apr. 22. 3. 0 P.M. 3.50 „	Pong Chow, Pescadores Islands, 23° 32' N., 119° 34' E.	1.	34 33.2 34 29.2	} 34 31.2	} 34 34.6 N.	Taken on the beach.
			2.	34 48.4 34 27.6			
28.	1872. Apr. 26. 4.15 P.M. 5. 0 „	Amoy, China, 24° 28' N., 118° 4' E.	1.	36 6.1 36 11.2	} 36 8.6	} 36 10.4 N.	Taken on the Island of Ku- lung-su, in the Garden of the British Consulate.
			2.	36 16 36 8.6			
29.	1873. Apr. 17. 10.16 A.M. 11. 0 „	Same.	1.	35 48.3 36 18.7	} 36 3.5	} 36 6.8 N.	Ditto.
			2.	36 18.1 36 2.1			
30.	1874. Apr. 25. 3.40 P.M. 4.20 „	Same.	1.	36 1.3 36 20.7	} 36 11	} 36 9.1 N.	Ditto.
			2.	36 20.1 35 54.4			
31.	1873. Apr. 29. 10. 0 A.M. 10.50 „	Kelung, Island of Formosa, China Sea, 25° 8' N., 121° 45' E.	1.	36 44.7 36 46.4	} 36 45.5	} 36 47 N.	Taken on the beach on the east side of the harbour.
			2.	36 54.3 36 42.8			
32.	1872. Dec. 18. 10.30 A.M. 11. 0 „	Foo Chow Foo, China, on the River Min, 26° 2' N., 119° 18' E.	1.	38 26.3 38 31.6	} 38 28.9	} 38 30.9 N.	Taken in the Garden of the British Consulate.
			2.	38 41.1 38 25			
33.	1872. Nov. 5. 3. 0 P.M. 3.40 „	Kiu Kiang, River Yangtoe, China, 29° 44' N., 116° 8' E.	1.	43 58 44 11.3	} 44 4.6	} 44 5.4 N.	In the Compound of the British Consulate.
			2.	44 16.9 43 55.6			
34.	1872. Dec. 12. 3. 0 P.M. 3.30 „	Ningpo, China, 29° 52' N., 121° 34' E.	1.	43 54.2 44 15.8	} 44 5	} 44 5.8 N.	In the Compound of the British Consulate.
			2.	44 13.4 44 0.1			

TABLE II. (continued).

No.	Date and time.	Station.	No. of needle.	Poles direct and reversed.	Mean dip.	Mean concluded dip.	Remarks.																																																																																																																				
35.	1872. Nov. 11. 4. 0 P.M. 4.30 "	Hankow, River Yangtse, China, 30° 33' N., 114° 20' E.	1.	45 6.1 45 32.2	} 45 19.1	} 45 19.5 N.	Taken in the Garden of the British Consulate.																																																																																																																				
			2.	45 24 45 15.9				} 45 19.9	36.	1872. May 14. 9.30 A.M. 10.30 "	Shanghai, China, 31° 15' N., 121° 29' E.	1.	46 10.9 46 22.9	} 46 16.9	} 46 14.3 N.	Taken in the Grounds of the British Consulate, near the Flagstaff.	2.	46 17.4 46 6	} 46 11.7	37.	1873. May 30. 10. 0 A.M. 10.50 "	Same.	1.	46 17.6 46 25.8	} 46 21.7	} 46 19.1 N.	Ditto.	2.	46 20.1 46 13.1	} 46 16.6	38.	1874. May 18. 10.0 A.M. 11.0 "	Same.	1.	46 7.7 46 25.8	} 46 16.7	} 46 17.4 N.	Ditto.	2.	46 26.7 46 9.6	} 46 18.2	39.	1872. Nov. 16. 3. 0 P.M. 3.35 "	Woosung, mouth of the Shanghai River, 31° 23' N., 121° 30' E.	1.	45 59.8 46 4.7	} 46 2.3	} 46 4 N.	Taken in the Harbour-master's Garden near the Signal Staff.	2.	46 11.6 45 59.8	} 46 5.7	40.	1872. Nov. 1. 4. 0 P.M. 4.45 "	Nanking, River Yangtse, China, 32° 6' N., 118° 44' E.	1.	47 5.6 47 19.4	} 47 12.5	} 47 13.6 N.	Taken on the shore. Right bank of the river.	2.	47 23.1 47 6.5	} 47 14.8	41.	1872. Oct. 31. 10.30 A.M. 11.15 "	Chin Kiang, River Yangtse. China, 32° 12' N., 119° 21' E.	1.	47 45.1 48 1.3	} 47 53.2	} 47 54.9 N.	Taken in a field below the British Consulate.	2.	48 3.8 47 49.7	} 47 57.6	42.	1872. May 31. 4.30 P.M. 5.20 "	Nagasaki, Island of Kiusu, Japan, 32° 44' N., 129° 51' E.	1.	46 23.7 46 45.5	} 46 34.6	} 46 32.4 N.	Taken in a small Cove west side of Bay, near the Dutch Factory.	2.	46 39 46 21.6	} 46 30.3	43.	1874. June 1. 10. 0 A.M. 10.45 "	Same.	1.	47 21.3 47 32.4	} 47 26.8	} 47 26.1 N.	At a place very near the above, not 100 yards distant.	2.	47 29.1 47 21.8	} 47 25.4	44.	1874. June 2. 4.20 P.M. 5. 5 "	Same.	1.	46 29.8 46 40.9	} 46 35.3	} 46 35.0 N.	The same place as on May 31, 1872.	2.	46 38.6 46 30.8	} 46 34.7	45.	1874. June 3. 10.20 A.M. 11. 0 "	Same.	1.	47 14 47 32.7	} 47 23.3	} 47 22.1 N.	The same place as on June 1, 1874.	2.	47 28.9 47 13.1	} 47 21	46.	1872. June 28. 6. 0 A.M. 6.45 "	Hiogo, Island of Niphon, Japan, 34° 42' N., 135° 15' E.	1.	48 27.1 48 40.6
36.	1872. May 14. 9.30 A.M. 10.30 "	Shanghai, China, 31° 15' N., 121° 29' E.	1.	46 10.9 46 22.9	} 46 16.9	} 46 14.3 N.	Taken in the Grounds of the British Consulate, near the Flagstaff.																																																																																																																				
			2.	46 17.4 46 6				} 46 11.7	37.	1873. May 30. 10. 0 A.M. 10.50 "	Same.	1.	46 17.6 46 25.8	} 46 21.7	} 46 19.1 N.	Ditto.	2.	46 20.1 46 13.1	} 46 16.6	38.	1874. May 18. 10.0 A.M. 11.0 "	Same.	1.	46 7.7 46 25.8	} 46 16.7	} 46 17.4 N.	Ditto.	2.	46 26.7 46 9.6	} 46 18.2	39.	1872. Nov. 16. 3. 0 P.M. 3.35 "	Woosung, mouth of the Shanghai River, 31° 23' N., 121° 30' E.	1.	45 59.8 46 4.7	} 46 2.3	} 46 4 N.	Taken in the Harbour-master's Garden near the Signal Staff.	2.	46 11.6 45 59.8	} 46 5.7	40.	1872. Nov. 1. 4. 0 P.M. 4.45 "	Nanking, River Yangtse, China, 32° 6' N., 118° 44' E.	1.	47 5.6 47 19.4	} 47 12.5	} 47 13.6 N.	Taken on the shore. Right bank of the river.	2.	47 23.1 47 6.5	} 47 14.8	41.	1872. Oct. 31. 10.30 A.M. 11.15 "	Chin Kiang, River Yangtse. China, 32° 12' N., 119° 21' E.	1.	47 45.1 48 1.3	} 47 53.2	} 47 54.9 N.	Taken in a field below the British Consulate.	2.	48 3.8 47 49.7	} 47 57.6	42.	1872. May 31. 4.30 P.M. 5.20 "	Nagasaki, Island of Kiusu, Japan, 32° 44' N., 129° 51' E.	1.	46 23.7 46 45.5	} 46 34.6	} 46 32.4 N.	Taken in a small Cove west side of Bay, near the Dutch Factory.	2.	46 39 46 21.6	} 46 30.3	43.	1874. June 1. 10. 0 A.M. 10.45 "	Same.	1.	47 21.3 47 32.4	} 47 26.8	} 47 26.1 N.	At a place very near the above, not 100 yards distant.	2.	47 29.1 47 21.8	} 47 25.4	44.	1874. June 2. 4.20 P.M. 5. 5 "	Same.	1.	46 29.8 46 40.9	} 46 35.3	} 46 35.0 N.	The same place as on May 31, 1872.	2.	46 38.6 46 30.8	} 46 34.7	45.	1874. June 3. 10.20 A.M. 11. 0 "	Same.	1.	47 14 47 32.7	} 47 23.3	} 47 22.1 N.	The same place as on June 1, 1874.	2.	47 28.9 47 13.1	} 47 21	46.	1872. June 28. 6. 0 A.M. 6.45 "	Hiogo, Island of Niphon, Japan, 34° 42' N., 135° 15' E.	1.	48 27.1 48 40.6	} 48 33.8	} 48 32.6 N.	Taken in the rear of the German Union Club, Kobé.	2.	48 43.1 48 19.8	} 48 31.4					
37.	1873. May 30. 10. 0 A.M. 10.50 "	Same.	1.	46 17.6 46 25.8	} 46 21.7	} 46 19.1 N.	Ditto.																																																																																																																				
			2.	46 20.1 46 13.1				} 46 16.6	38.	1874. May 18. 10.0 A.M. 11.0 "	Same.	1.	46 7.7 46 25.8	} 46 16.7	} 46 17.4 N.	Ditto.	2.	46 26.7 46 9.6	} 46 18.2	39.	1872. Nov. 16. 3. 0 P.M. 3.35 "	Woosung, mouth of the Shanghai River, 31° 23' N., 121° 30' E.	1.	45 59.8 46 4.7	} 46 2.3	} 46 4 N.	Taken in the Harbour-master's Garden near the Signal Staff.	2.	46 11.6 45 59.8	} 46 5.7	40.	1872. Nov. 1. 4. 0 P.M. 4.45 "	Nanking, River Yangtse, China, 32° 6' N., 118° 44' E.	1.	47 5.6 47 19.4	} 47 12.5	} 47 13.6 N.	Taken on the shore. Right bank of the river.	2.	47 23.1 47 6.5	} 47 14.8	41.	1872. Oct. 31. 10.30 A.M. 11.15 "	Chin Kiang, River Yangtse. China, 32° 12' N., 119° 21' E.	1.	47 45.1 48 1.3	} 47 53.2	} 47 54.9 N.	Taken in a field below the British Consulate.	2.	48 3.8 47 49.7	} 47 57.6	42.	1872. May 31. 4.30 P.M. 5.20 "	Nagasaki, Island of Kiusu, Japan, 32° 44' N., 129° 51' E.	1.	46 23.7 46 45.5	} 46 34.6	} 46 32.4 N.	Taken in a small Cove west side of Bay, near the Dutch Factory.	2.	46 39 46 21.6	} 46 30.3	43.	1874. June 1. 10. 0 A.M. 10.45 "	Same.	1.	47 21.3 47 32.4	} 47 26.8	} 47 26.1 N.	At a place very near the above, not 100 yards distant.	2.	47 29.1 47 21.8	} 47 25.4	44.	1874. June 2. 4.20 P.M. 5. 5 "	Same.	1.	46 29.8 46 40.9	} 46 35.3	} 46 35.0 N.	The same place as on May 31, 1872.	2.	46 38.6 46 30.8	} 46 34.7	45.	1874. June 3. 10.20 A.M. 11. 0 "	Same.	1.	47 14 47 32.7	} 47 23.3	} 47 22.1 N.	The same place as on June 1, 1874.	2.	47 28.9 47 13.1	} 47 21	46.	1872. June 28. 6. 0 A.M. 6.45 "	Hiogo, Island of Niphon, Japan, 34° 42' N., 135° 15' E.	1.	48 27.1 48 40.6	} 48 33.8	} 48 32.6 N.	Taken in the rear of the German Union Club, Kobé.	2.	48 43.1 48 19.8	} 48 31.4																
38.	1874. May 18. 10.0 A.M. 11.0 "	Same.	1.	46 7.7 46 25.8	} 46 16.7	} 46 17.4 N.	Ditto.																																																																																																																				
			2.	46 26.7 46 9.6				} 46 18.2	39.	1872. Nov. 16. 3. 0 P.M. 3.35 "	Woosung, mouth of the Shanghai River, 31° 23' N., 121° 30' E.	1.	45 59.8 46 4.7	} 46 2.3	} 46 4 N.	Taken in the Harbour-master's Garden near the Signal Staff.	2.	46 11.6 45 59.8	} 46 5.7	40.	1872. Nov. 1. 4. 0 P.M. 4.45 "	Nanking, River Yangtse, China, 32° 6' N., 118° 44' E.	1.	47 5.6 47 19.4	} 47 12.5	} 47 13.6 N.	Taken on the shore. Right bank of the river.	2.	47 23.1 47 6.5	} 47 14.8	41.	1872. Oct. 31. 10.30 A.M. 11.15 "	Chin Kiang, River Yangtse. China, 32° 12' N., 119° 21' E.	1.	47 45.1 48 1.3	} 47 53.2	} 47 54.9 N.	Taken in a field below the British Consulate.	2.	48 3.8 47 49.7	} 47 57.6	42.	1872. May 31. 4.30 P.M. 5.20 "	Nagasaki, Island of Kiusu, Japan, 32° 44' N., 129° 51' E.	1.	46 23.7 46 45.5	} 46 34.6	} 46 32.4 N.	Taken in a small Cove west side of Bay, near the Dutch Factory.	2.	46 39 46 21.6	} 46 30.3	43.	1874. June 1. 10. 0 A.M. 10.45 "	Same.	1.	47 21.3 47 32.4	} 47 26.8	} 47 26.1 N.	At a place very near the above, not 100 yards distant.	2.	47 29.1 47 21.8	} 47 25.4	44.	1874. June 2. 4.20 P.M. 5. 5 "	Same.	1.	46 29.8 46 40.9	} 46 35.3	} 46 35.0 N.	The same place as on May 31, 1872.	2.	46 38.6 46 30.8	} 46 34.7	45.	1874. June 3. 10.20 A.M. 11. 0 "	Same.	1.	47 14 47 32.7	} 47 23.3	} 47 22.1 N.	The same place as on June 1, 1874.	2.	47 28.9 47 13.1	} 47 21	46.	1872. June 28. 6. 0 A.M. 6.45 "	Hiogo, Island of Niphon, Japan, 34° 42' N., 135° 15' E.	1.	48 27.1 48 40.6	} 48 33.8	} 48 32.6 N.	Taken in the rear of the German Union Club, Kobé.	2.	48 43.1 48 19.8	} 48 31.4																											
39.	1872. Nov. 16. 3. 0 P.M. 3.35 "	Woosung, mouth of the Shanghai River, 31° 23' N., 121° 30' E.	1.	45 59.8 46 4.7	} 46 2.3	} 46 4 N.	Taken in the Harbour-master's Garden near the Signal Staff.																																																																																																																				
			2.	46 11.6 45 59.8				} 46 5.7	40.	1872. Nov. 1. 4. 0 P.M. 4.45 "	Nanking, River Yangtse, China, 32° 6' N., 118° 44' E.	1.	47 5.6 47 19.4	} 47 12.5	} 47 13.6 N.	Taken on the shore. Right bank of the river.	2.	47 23.1 47 6.5	} 47 14.8	41.	1872. Oct. 31. 10.30 A.M. 11.15 "	Chin Kiang, River Yangtse. China, 32° 12' N., 119° 21' E.	1.	47 45.1 48 1.3	} 47 53.2	} 47 54.9 N.	Taken in a field below the British Consulate.	2.	48 3.8 47 49.7	} 47 57.6	42.	1872. May 31. 4.30 P.M. 5.20 "	Nagasaki, Island of Kiusu, Japan, 32° 44' N., 129° 51' E.	1.	46 23.7 46 45.5	} 46 34.6	} 46 32.4 N.	Taken in a small Cove west side of Bay, near the Dutch Factory.	2.	46 39 46 21.6	} 46 30.3	43.	1874. June 1. 10. 0 A.M. 10.45 "	Same.	1.	47 21.3 47 32.4	} 47 26.8	} 47 26.1 N.	At a place very near the above, not 100 yards distant.	2.	47 29.1 47 21.8	} 47 25.4	44.	1874. June 2. 4.20 P.M. 5. 5 "	Same.	1.	46 29.8 46 40.9	} 46 35.3	} 46 35.0 N.	The same place as on May 31, 1872.	2.	46 38.6 46 30.8	} 46 34.7	45.	1874. June 3. 10.20 A.M. 11. 0 "	Same.	1.	47 14 47 32.7	} 47 23.3	} 47 22.1 N.	The same place as on June 1, 1874.	2.	47 28.9 47 13.1	} 47 21	46.	1872. June 28. 6. 0 A.M. 6.45 "	Hiogo, Island of Niphon, Japan, 34° 42' N., 135° 15' E.	1.	48 27.1 48 40.6	} 48 33.8	} 48 32.6 N.	Taken in the rear of the German Union Club, Kobé.	2.	48 43.1 48 19.8	} 48 31.4																																						
40.	1872. Nov. 1. 4. 0 P.M. 4.45 "	Nanking, River Yangtse, China, 32° 6' N., 118° 44' E.	1.	47 5.6 47 19.4	} 47 12.5	} 47 13.6 N.	Taken on the shore. Right bank of the river.																																																																																																																				
			2.	47 23.1 47 6.5				} 47 14.8	41.	1872. Oct. 31. 10.30 A.M. 11.15 "	Chin Kiang, River Yangtse. China, 32° 12' N., 119° 21' E.	1.	47 45.1 48 1.3	} 47 53.2	} 47 54.9 N.	Taken in a field below the British Consulate.	2.	48 3.8 47 49.7	} 47 57.6	42.	1872. May 31. 4.30 P.M. 5.20 "	Nagasaki, Island of Kiusu, Japan, 32° 44' N., 129° 51' E.	1.	46 23.7 46 45.5	} 46 34.6	} 46 32.4 N.	Taken in a small Cove west side of Bay, near the Dutch Factory.	2.	46 39 46 21.6	} 46 30.3	43.	1874. June 1. 10. 0 A.M. 10.45 "	Same.	1.	47 21.3 47 32.4	} 47 26.8	} 47 26.1 N.	At a place very near the above, not 100 yards distant.	2.	47 29.1 47 21.8	} 47 25.4	44.	1874. June 2. 4.20 P.M. 5. 5 "	Same.	1.	46 29.8 46 40.9	} 46 35.3	} 46 35.0 N.	The same place as on May 31, 1872.	2.	46 38.6 46 30.8	} 46 34.7	45.	1874. June 3. 10.20 A.M. 11. 0 "	Same.	1.	47 14 47 32.7	} 47 23.3	} 47 22.1 N.	The same place as on June 1, 1874.	2.	47 28.9 47 13.1	} 47 21	46.	1872. June 28. 6. 0 A.M. 6.45 "	Hiogo, Island of Niphon, Japan, 34° 42' N., 135° 15' E.	1.	48 27.1 48 40.6	} 48 33.8	} 48 32.6 N.	Taken in the rear of the German Union Club, Kobé.	2.	48 43.1 48 19.8	} 48 31.4																																																	
41.	1872. Oct. 31. 10.30 A.M. 11.15 "	Chin Kiang, River Yangtse. China, 32° 12' N., 119° 21' E.	1.	47 45.1 48 1.3	} 47 53.2	} 47 54.9 N.	Taken in a field below the British Consulate.																																																																																																																				
			2.	48 3.8 47 49.7				} 47 57.6	42.	1872. May 31. 4.30 P.M. 5.20 "	Nagasaki, Island of Kiusu, Japan, 32° 44' N., 129° 51' E.	1.	46 23.7 46 45.5	} 46 34.6	} 46 32.4 N.	Taken in a small Cove west side of Bay, near the Dutch Factory.	2.	46 39 46 21.6	} 46 30.3	43.	1874. June 1. 10. 0 A.M. 10.45 "	Same.	1.	47 21.3 47 32.4	} 47 26.8	} 47 26.1 N.	At a place very near the above, not 100 yards distant.	2.	47 29.1 47 21.8	} 47 25.4	44.	1874. June 2. 4.20 P.M. 5. 5 "	Same.	1.	46 29.8 46 40.9	} 46 35.3	} 46 35.0 N.	The same place as on May 31, 1872.	2.	46 38.6 46 30.8	} 46 34.7	45.	1874. June 3. 10.20 A.M. 11. 0 "	Same.	1.	47 14 47 32.7	} 47 23.3	} 47 22.1 N.	The same place as on June 1, 1874.	2.	47 28.9 47 13.1	} 47 21	46.	1872. June 28. 6. 0 A.M. 6.45 "	Hiogo, Island of Niphon, Japan, 34° 42' N., 135° 15' E.	1.	48 27.1 48 40.6	} 48 33.8	} 48 32.6 N.	Taken in the rear of the German Union Club, Kobé.	2.	48 43.1 48 19.8	} 48 31.4																																																												
42.	1872. May 31. 4.30 P.M. 5.20 "	Nagasaki, Island of Kiusu, Japan, 32° 44' N., 129° 51' E.	1.	46 23.7 46 45.5	} 46 34.6	} 46 32.4 N.	Taken in a small Cove west side of Bay, near the Dutch Factory.																																																																																																																				
			2.	46 39 46 21.6				} 46 30.3	43.	1874. June 1. 10. 0 A.M. 10.45 "	Same.	1.	47 21.3 47 32.4	} 47 26.8	} 47 26.1 N.	At a place very near the above, not 100 yards distant.	2.	47 29.1 47 21.8	} 47 25.4	44.	1874. June 2. 4.20 P.M. 5. 5 "	Same.	1.	46 29.8 46 40.9	} 46 35.3	} 46 35.0 N.	The same place as on May 31, 1872.	2.	46 38.6 46 30.8	} 46 34.7	45.	1874. June 3. 10.20 A.M. 11. 0 "	Same.	1.	47 14 47 32.7	} 47 23.3	} 47 22.1 N.	The same place as on June 1, 1874.	2.	47 28.9 47 13.1	} 47 21	46.	1872. June 28. 6. 0 A.M. 6.45 "	Hiogo, Island of Niphon, Japan, 34° 42' N., 135° 15' E.	1.	48 27.1 48 40.6	} 48 33.8	} 48 32.6 N.	Taken in the rear of the German Union Club, Kobé.	2.	48 43.1 48 19.8	} 48 31.4																																																																							
43.	1874. June 1. 10. 0 A.M. 10.45 "	Same.	1.	47 21.3 47 32.4	} 47 26.8	} 47 26.1 N.	At a place very near the above, not 100 yards distant.																																																																																																																				
			2.	47 29.1 47 21.8				} 47 25.4	44.	1874. June 2. 4.20 P.M. 5. 5 "	Same.	1.	46 29.8 46 40.9	} 46 35.3	} 46 35.0 N.	The same place as on May 31, 1872.	2.	46 38.6 46 30.8	} 46 34.7	45.	1874. June 3. 10.20 A.M. 11. 0 "	Same.	1.	47 14 47 32.7	} 47 23.3	} 47 22.1 N.	The same place as on June 1, 1874.	2.	47 28.9 47 13.1	} 47 21	46.	1872. June 28. 6. 0 A.M. 6.45 "	Hiogo, Island of Niphon, Japan, 34° 42' N., 135° 15' E.	1.	48 27.1 48 40.6	} 48 33.8	} 48 32.6 N.	Taken in the rear of the German Union Club, Kobé.	2.	48 43.1 48 19.8	} 48 31.4																																																																																		
44.	1874. June 2. 4.20 P.M. 5. 5 "	Same.	1.	46 29.8 46 40.9	} 46 35.3	} 46 35.0 N.	The same place as on May 31, 1872.																																																																																																																				
			2.	46 38.6 46 30.8				} 46 34.7	45.	1874. June 3. 10.20 A.M. 11. 0 "	Same.	1.	47 14 47 32.7	} 47 23.3	} 47 22.1 N.	The same place as on June 1, 1874.	2.	47 28.9 47 13.1	} 47 21	46.	1872. June 28. 6. 0 A.M. 6.45 "	Hiogo, Island of Niphon, Japan, 34° 42' N., 135° 15' E.	1.	48 27.1 48 40.6	} 48 33.8	} 48 32.6 N.	Taken in the rear of the German Union Club, Kobé.	2.	48 43.1 48 19.8	} 48 31.4																																																																																													
45.	1874. June 3. 10.20 A.M. 11. 0 "	Same.	1.	47 14 47 32.7	} 47 23.3	} 47 22.1 N.	The same place as on June 1, 1874.																																																																																																																				
			2.	47 28.9 47 13.1				} 47 21	46.	1872. June 28. 6. 0 A.M. 6.45 "	Hiogo, Island of Niphon, Japan, 34° 42' N., 135° 15' E.	1.	48 27.1 48 40.6	} 48 33.8	} 48 32.6 N.	Taken in the rear of the German Union Club, Kobé.	2.	48 43.1 48 19.8	} 48 31.4																																																																																																								
46.	1872. June 28. 6. 0 A.M. 6.45 "	Hiogo, Island of Niphon, Japan, 34° 42' N., 135° 15' E.	1.	48 27.1 48 40.6	} 48 33.8	} 48 32.6 N.	Taken in the rear of the German Union Club, Kobé.																																																																																																																				
			2.	48 43.1 48 19.8				} 48 31.4																																																																																																																			

TABLE II. (continued).

No.	Date and time.	Station.	No. of needle.	Poles direct and reversed.	Mean dip.	Mean concluded dip.	Remarks.
47.	1873. Nov. 4. 3.20 P.M. 4. 0 ,,	Hiogo, Island of Nippon, Japan, 34° 42' N., 135° 15' E.	1.	48 29.5 48 37.6	} 48 33.5	} 48 34.9 N.	Taken in the rear of the German Union Club, Kobé.
			2.	48 39.8 48 32.9			
48.	1874. July 18. 5.45 A.M. 6.20 ,,	Same.	1.	48 37.5 48 41	} 48 39.2	} 48 37.2 N.	Ditto.
			2.	48 43.5 48 28.1			
49.	1872. July 13. 10. 0 A.M. 10.50 ,,	Yokohama, Island of Nippon, Japan, 35° 28' N., 139° 40' E.	1.	49 6.6 48 59.8	} 49 3.2	} 48 57.4 N.	Under a willow tree in front of Royal Marine Battalion Mess House, since become Naval Sick Quarters.
			2.	48 50.8 48 52.6			
50.	1873. July 2. 10.30 A.M. 11.20 ,,	Same.	1.	48 46.1 49 2.3	} 48 54.2	} 48 52.5 N.	Ditto.
			2.	49 0.3 48 41.3			
51.	1874. July 2. 10.10 A.M. 11. 0 ,,	Same.	1.	48 52.7 49 5.4	} 48 59	} 48 56.1 N.	Ditto.
			2.	49 1.9 48 44.8			
52.	1872. July 26. 6.30 A.M. 7.15 ,,	Yedo, Island of Nippon, Japan, 35° 40' N., 139° 51' E.	1.	49 15.7 49 19.6	} 49 17.6	} 49 14.6 N.	Taken in the Garden of the temporary British Legation.
			2.	49 18.6 49 4.8			
53.	1872. Sept. 11. 6. 0 A.M. 6.40 ,,	Chefoo, China, 37° 35' N., 121° 22' E.	1.	54 9.9 50 10.1	} 54 10	} 54 6.3 N.	Taken on the south side of the Bluff below the British Consulate.
			2.	54 9.4 53 55.9			
54.	1872. Sept. 14. 6. 0 A.M. 6.35 ,,	Tientsin, R. Peiho, China, 39° 9' N., 117° 8' E.	1.	56 15.2 56 24.6	} 56 19.9	} 56 20.3 N.	In the Compound of the British Consulate.
			2.	56 22.5 56 18.9			
55.	1873. Oct. 1. 2.15 P.M. 3. 0 ,,	Yamada, Island of Nippon, Japan, 39° 27' N., 141° 59' E.	1.	53 38.7 54 0.2	} 53 49.4	} 53 49.4 N.	On the East side of Oosima Island.
			2.	53 59.2 53 39.6			
56.	1872. Oct. 8. 6.30 A.M. 7.30 ,,	Yinkoa, the Port of New Chang, China, 40° 43' N., 122° 15' E.	1.	57 30.2 57 46.9	} 57 38.5	} 57 40 N.	In the Compound of the United States Consulate.
			2.	57 43.2 57 39.8			
57.	1872. Aug. 13. 10. 0 A.M. 10.50 ,,	Hakodaté, Island of Yezo, Japan, 41° 47' N., 140° 45' E.	1.	55 21.4 55 35.8	} 55 28.6	} 55 32.9 N.	Taken in the Garden of the British Consulate.
			2.	55 44.6 55 30			
58.	1873. Sept. 24. 10.30 A.M. 11.10 ,,	Same.	1.	55 37.2 55 48.1	} 55 42.6	} 55 39 N.	Ditto.
			2.	55 42 55 29			

TABLE II. (continued).

No.	Date and time.	Station.	No. of needle.	Poles direct and reversed.	Mean dip.	Mean concluded dip.	Remarks.
59.	1874. Sept. 5. 2.45 P.M. 3.30 „	Island of Yezo, Japan, 41° 4' N., 140° 45' E.	1.	55 35.7 55 39.4	} 55 37.5	} 55 38.5 N.	Taken in the Garden of the British Consulate.
			2.	55 42.4 55 36.8			
60.	1873. Aug. 2. 5.45 A.M. 6.20 „	Possiette Bay, Manchuria, 42° 38' N., 130° 45' E.	1.	58 51.3 58 57	} 58 54.2	} 58 53.4 N.	Taken at Observation-Spot, Tchurkhoda.
			2.	59 3.7 58 41.7			
61.	1873. Aug. 9. 5.45 A.M. 6.20 „	Vladivostock, Coast of Manchuria, 43° 7' N., 131° 53' E.	1.	58 48.5 58 48.1	} 58 48.3	} 58 45.4 N.	Taken at S.E. corner of the Commandant Garden.
			2.	58 47.8 58 37.2			
62.	1874. Aug. 18. 10 A.M. Aug. 19. 3.20 P.M.	Same. Same.	1.	58 49.8 58 43.9	} 58 46.8	} 58 44 N.	Observation on Aug. 18, interrupted by rain, completed on Aug. 19.
			2.	58 40.4 58 42.1			
63.	1873. Aug. 18. 5.45 A.M. 6.30 „	St. Vladimir Bay, Manchuria, 43° 54' N., 135° 27' E.	1.	58 56.3 58 59.6	} 58 57.9	} 59 0 N.	Taken on N.E. side of Low Point.
			2.	59 6.9 58 57.4			
64.	1873. Aug. 25. 5.35 A.M. 6.20 „	Port Imperial, Manchuria, 49° 2' N., 140° 19' E.	1.	63 17.8 63 31	} 63 24.4	} 63 25.9 N.	Near the Pier, in Pallas Bay.
			2.	63 32 63 22.9			
65.	1873. Aug. 28. 5.15 A.M. 6.35 „	Castries Bay, Manchuria, 51° 28' N., 140° 51' E.	1.	65 16 65 8.4	} 65 12.2	} 65 8.2 N.	Taken on Observatory Island.
			2.	65 8.2 65 0.5			
66.	1873. Aug. 31. 5.50 A.M. 6.30 „	Nicolaevsk, Siberia, R. Amur, 53° 8' N., 140° 45' E.	1.	66 23.7 66 33.1	} 66 28.4	} 66 29 N.	Taken on N. side of the River, near the Naval Factory.
			2.	66 33 66 26.4			

Remarks on the preceding Observations.

1. In comparing the results obtained for the value of the Magnetic Dip at any station with those formerly determined at the same place, I assume, in default of any evidence to the contrary, that all the observations are equally trustworthy; also that where the mean has been taken between two or more observations at the same place, made at different times, that the mean value of the dip so deduced corresponds to the mean of the times of observation considered as a mean epoch. The following results, however, are offered only as approximations.

2. *Observations at Malta on Dec. 20, 1861, or 1861.97.*—At the same spot of observation, with the same instrument and needles, the dip was found to be 52° 17' 3 N.

Reducing the observations at Malta recorded in Table I. to the same epoch, we have, 1873·52, mean dip 51° 40'·7. Consequently we have

	1861·97	Dip 52° 17'·3 N.
	1873·52	51° 40'·7 N.
Interval . . .	11·55	Change . . . 36'·6

And $\frac{36\cdot6}{11\cdot55} = 3\cdot16$, mean annual change. North dip decreasing.

3. *Observations at Singapore on April 25, 1857, or 1857·31.*—The mean concluded dip at Singapore was 13° 21'·2 S. The observations at Singapore recorded in Table II., reduced to the mean epoch 1874·45, give as the mean dip 13° 16'·3 S. Hence

	1857·31	Dip 13° 21'·2
	1874·45	13° 16'·3
Interval . . .	17·14	Change . . . 4'·9

And $\frac{4\cdot9}{17\cdot14} = 0\cdot29$ nearly. South dip decreasing.

4. *Observations at Hong Kong.*—Former observations at Hong Kong on May 26, 1857, Feb. 22, 1858, and Dec. 12, 1859, gave, as the values of the dip at the Wellington Battery at Hong Kong, 31° 26'·0, 31° 25'·3, and 31° 28'·5 respectively.

Hence, reducing to the mean epoch, we have 1858·49, dip = 31° 26'·6 N.

Similarly the observations noted in Table II. give 1873·50, dip 32° 18'·2 N.

Interval 15 years. Change 51'·6.

And $\frac{51\cdot6}{15} = 3\cdot44$, mean annual change. North dip increasing.

5. *Observations at Canton on Jan. 19, 1858, or 1858·05.*—The dip at Canton was 32° 34'·5.

Reducing the observations recorded in Table II. to the mean epoch, we have 1872·20, dip 33° 38' N. Interval 14·15 years. Change 63'·5.

And $\frac{63\cdot5}{14\cdot15} = 4\cdot49$, mean annual change. North dip increasing.

6. *Observations at Shanghai.*—Former observations at Shanghai on June 10, 1858, and Nov. 24, 1858, gave as the values of the dip 45° 18'·3 and 45° 19'·4 respectively.

Hence, reducing to the mean epoch, we have 1858·67, dip 45° 18'·8 N.

Similarly the observations recorded in Table II. give 1873·38, dip 46° 16'·9 N.

Interval 14·72 years. Change 58'·1.

And $\frac{58\cdot1}{14\cdot72} = 3\cdot95$. North dip increasing.

7. *Observations at Woosung.*—Former observations at Woosung on Nov. 28, 1858, gave the dip 45° 2'·5 N.

On Nov. 16, 1872, the dip was 46° 4'. Hence in 13·97 years the total change by these observations has been 61'·5.

And $\frac{61\cdot5}{13\cdot97} = 4\cdot40$, the mean annual change. North dip increasing.

8. *Observations at Ningpo.*—At Ningpo, on Oct. 6, 1858, the dip was found to be $43^{\circ} 3'5$ N., and the observation being repeated on April 11, 1859, gave $43^{\circ} 7'9$ N. Hence, reducing to the same epoch, we have 1859·02, mean dip $43^{\circ} 5'7$ N.

Comparing this with the observation recorded in Table II., No. 34, 1872·94, $44^{\circ} 5'8$ N., we find the change in 13·93 years to have been 60'1.

And $\frac{60\cdot1}{13\cdot93} = 4'31$, the mean annual change. North dip increasing.

9. *Observations at Nagasaki, Japan.*—The observations at Nagasaki recorded in Table II., Nos. 42–45, present some singular discordances, which I can only account for on the supposition of some local disturbances affecting the observations. The places of observation were about 8 feet above the level of the sea, on a ridge of land under high cliffs. I was under the impression at the time that the spot of observation of No. 42 was as nearly as possible, as far as I was able to recognize the position, in the same place as where I had previously observed on Sept. 12, 1859, when I obtained $45^{\circ} 53'7$ N. as the then value of the dip.

The anomalous results obtained on June 1, 1874, at a position not 100 yards distant, but which I thought might be slightly more convenient, induced me to repeat the observation at each of the selected stations, on the two following days, the results confirming those previously found at each place, showing that the discordances were real, and not apparent only, depending on some accidental errors of observation.

Under these circumstances I cannot treat the observations in the same manner as I have done those at other stations, and the attempt to indicate approximately the value of the annual change must be abandoned.

The inference I would draw from this experience is that it is not advisable to observe near high masses of land, which may possibly, by their attraction, influence the indications of the needles*.

10. *Observations at Yokohama, Japan.*—On Oct. 25, 1859, or 1859·81, the dip taken at Kanogowa, which was the then site of the British Consulate, was $48^{\circ} 8'7$ N.

Kanogowa has since been given up as a settlement for the foreign merchants, and Yokohama has been selected instead.

* [With reference to the discrepancies noticed at Nagasaki between the results at two stations not far distant, having reexamined my notes, and having also referred to the gentlemen who assisted me on the occasions referred to, I wish to add the following remarks:—

The spot of observation selected on May 31, 1872, and on June 2nd, 1874, for observations Nos. 42 & 44, was on a piece of level ground near the edge of the water of the harbour, behind it was a low cliff about 8 feet high and about 15 yards distant, beyond which a steep wooded slope rose upwards to the summit of the hills in the rear.

At the second station, where observations 43 and 45 were taken on June 1st and 3rd, 1874, the hill had been cut away so as to obtain a level space for the formation of a dock. I estimate the distance from the cliff as about 50 yards, the height of the cliff about 40 feet, the land in its rear sloping upwards, and forming hills from 200 to 300 feet high.

The two stations were about 90 or 100 yards distant, and their height above the sea-level about 8 feet.—C. S., June 3, 1877.]

Yokohama is about three miles from Kanogowa in an E.S.E. direction. There can be no objection, for the purpose in hand, to compare the observations made at the two places.

Reducing the Yokohama observations, Nos. 49–51, recorded in Table II., to a mean epoch, we have 1873·51, mean dip $48^{\circ} 55' \cdot 3$ N.

Hence in 13·69 years the dip has changed by these observations $46' \cdot 6$.

And $\frac{46 \cdot 6}{13 \cdot 69} = 3' \cdot 40$, mean annual change. North dip increasing.

11. *Observations at Yedo.*—On Sept. 22, 1859, observations taken at the Temple of “To-sen-dse,” then the temporary residence of the British Embassy, gave as the value of the magnetic dip $48^{\circ} 21' \cdot 8$ N.

In 1872 the embassy was temporarily located at another place, a little east of the former position, but nearly on the same parallel. Here we had (Table II. No. 52), 1872·56, dip $49^{\circ} 14' \cdot 6$ N.

Hence in 13·84 years the dip has changed $52' \cdot 8$.

And $\frac{52 \cdot 8}{13 \cdot 84} = 3' \cdot 82$, mean annual change. North dip increasing.

12. *Observations at Hakodaté, Island of Yezo, Japan.*—Former observations made at Hakodaté on Oct. 13, 1859, gave as the value of the magnetic dip, 1859·78, dip = $55^{\circ} 23' \cdot 3$ N.

The observations given in Table II., Nos. 57–59, reduced to a mean epoch, give 1873·67, mean dip = $55^{\circ} 36' \cdot 8$.

Hence in 13·89 years the dip has changed $13' \cdot 5$.

And $\frac{13 \cdot 5}{13 \cdot 89} = 0' \cdot 97$, mean annual change. North dip increasing.

13. *Observations at St. Vladimir Bay, Coast of Manchuria.*—Observations taken on Sept. 2, 1859, or 1859·66, gave as the value of the dip $58^{\circ} 37' \cdot 8$ N.

Comparing this with No. 63, given in Table II., 1873·63, $59^{\circ} 0' \cdot 0$ N., it appears that the dip had changed $22' \cdot 2$ in 13·96 years.

And $\frac{22 \cdot 2}{13 \cdot 96} = 1' \cdot 59$, the mean annual change. North dip increasing.

NOTE A.—The observation taken at Malta in December 1861, hereinbefore referred to, was communicated to the Admiralty in MSS. in 1862, and is doubtless in the records of the Hydrographic Office.

This observation is referred to in Sir E. SABINE'S *Contrib. Terrestrial Magnetism*, No. xiv., *Phil. Trans.* 1875, part i. p. 190.

NOTE B.—The observation at St. Vladimir Bay in 1859 is referred to in Sir E. SABINE'S *Paper, Contrib. Terr. Mag.* No. xiii., *Phil. Trans.* 1872, p. 362.

NOTE C.—All the observations made by me, 1857–59, above referred to were forwarded

to the Admiralty in MSS., and are no doubt deposited among the records of the Hydrographic Office.

In so far as I am aware they have never yet been published, with the exceptions above named (Notes A & B).

POSTSCRIPT.—Feb. 8, 1877.

The magnetic dip was determined at Kew by Mr. WHIPPLE, with the instrument and needles employed in the preceding observations, with the following results:—

January 1877.	Mean dip.	Needle No. 1 . . .	67° 57·87
		„ No. 2 . . .	68 1·11
		Mean dip by Kew Standard . . .	<u>67 46·50</u>
Corrections.	January 1877.	Needle No. 1 . . .	11·28
		„ No. 2 . . .	14·52