PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY A
MATHEMATICAL, PHYSICAL & ENGINEERING SCIENCES

On the Magnetical Results of the Voyage of H.M.S. "Penguin," 1890-93

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IX. *On the Magnetical Results of the Voyage of H.M.S. "Penguin,"* 1890–93.

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IN the recent magnetic surveys conducted in different countries, the details of which have been published, one point stands out prominently from the rest, that the more minute the survey, the more surely do the observations show that the needle is subject to "local" and "regional" magnetic disturbances, varying in amount from the normal values of the magnetic elements, as deduced from extended observations made over the whole country.

A reference alone to that recent and most valuable contribution to terrestrial magnetism, "A Magnetic Survey of the British Isles," by Professors A. W. RÜCKER, F.R.S., and T. E. THORPE, F.R.S., is quite sufficient to show the certainty of these disturbances.

Our knowledge of the magnetic elements on land and their disturbances is constantly being added to, but there is a much larger area for exploration, which, whilst leaving the dry land to the observers on land, seems specially to belong to those whom we may term the seagoing magneticians, namely, the broad sea, the coasts washed by the sea, and what is equally important to science and navigation, the land under the sea. It is a fact that as yet we have not obtained anything like an exact knowledge of the form which the "isomagnetics" may take on going from the assumed normal lines, passing from over the deep sea to cross depths of water under 100 fathoms, until the dry land with its known disturbances is reached.

Although along those parts of the coasts of great continents more commonly visited, several series of observations of the magnetic elements have been made by the war-vessels of various nationalities, for the coasts of Australia, from Adelaide westward round north to Cape York, there were, previous to 1885, only some three or four stations at which either Dip or Force had been observed.

To remedy this defect as far as possible, Admiral WHARTON, F.R.S., Hydrographer to the Admiralty, caused H.M. surveying vessel "Meda" to be furnished with the necessary magnetic instruments, with which the elements were observed at twelve stations, distributed between King George's Sound and Cossack, in N.W. Australia, by Navigating-Lieutenant DOCKRELL, of that ship.

Unfortunately the continuance of this series was cut short by the close of the survey, but not until a remarkable disturbance of the compass observed on board the "Meda," when approaching Cossack (Port Walcott), in N.W. Australia, the disturbance being evidently caused by magnetic bodies in the land under the sea. Time only sufficed to approximately localize the position of greatest disturbance.

Towards the close of 1889 H.M.S. "Penguin" was appropriated for surveying service in Australia, under the command of Captain W. U. Moore, R.N. Once more the Hydrographer decided that the magnetic survey of the western coasts of Australia should be proceeded with as far as the requirements of the hydrographic survey would admit. Lieutenant J. W. Combe, R.N., of the "Penguin," was selected to make the observations, and was therefore specially instructed at the Admiralty and at Kew Observatory in the use of the several magnetic instruments supplied to the "Penguin."

The "Penguin" is a composite-built screw steam vessel of 1130 tons displacement and 700 indicated horse-power, and consequently a suitable vessel as regards size for magnetic observations at sea. The amount of iron, however, used in her construction, made her practically an iron ship, and the magnetic observations were confined to those of the Declination or Variation when the ship could be swung, or, in other words, when her head could be placed on eight or more points equally distributed round the compass, and for Dip and Force when the Relative instruments used on board could be compared with the Absolute instruments on land under proper conditions :—

The following is a list of the instruments supplied :—

For Absolute observations on land	(1) Unifilar Magnetometer, No. 25, by Elliot, with two magnets. (2) Barrow's Dip Circle.
For Relative observations on board ship	A Fox Dip and Intensity Apparatus, No. C. 10.

Also an Admiralty Standard Compass for observations on board and on land.

Base Station.

Kew Observatory was the adopted base station, where the Unifilar Magnetometer and Dip Circle were verified and Constants obtained. On return from abroad Lieutenant Combe repeated the observations to test the condition of the instruments after their three years' work, during which they were subjected to great change of climate and the chances inseparable from frequent transit from ship to shore.

In order to show how far the absolute instruments remained in good order under such circumstances, the following final observations were made at Kew and other fixed observatories. The symbols δ for the Declination, H for the Horizontal Force expressed in C.G.S. units, and θ for the Dip have been adopted.

		δ.	H.	θ.	Needle.
Kew Observatory . . .	Mean for Sept., 1893 .	17° 27′·3 W.	·18243	+67° 26′·1	
H.M.S. "Penguin" . .	5th and 6th Sept., 1893	17 29·3	25 a., ·18262 25 d., ·18257	+67 25·2 +67 22·7 +67 27·5 +67 26·5	1 2 3 4
		δ.	H.	θ.	Needle.
Melbourne Observatory .	Mean for 1891 . . .	7° 58′·5 E.	·23479	−67° 12′·9	
H.M.S. "Penguin" . .	March, 1891 . . .	*8 5·7	25 a., ·23475 25 d., ·23453	−67 15·6 −67 14·3 −67 15·2 −67 17·3	1 2 3 4
		δ.	H.	θ.	Needle.
Hong Kong Observatory	Mean for 1892 . . .	0° 33′·6 E.	·36352	+32° 3′·5	
H.M.S. "Penguin" . .	. . . .	0 35·4	25 a., ·36397 25 d., ·36388	+32 3·0 +32 2·5 +32 3·1 +32 4·3	1 2 3 4

The final results obtained at Kew, in September, 1893, have been corrected for the diurnal range obtained from the Report of the Kew Committee, and the mean results obtained at Kew, for the month of September, have been adopted as a standard of comparison.

* Mean of six observations at different hours on three days, corrected for diurnal variation from Observatory curves.

DIFFERENCES between "Penguin" and Observatories.

	δ.	H.	θ.	Needle.
At Kew	+2′·0	25 a., +·00019 25 d., +·00014	−0′·9 −3·4 +1·4 +0·4	1 2 3 4
At Melbourne . . .	+7·2	25 a., −·00004 25 d., −·00026	+2·7 +1·4 +2·3 +4·4	1 2 3 4
At Hong Kong . . .	+1·8	25 a., +·00045 25 d., +·00036	−0·5 −1·0 −0·4 +0·8	1 2 3 4

Observing how nearly the "Penguin's" results agree with those of Kew and Hong Kong, it seems fair to assume that, in spite of the increased discordance observed at Melbourne, the instruments remained in a satisfactory condition throughout the period of observation.

It is not proposed to record here in full the moments of the two magnets observed in the Force observations, but it may be explained that the several values were treated graphically, with the following results:—

	Magnet 25, *a*.	Magnet 25, *d*.
March, 1890	m = ·029172	·027568
December, 1890	= ·029094	·027494
February, 1892	= ·029050	·027469
September, 1893	= ·028995	·027328

Thus, during the first nine months, the moments of both magnets declined somewhat rapidly, after which they slowly diminished in value until the close of the series at Kew. It may be noted that, throughout the series, no single value of m differed more than ± ·00001 from those of the curve obtained from the whole set employed for obtaining H.

The value of P has been calculated by the formula

$$(\text{Log } A_1 - \log A_2) \times 5{\cdot}64 = P$$

where A_1 and A_2 are the values of m/H at the two distances. The mean value for the whole series is

$$P = -\ {\cdot}00080228.$$

Considering the importance of a uniform system of exhibiting the value of the observer's work in observations of similar nature, it was originally intended to adopt that of Professors RÜCKER and THORPE, as explained in their "Magnetic Survey of Great Britain" (see 'Phil. Trans.,' 1890). The difficulty then arose of there being no means for ascertaining the solar diurnal variations and effects of disturbances on the elements observed at places distributed over so large an area of the world. Thus, defects of observation and movements of the needle from magnetical causes could not be separated, and RÜCKER and THORPE's method was reluctantly abandoned.

With regard to the use of the Fox Dip and Intensity apparatus, it should be understood that, being a relative instrument, it was constantly compared with the absolute instruments. The index errors affecting the Dip observations were known to the nearest minute, and the change of magnetic force in the deflectors used in the force observations were ascertained by obtaining the values of the "weight equivalents" at four stations, so that the magnetic condition of the instrument was known whenever it was used. The temperature corrections were too small to be applied to force observations taken under conditions of small change of temperature.

The results obtained on land with the absolute instruments are given in Table I.; those with relative instruments in Table II.

Local Magnetic Disturbances.

Although the amount of local magnetic disturbance over given areas, and the causes thereof, have for some years past been a subject of close enquiry among magneticians, it does not appear that anything like close attention has been paid to those local magnetic disturbances experienced on board ship which are independent of any direct action from iron or steel used in the construction of the ship. It is certain, however, that conclusions have been drawn and promulgated that are absolutely unfounded. Amongst them may be mentioned the erroneous impression that visible land, when miles distant, affects a ship's compasses, to the danger of the ship.

In view of placing the local magnetic disturbances observed in depths of water under 100 fathoms of water on a proper basis, instructions were given to H.M.S. "Penguin" to devote as much time to such an enquiry as her special surveying duties would permit. H.M.S. "Meda," having reported on the remarkable disturbance of the compass experienced on board in the neighbourhood of Cossack, Port Walcott, in N.W. Australia, the results of a magnetic survey were of great importance to navigation, and consequently some days were devoted to the examination of the port. A discussion of the observations made, with diagrams, forms the concluding and it is presumed the most important part of this paper. The results of observations made on islands and at Cossack for local magnetic disturbance will now be given in order of time.

Perim Island.

Two stations two miles apart were selected on this island for the absolute observations: (1) at Signal Hill, near the west end of the island and about 100 feet above the sea; (2) the high lighthouse near the east end, about 200 feet above the sea, the instruments being set up on lava rock. There were also three auxiliary stations where the Fox apparatus was employed, and relative observations made: Nos. 1 and 2 on the north coast, on broken coral; and No. 3 in a sandy bay at the S.E. end of the island. The declination was only observed at the high stations with a value at both $= 3° 16'$ W. Comparing this with the value obtained on board by swinging in 19 fathoms of water $= 3° 25'$ W., the difference of $9'$ shows but small disturbance.

Inclination—With this element there is a difficulty in obtaining an exact normal value, but as the observation at Auxiliary Station No. 3 was made on a sandy beach, and the results agree with the Chart of Normal Values at the Admiralty, it has been adopted.

Station.	Observed Dip.	Normal.	Disturbance.
Signal Hill	5° 27′ N.	3° 30′	+1° 57′
High Lighthouse	5 3	..	+1 33
Auxiliary Station No. 1	5 4	..	+1 34
Auxiliary Station No. 2	5 4	..	+1 34

Horizontal Force.—Assuming the value of H at Auxiliary Station No. 3 as normal, we have the following:—

Station.	Observed H.	Normal.	Disturbance.
Signal Hill	·359	·355	+·004
High Lighthouse	·341	..	−·014
Auxiliary Station No. 1	·355	..	− 0
Auxiliary Station No. 2	·352	..	−·003

Baudin Island.

On this island the three elements were observed at two stations: (A) on the south slope of the island, on hard compact gray sandstone, with fragments of ironstone, situated 100 feet above the sea; (B) on the foreshore, where the beach consisted of coralline sand and coralline limestone. Two specimens of rock from this island were found to be magnetic, with values of $k =$ ·000217 and ·000529 in C.G.S. units (see Appendix B).

Station B values have been adopted as the normal for the following reasons. The ship was swung in 19 fathoms of water near the island in two successive years with the same results as regards Declination = 2° 11′ E. The Dip and Force agree nearly with the best normal values on the charts.

DISTURBANCES.

	δ.	θ.	H.
Station A	° ′ 3 16 W.	− 42·55	·3572
Station B, adopted normal . . .	2 14 E.	− 40·7	·3574
Disturbance	5 30 W.	− 2·48	·0002

Port Walcott (*Cossack*).

Although the name of the township of Cossack may be more familiar than the name of the port in which it is situated, still, as the observations about to be considered refer chiefly to the port approaches to Cossack, and extend over an area of some miles, the name Port Walcott has been adopted.

The accompanying map of Port Walcott shows the relative positions of the points where land observations were made and the region of magnetic disturbance in land under the sea. The latter region we may hereafter refer to as the "Magnetic Shoal," over which the "magnetic soundings"* were taken (see *post*).

Land Observations.

There is the usual difficulty in this place of determining the normal values of the magnetic elements, but an observation was made with the Fox apparatus on board the ship in 19 fathoms when approaching the port, giving a corrected value of 51°. This reduced for difference of Dip, due to difference of the latitude, makes the Dip at Reader Head (see map) = 51° 16′, the observation on land at the same place being = 51° 20′.

Again, by swinging the ship 4 miles east of Reader Head station, the Declination was observed to be = 0° 15′ E., as compared with 0° 4′ W. on the head.

The station at Reader Head being also in a sandy neighbourhood, was therefore adopted as the position of normal values.

* The term "magnetic soundings" is here meant to apply to the several magnetic disturbances in analogy with the soundings taken to determine the position and extent of a shoal of sand, for example. —E. W. CREAK.

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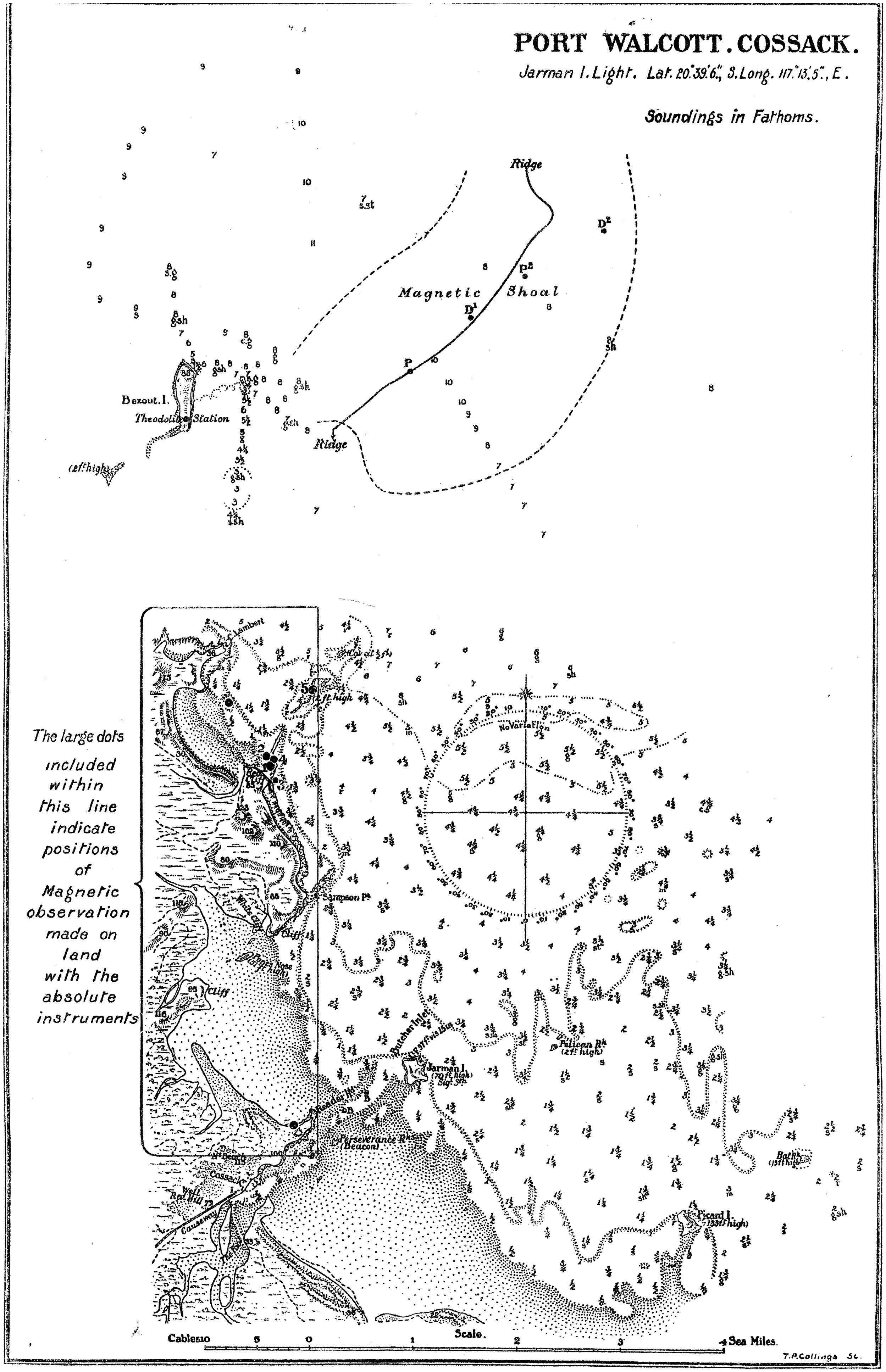

PORT WALCOTT. COSSACK.
Jarman I. Light. Lat. 20°39'6" S. Long. 117°13'5" E.
Soundings in Fathoms.
Ridge
Magnetic Shoal
Bezout. I.
Theodolite Station
(2ft high)
Ridge
The large dots included within this line indicate positions of Magnetic observation made on land with the absolute instruments
Lambert
No Variation
Sampson Pt
White Cliff
Cliff
Butcher Inlet
Jarman I. (70 ft high) Sig. Stn.
Pelican Rk (2ft high)
Perseverance Rk (Beacon)
Cossack
Picard I. (133 ft high)
Cables 10 5 0 1 Scale. 2 3 4 Sea Miles.
T.P. Collings Sc.

Land Disturbances.

Declination.

Normal.	Bezout I.	Cape Lambert.	Red Cliff stations.			
			2.	3.	4.	5.
0° 4′ W.	0° 22′ W.	0° 4′ W.	7° 56′ W.	1° 11′ E.	2° 53′ E.	1° 4′ E.
Disturbance .	0 18 W.	..	7 52 W.	1 15 E.	2 57 E.	1 8 E.

Inclination.

Normal.	Bezout I.	Cape Lambert.	Red Cliff stations.				
			1.	2.	3.	4.	5.
51° 20′ S.	50° 2′ S.	50° 13′ S.	52° 18′	54° 12′	50° 41′	52° 30′	51° 36′
Disturbance .	+ 1 18	+ 1 7	− 0 58	− 2 52	+ 0 39	− 1 10	− 0 16

Horizontal Force (Metric Units).

This was only observed at No. 1 Red Cliff station besides the normal, with a difference of 0·0878 as a disturbance.

There is nothing in the amount of the above disturbances to call for special remark, as they have often been largely exceeded in other countries.

There is, however, one point which requires notice, and that is the different signs shown by the Dip disturbances, the north-seeking pole of the needle being repelled at four Dip stations, and attracted at three stations out of the seven. Attention is called to this as bearing upon subsequent results obtained on board the ship.

Disturbances Caused by Land under the Sea.

The instruments employed for observing on board the ship :—

1. Standard compass on poop, 75 feet above the sea-bottom.
2. Fox apparatus (C. 10) for Dip and Force 82 feet above the sea-bottom.
3. A compass occupying the place of the Fox apparatus when removed, and called the "Fox compass."

Before proceeding to show the remarkable amount of the disturbances of the magnetic elements observed at Port Walcott, it must be remembered that the only means available for obtaining the observations was on board a composite-built* vessel with steam machinery; in fact, that the observers had *nolens volens* placed the ship, herself a disturbing magnet, between the instruments and the source of disturbance.

It was therefore necessary, first of all, to determine to what extent this interposed magnet, the ship, disturbed the needles on board. For this purpose the ship was swung off Baudin Island in 19 fathoms of water on May 6, 1891: (*a*) for values of Dip and Intensity on the eight principal points of the compass; (*b*) simultaneous observations of the Standard and Fox compasses for deviation on all points of the compass.

Adopting the methods and formulæ described in the Admiralty 'Manual of Scientific Enquiry' (Art. Terrestrial Magnetism) for 1886, the following table of Disturbance of the Dip and Total Force, caused by the Horizontal Forces of the ship, was computed:—

Ship's head.	Correction for Dip.	Correction for Total Force.
		met. units.
North . . .	−0° 17′	+·074
N.E.	+1 27	+·192
East	+2 26	+·305
S.E.	+1 29	+·177
South . . .	+0 17	+·014
S.W.	+1 48	+·118
West	+2 26	+·217
N.W.	+0 49	+·157

Next adopting the notation of the Admiralty 'Manual for Deviations of the Compass' (1893), the following coefficients, representing the horizontal disturbances of the ship, were computed from the observed deviations:—

	B.	C.	D.
Standard compass . .	+0° 45′	−0° 11′	+3° 55′
Fox compass	+0 35	−0 4	+2 22

Having corrected the Dips for effects of the ship's horizontal forces, the resulting mean Dip was compared with the normal values at Baudin Island, and found to differ only 2′. The Vertical Force of the ship was therefore considered zero.

Now at Port Walcott the coefficients B, C, D were found to be:—

* Composite-built ships have iron frames and wood planking.

	B.	C.	D.
Standard compass . .	−0° 26′	−0° 32′	+4° 2′
Fox compass	+0 50	0 0	+2 20

or nearly the same as off Baudin Island, and as the Dip corrected for horizontal forces in the ship differed only 10′ from the normal, it was considered that the tables of correction for the three elements obtained off Baudin Island might for the purposes of this discussion be used for the observations over the "magnetic shoal" at Port Walcott, and this has been done.

Although no direct observations of the mean Horizontal Force to north (or λ of the Admiralty 'Manual') were obtained at the compass position where the Declination observations were made, still on comparing the best values of the Horizontal Force obtained on board with those on land, a small diminution was found, giving a mean force to north = ·98 (considering the land force = 1·0) at the Fox position.

At the Standard compass position the mean force to north may be assumed as ·97.

Having so far defined the magnetic condition of the ship, we are in a position to review the order of observation at the magnetic shoal and consider the results.

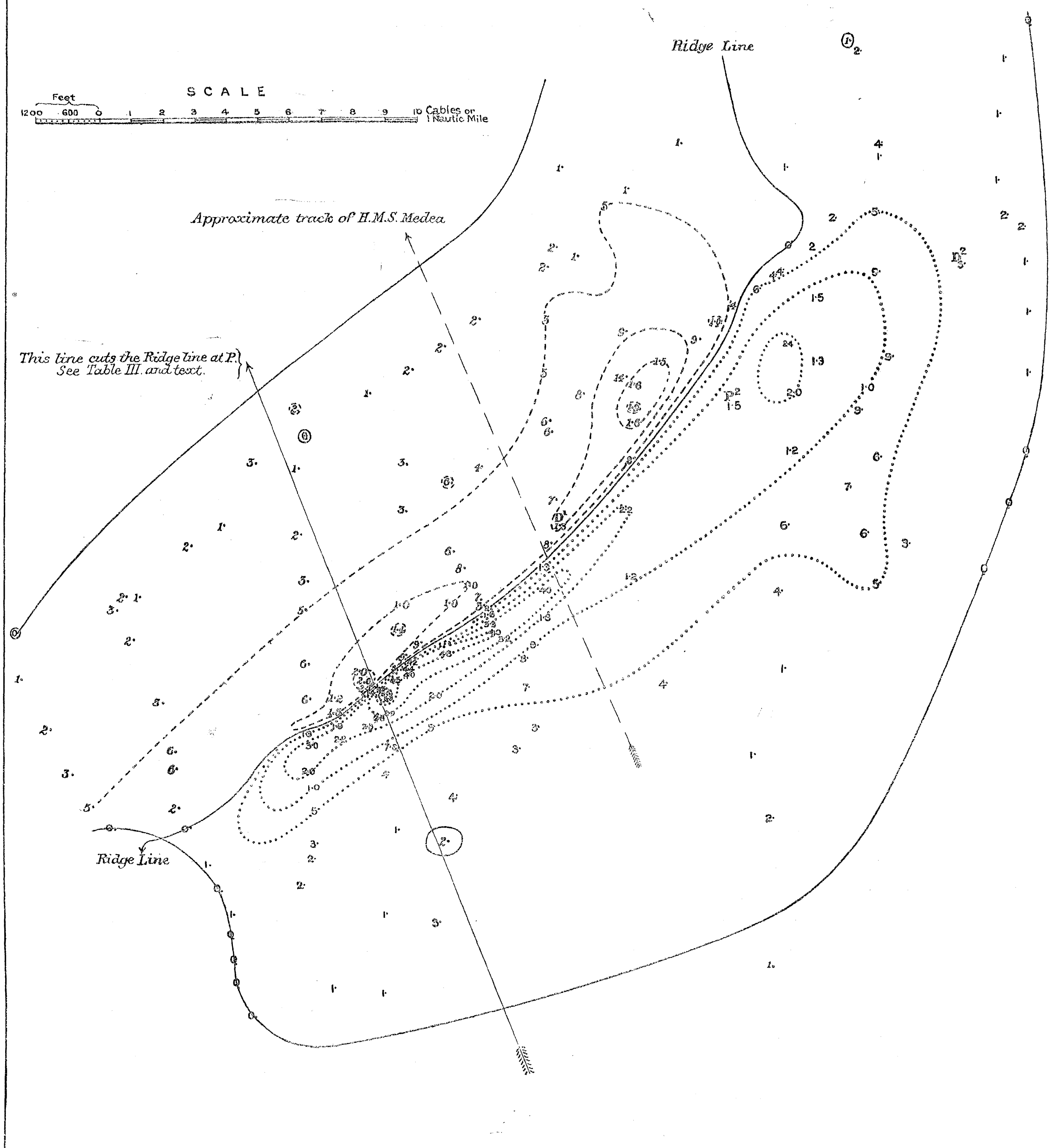
A preliminary examination of the general limits of the area of Disturbance at Port Walcott was made in November, 1890. The 22nd to the 25th of the following April were devoted to completing the magnetic survey of the shoal, the distribution of the observers being as follows:—Lieutenant TANCRED, with a theodolite, was placed on Bezout Island, to take the true bearings of the Standard compass as the ship changed her position. Lieutenant PARRY, on board the ship, took compass bearings of the theodolite station on Bezout with the Standard compass, the direction of the ship's head being noted by Sub-Lieutenant OLIVER. The Dip and Force observations were made by Lieutenant COMBE, the position of the ship being fixed and depth of water taken at every magnetic observation.

On the first day the ship was run across the area of disturbance in the north and south directions, whilst the observations of Declination were made, buoys being placed at positions of greatest disturbance. On the second day the Declination observations were continued over the eastern and western extremities of the shoal, special attention being given to the spaces between the buoys.

The third and fourth days were occupied with observations of the Dip and Force with such additional observations of the Declination as could be made, the method of ensuring reliable results being as follows. The position of maximum disturbance had already been pointed out by the Declination observations; the ship was therefore moored in its immediate neighbourhood, one anchor being let go on the west side of the point of greatest westerly disturbance; the other anchor on the east side of the greatest easterly disturbance. Thus, by working the cables as requisite, the ship

Diagram A. Declination disturbances given in Curves of equal value 5°. 10°. 20°. 30°. 40° and 50°

The figures represent the amount of disturbances in degrees and the dots show the points of observation.
.... denote equal values of disturbance of the needle Eastward } *of the true Meridian.*
– – – – – Westward }
———— are lines of no disturbance
The Declination at Reader's Head near Cossack being taken as zero.
The letters D^1, D^2, and P^2 show the positions of disturbance of Vertical force – see Table III.



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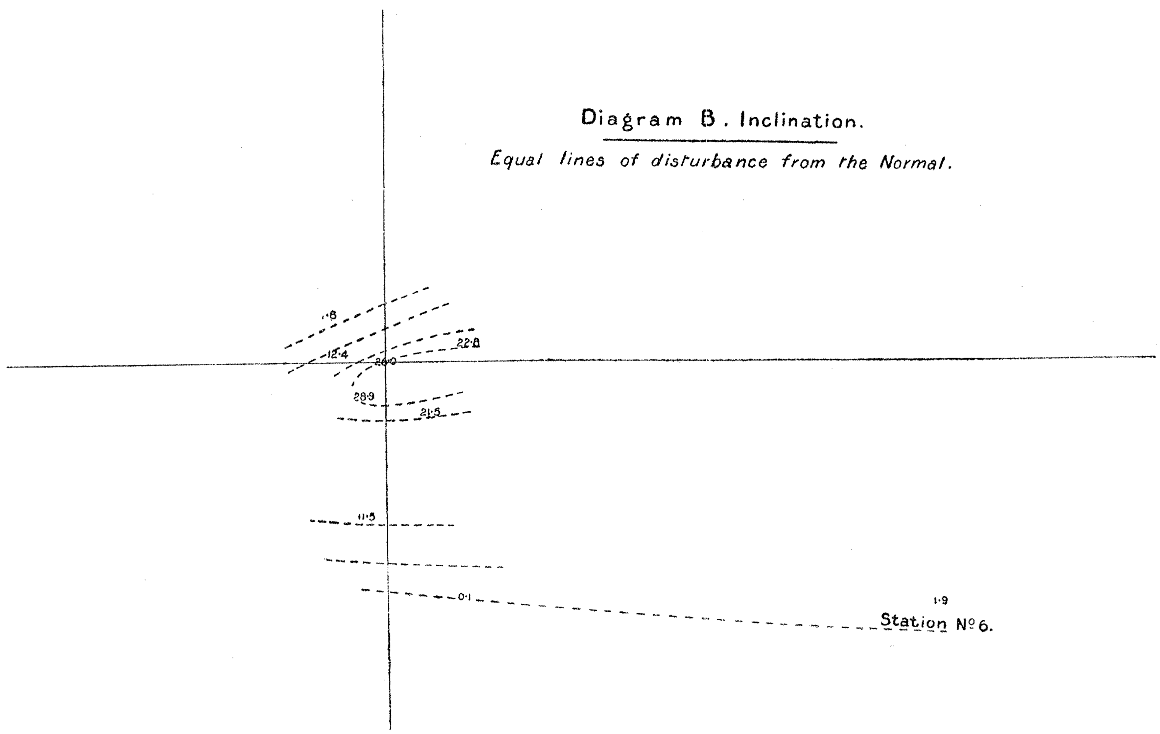
was hauled over the area of maximum disturbance and fixed in any desired position. The direction of the stream also favoured the retention of the ship's head in a given direction, an important factor when ship observations are concerned.

With the exception of one observation, marked No. 6, the data for Diagrams B, C, D were obtained in this manner, but the remaining observations at Stations 11, 12, and 13 were made with the ship under way. The observations of the four days are recorded in Tables III. and IV., with their various corrections and final results.



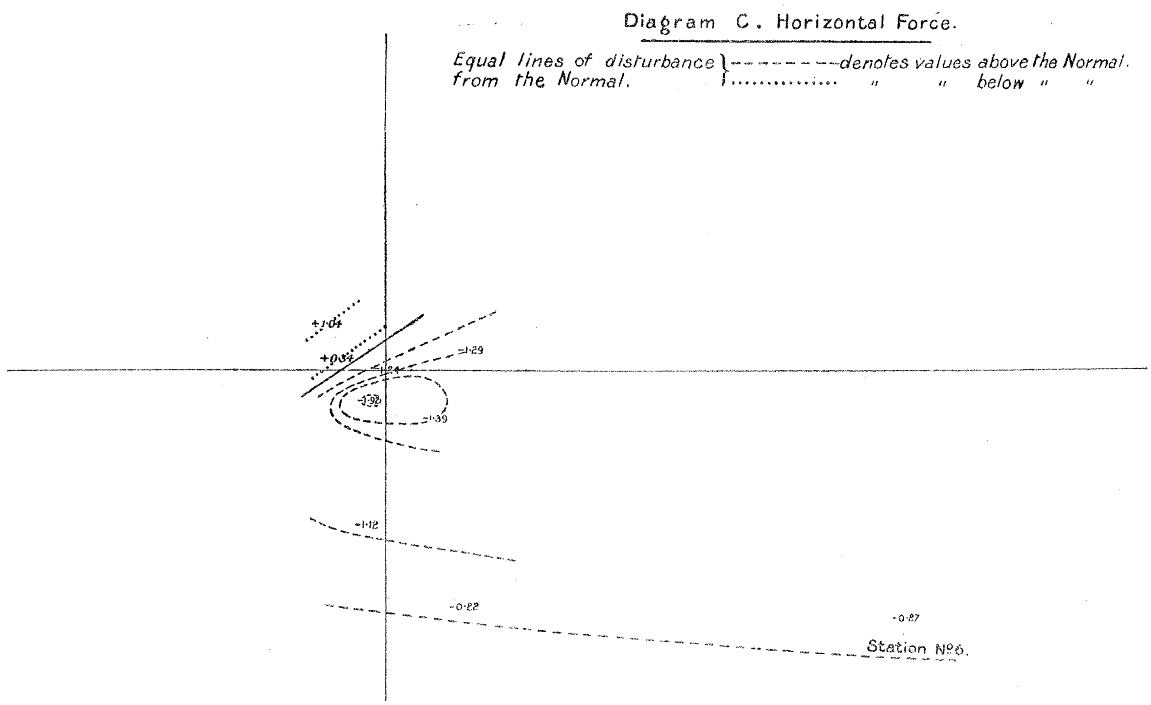
Graphic Representation of the Observed Disturbances.

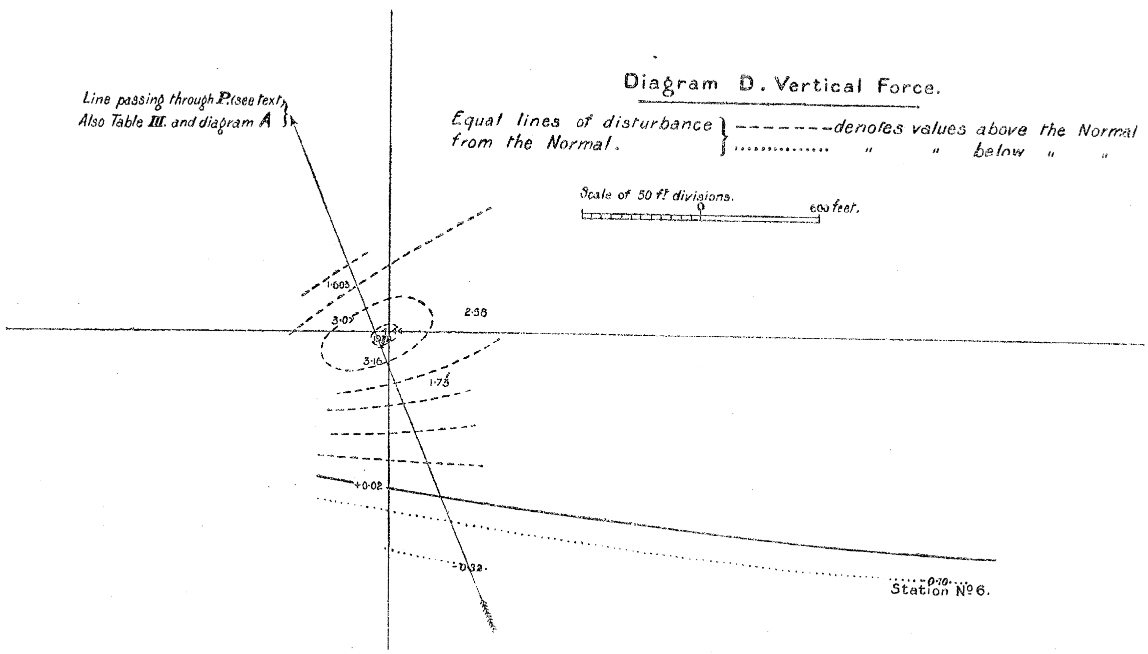
On Diagram A are shown lines of equal values of the disturbances in the Declination taken from Table IV. The figures represent the values of disturbances expressed in degrees, the dots denoting the position of the ship's Standard compass at each observation. Lines of no disturbance are drawn plain, easterly disturbances dotted, and westerly pecked. The values of the lines are 5°, 10°, 20°, 30°, 40°, and 50°. Whilst the general direction of this magnetic shoal is N. 50° E. (true), the approximate dimensions of it are 3 miles long by $1\frac{1}{4}$ miles at its widest part.

On Diagram B the observed disturbances of the Dip are shown, and on C and D those of the Horizontal and Vertical Forces respectively. The figures are taken from Table III., the dots representing the position of the ship as well as the decimal point, and the curves of equal value are drawn.

It may possibly be considered that the observed values of the Declination and

Horizontal Force should have been corrected for reduction of the mean Horizontal Force due to the iron of the ship previously mentioned. This correction was abandoned in view of the fact that, with such large disturbances in which only the





nearest degree of Declination and the Horizontal Force to the second place of decimals were considered, such correction was unnecessary. Moreover, it is highly probable that the ship with her iron frames and her keel between 30 and 40 feet nearer the source of disturbance than the observing instruments, placed in different parts of so powerful a magnetic field, was subject to a measure of induction which there was no means of gauging.

It was suggested that observations to test the effects of this induction might be made on a wooden raft, but neither the state of the sea nor time available permitted this.

On the possible Cause of the Disturbances.

Having in possession the amount of the several disturbances observed, the question arises what is the disturbing cause? It is certain, by the sea soundings, that the source of the disturbance was some 82 feet below the Force instruments.

Referring to Diagram A, the central line of no disturbance is clearly defined by the change of sign in the observed values of the disturbances, and this line may be termed a "ridge line" extending with its sinuosities for a distance of 3·5 miles, and passing through the point of greatest upward Vertical Force disturbance. Points of decreasing value of upward Vertical Force are shown at P^2 and D^1, whilst at D^2 the disturbance is comparatively small and downwards.

Also in Diagram D a transverse sectional line will be seen passing across the curves. This line passes through the area of greatest disturbance in the Vertical Force and of the Declination, and its direction has been selected as also passing through points in the curves which are best authenticated by observation.

The principal results, therefore, may be expressed shortly as follows:—At a point situated N. 78° E. (true), distant 2·155 miles from the Station on Bezout Island, there exists in the land below the sea a source of magnetic disturbance, causing disturbances of the following magnitude:—

Declination.		Dip.	Horizontal Force.		Vertical Force.
26° W. on N. side	to 56° E. on S. side.	−29°	+1·04 on N. side	to −1·92 on S. side.	−4·44 to +0·32

Of the nature of the land under the sea causing such abnormal magnetic disturbances, there is scant information upon which to form any decided opinion. A geological survey of the most disturbed part of the coast at Red Cliff was made by Mr. WALKER, Chief Engineer of the "Penguin," which is given in full with diagram in Appendix B.

A number of specimens of rock and sand were collected by the "Penguin" in several parts of Australia, which Professor RÜCKER has been kind enough to examine. Among these was a specimen of sand taken from the bottom where the magnetic shoal lies, but none of those brought from Port Walcott showed any signs of magnetic susceptibility (see Appendix B).

Professor JUDD, F.R.S., has been also kind enough to look over the geological paper, and he writes: "The only possible chance I can see for other conclusions" (he had previously considered from Appendix A that there was no geological formation to account for the magnetic phenomena) "is, that the term quartzite is used for volcanic rock, or that ironstone dykes are really a decomposed igneous rock (basaltic diabase) which at a slight depth would be found to show their normal magnetic character."

In conclusion, I would remark that the highest credit is due to Lieutenant COMBE, R.N., who, under Captain MOORE, had charge of the magnetic observations. There is no link missing in the chain of evidence as to their completeness in every detail. The management of the ship during the survey of the magnetic shoal was fully fitted to a successful issue.

I have to thank Professors RÜCKER and JUDD for valuable assistance with reference to Appendices A and B.

It is evident, from the scant but well authenticated reports from different parts of the world, that there is much to be done in the direction of ascertaining the position and dimensions of local magnetic disturbances of land under the sea, and it is hoped that what has been done by the "Penguin" will be a source of emulation to others whose lot is cast in a seafaring life.

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TABLE I.—H.M.S. "Penguin." Table of Magnetic Elements Observed during 1890–93.

Place of observation.	Date.	Time.	Declination = δ.	Inclination or Dip = θ. Date.	Needle.	Time.	θ.	Absolute Horizontal Force = H. Date.	Magnet.	Time.	H.
(1) MALTA. Site of Spencer's Monument N. 45° W. (true) 159 yards Lat. 35° 52′ 57″ N. Long. 14° 30′ 42″ E.	1890. 8 March	8.50 A.M.	° ′ 9 42·1 W.	1890. 4 March 7 ,,	3 4 4 4	10 A.M. to noon 10 A.M. to noon	° ′ 51 12·1 N. 51 4·3 N. 51 6·4 N. 51 16·0 N.	1890. 4 March 7 ,, 7 ,,	25 *a* 25 *d* 25 *a*	2 P.M. 1.45 P.M. 2 P.M.	·26509 ·26509 ·26441
(2) SUEZ. West end of Canal Breakwater Lat. 29° 55′ 52″ N. Long. 32° 33′ 33″ E.	15 March	3.30 P.M.	4 30·1 W.	15 March	3 4 4 3 4	9 A.M. 10 A.M. noon 2 P.M. 4 P.M.	40 33·6 N. 40 35·4 N. 40 43·4 N. 40 39·3 N. 40 43·7 N.	15 March	25 *a* 25 *d*	1.15 P.M. 1.45 P.M.	·30296 ·30388
(3) PERIM. (1) Signal Hill Station Lat. 12° 38′ 45″ N. Long. 43° 23 41″ E.	27 March 28 ,,	2 P.M. 5.30 P.M.	3 15·4 W. 3 17·3 W.	27 March 28 ,, 28 ,,	3 3 4 3 4	3.30 P.M. 11 A.M. 11 A.M. 3 P.M. 3 P.M.	5 27·2 N. 5 27·3 N. 5 25·4 N. 5 27·5 N. 5 30·5 N.	29 March	25 *a* 25 *d*	12.30 P.M. 1.30 P.M.	·35903 ·35904
(2) High Lighthouse Station Lat. 12° 39′ 0″ N. Long. 43° 25′ 41″ E.	1 April 2 ,,	2.30 P.M. 5.15 P.M.	3 18·9 W. 3 13·1 W.	1 April	By two needles of Fox instrument corrected for I.E.	11.30 A.M.	5 3·5 N.	1 April	25 *d* 25 *a*	noon 1.30 P.M.	·34108 ·34102

TABLE I.—H.M.S. "Penguin." Table of Magnetic Elements Observed during 1890–93 (continued).

Place of observation.	Date.	Time.	Declination = δ.	Inclination or Dip = θ.				Absolute Horizontal Force = H.			
				Date.	Needle.	Time.	θ.	Date.	Magnet.	Time.	H.
(4) BAUDIN ISLAND.	1890.		° ′	1890.			° ′	1890.			
(1) South Slope Station	19 July	8.40 A.M.	3 15·9 W.	19 July	4	10.30 A.M.	42 54·2 S.	19 July	25 *a*	2 P.M.	·35720
Lat. 14° 7′ 50″ S.		5.10 P.M.	3 16·3 W.		4	3 P.M.	42 56·1 S.		25 *d*	1.30 P.M.	·35720
Long. 125° 36′ 13″ E.											
(2) Sandy Point Station	21 July	4.40 P.M.	2 19·5 E.	21 ,,	3	10 A.M.	40 7·3 S.	21 ,,	25 *a*	1.20 P.M.	·35742
Lat. 14° 7′ 50″ S.	22 ,,	8.20 A.M.	2 9·7 E.		3	2 P.M.	40 5·8 S.		25 *d*	1 P.M.	·35740
Long. 125° 36′ 20″ E.					4	10 A.M.	40 9·8 S.				
Same station as No. (2) above	1891. 7 May	8.15 A.M.	2 13·8 E.		4	2 P.M.	40 5·0 S.				
		4 A.M.	2 15·0 E.								
(5) PORT DARWIN.	1890.										
Fort Hill Station	30 June	4.30 P.M.	2 39·6 E.	28 June	3	10.30 A.M.	36 46·6 S.	30 June	25 *a*	2.15 P.M.	·36588
Lat. 12° 28′ 28″ S.	1 July	7.30 A.M.	2 38·7 E.		4	10.30 A.M.	36 53·1 S.	30 ,,	25 *d*	1.30 P.M.	·36589
Long. 130° 50′ 37″ E.	1 ,,	4.40 P.M.	2 39·4 E.		3	2.30 P.M.	36 51·8 S.	1 July	25 *a*	1.20 P.M.	·36622
	2 ,,	7.30 A.M.	2 37·9 E.		4	2.30 P.M.	36 52·0 S.				
				1 July	3	11.30 A.M.	36 49·4 S.				
					4	11.30 A.M.	36 52·8 S.				
(6) ADMIRALTY GULF.											
Low rocks	9 July	8.15 A.M.	2 2·5 E.	9 July	3	10 A.M.	39 55·3 S.	9 July	25 *a*	1.40 P.M.	·35855
Lat. 14° 3′ 50″ S.	9 ,,	5 P.M.	2 6·9 E.		4	10 A.M.	39 57·0 S.		25 *d*	1.6 P.M.	·35875
Long. 125° 52′ 34″ E.	10 ,,	8.20 A.M.	2 0·9 E.		3	2 P.M.	39 55·6 S.	10 ,,	25 *a*	2 P.M.	·35844
		3.40 P.M.	2 5·5 E.		4	2 P.M.	39 58·0 S.		25 *d*	1.30 P.M.	·35845
				11 ,,	3	10.30 A.M.	39 53·7 S.	11 ,,	25 *a*	1.40 P.M.	·35871
					4	10.30 A.M.	39 56·7 S.				
					3	2.30 P.M.	39 54·2 S.				
					4	2.30 P.M.	39 56·3 S.				

TABLE I.—H.M.S. "Penguin." Table of Magnetic Elements Observed during 1890–93 (continued).

Place of observation.	Date.	Time.	Declination = δ.	Inclination or Dip = θ.				Absolute Horizontal Force = H.			
				Date.	Needle.	Time.	θ.	Date.	Magnet.	Time.	H.
(7) FANNY BAY. Lat. 12° 26′ 10″ S. Long. 130° 50′ 8″ E.	1890. 7 August 8 ,,	 4.45 P.M. 8.15 A.M.	° ′ 2 37·6 E. 2 41·1 E.	1890. 7 August 8 ,,	 4 4 4 3 3 3	 10 A.M. 3 P.M. 10 A.M. 10 A.M. 2 P.M. 3 P.M.	° ′ 36 49·7 S. 36 48·6 S. 36 47·8 S. 36 49·4 S. 36 48·5 S. 36 48·2 S.	1890. 7 August	 25 *a* 25 *d*	 noon 0.30 P.M.	 ·36580 ·36554
(8) COSSACK. Station S. 81° W., 2,280 feet from Reader Head Lat. 20° 39′ 42″ S. Long. 117° 11′ 51″ E.	5 Nov. 4 ,,	6.20 A.M. 4.20 P.M. 7.20 A.M.	0 2·6 W. 0 5·7 W. 0 3·1 W.	4 Nov.	3 4 3 4	10.30 A.M. 10.30 A.M. 2 P.M. 3 P.M.	51 22·1 S. 51 18·4 S. 51 20·2 S. 51 19·7 S.	5 Nov.	25 *d* 25 *a*	1.0 P.M. 1.30 P.M.	·31917 ·31909
(9) BEZOUT ISLAND (near Cossack). South part of Island, 88 feet high Lat. 20° 32′ 45 S. Long. 117° 11′ 15″ E.	6 Nov.	7.30 A.M.	0 22·0 W.	6 Nov.	3 4	9.30 A.M. 10.30 A.M.	50 2·1 S. 50 1·8 S.				
(10) ROEBUCK BAY. Broome Station Lat. 17° 57′ 36″ S. Long. 122° 14′ 32″ E.	29 Oct.	5.30 P.M. 8 A.M.	1 19·8 E. 1 12·3 E.	29 Oct. 29 ,, 30 ,,	4 4 3 3 4 4	11 A.M. 4 P.M. 11 A.M. 4 P.M. 11 A.M. 3 P.M.	46 17·0 S. 46 15·9 S. 46 16·4 S. 46 16·0 S. 46 15·1 S. 46 14·7 S.	29 Oct.	25 *a* 25 *d*	noon ,,	·34058 ·34028

TABLE I.—H.M.S. "Penguin." Table of Magnetic Elements Observed during 1890–93 (continued).

Place of observation.	Date.	Time.	Declination = δ.	Inclination or Dip = θ. Date.	Needle.	Time.	θ.	Absolute Horizontal Force = H. Date.	Magnet.	Time.	H.
(11) GASCOGNE RIVER.	1890.		° ′	1890.			° ′	1890.			
Mouth of River, on sand hills.	11 Nov.	4.30 P.M.	1 50·1 W.	11 Nov.	4	10 A.M.	56 19·0 S.	11 Nov.	25 *d*	10 A.M.	·29389
Lat. 24° 53′ 45″ S.					3	11 A.M.	56 21·4 S.		25 *a*	10 A.M.	·29377
Long. 113° 39′ 40″ E.					3	2 P.M.	56 22·2 S.				
					4	3 P.M.	56 19·2 S.				
(12) FREMANTLE.											
Arthur Head Lighthouse, S. 15° E.	25 Nov.	5.30 P.M.	3 46·3 W.	25 Nov.	3	10 A.M.	63 45·4 S.	25 Nov.	25 *a*	1 P.M.	·25357
(true) 170 feet.	26 ”	7 A.M.	3 48·6 W.		4	11 A.M.	63 45·0 S.	26 ”	25 *a*	1 P.M.	·25364
Lat. 32° 3′ 14″ S.	26 ”	5.30 P.M.	3 48·2 W.		4	2 P.M.	63 45·3 S.		25 *d*	1 P.M.	·25340
Long. 115° 44′ 25″ E.					3	3 P.M.	63 45·8 S.				
				26 ”	3	10 A.M.	63 46·3 S.				
					3	3 P.M.	63 46·8 S.				
(13) HOBART.	1891.			1891.				1891.			
Kangaroo Point Station.	23 Feb.	5 P.M.	9 55·3 E.	23 Feb.	3	10 A.M.	71 8·9 S.	23 Feb.	25 *a*	noon	·20169
Lat. 42° 52′ 55″ S.	25 ”	8.30 A.M.	9 43·8 E.		3	3 P.M.	71 9·4 S.	25 ”	25 *a*	”	·20172
Long. 147° 22′ 15″ E.		5.20 P.M.	9 53·4 E.		4	10 A.M.	71 8·2 S.		25 *d*	”	·20155
	26 ”	7.40 A.M.	9 45·9 E.		4	3 P.M.	71 8·3 S.	26 ”	25 *d*	”	·20191
					3	11 A.M.	71 9·1 S.	27 ”	25 *a*	”	·20172
				26 ”	3	3 P.M.	71 9·6 S.				
(14) MELBOURNE.											
At the Observatory.	17 March	5.20 P.M.	8 10·4 E.	17 March	3	10 A.M.	67 15·7 S.	17 March	25 *a*	noon	·23475
Lat. 37° 49′ 53″ S.		5.30 P.M.	8 9·3 E.		4	11 A.M.	67 17·1 S.		25 *d*	1 P.M.	·23453
Long. 144° 58′ 42″ E.	19 ”	8.40 A.M.	8 0·5 E.		3	3 P.M.	67 14·7 S.				
		4.45 P.M.	8 8·0 E.		4	3 P.M.	67 17·6 S.				
	20 ”	9 A.M.	8 3·4 E.	18 ”	2	11 A.M.	67 14·2 S.				
		3·45 P.M.	8 8·8 E.		1	noon	67 15·4 S.				
					1	2.40 P.M.	67 15·8 S.				
					2	3.30 P.M.	67 14·4 S.				

TABLE I.—H.M.S. "Penguin." Table of Magnetic Elements Observed during 1890–93 (continued).

Place of observation.	Date.	Time.	Declination = δ.	Inclination or Dip = θ. Date.	Needle.	Time.	θ.	Absolute Horizontal Force = H. Date.	Magnet.	Time.	H.
(15) ADELAIDE.	1891.		° ′	1891.			° ′	1891.			
Observatory. Lat. 34° 55′ 32″ S. Long. 138° 35′ 5″ E.	30 March	7.30 A.M. 5.20 P.M. 8.20 A.M.	5 35·2 E. 5 40·4 E. 5 34·8 E.	30 Mar.	3 1 1 3	10.30 A.M. 11.30 A.M. 3.0 P.M. 3.30 P.M.	65 27·8 S. 65 26·1 S. 65 26·7 S. 65 27·8 S.	30 March 31 ,,	25 a 25 d 25 a 25 d	noon. 1.20 P.M. 1.30 P.M. 0.45 P.M.	·24775 ·24776 ·24742 ·24750
(16) ALBANY.											
Wakefield Point, ruin of old Commissariat Store, S.W. (true), 110 yards. Lat. 35° 2′ 0″ S. Long. 117° 54′ 3″ E.	8 April 7 ,,	4 P.M. 8 A.M. 4 P.M. 8 A.M.	4 0·5 W. 4 5·6 W. 4 2·4 W. 4 8·1 W.	7 April 8 ,, 7 ,,	3 3 4 4 1 1	10 A.M. 3 P.M. 10 A.M. 3 P.M. 3 P.M. 11 A.M.	66 18·0 S. 66 19·5 S. 66 17·2 S. 66 17·2 S. 66 17·6 S. 66 16·6 S.	7 April 8 ,,	25 a 25 d 25 a 25 d	2 P.M. 1.30 P.M. 2.10 P.M. 1.50 P.M.	·23965 ·23966 ·23888 ·23881
(17) NEAR COSSACK.											
Cape Lambert. Lat. 20° 35′ 45″ S. Long. 117° 11′ 20″ E.	22 April	8 A.M.	0 4·5 W.	22 April	3	10 A.M.	50 13·3 S.				
Red Cliff Station, No. 1. Lat. 20° 36′ 20″ S. Long. 117° 11′ 36″ E.				22 ,,	3	noon	52 18·5 S.	22 April	25 a		·31039
Red Cliff Point, No. 2 Station. Lat. 20° 36′ 16″ S. Long. 117° 11′ 33″ E.	22 ,,	4.50 P.M.	7 56·1 W.	22 ,,	3	4.0 P.M.	54 11·9 S.				

TABLE I.—H.M.S. "Penguin." Table of Magnetic Elements Observed during 1890–93 (continued).

Place of observation.	Date.	Time.	Declination = δ.	Inclination or Dip = θ.				Absolute Horizontal Force.			
				Date.	Needle.	Time.	θ.	Date.	Magnet.	Time.	H.
(17) NEAR COSSACK (continued).	1891.		° ′	1891.			° ′	1891.			
Red Cliff Point, No. 3 Station. Lat. 20° 36′ 30″ S. Long. 117° 11′ 43″ E.	23 April	8 A.M.	1 11·4 E.	23 April	3	9.30 A.M.	50 41·1 S.				
Red Cliff Point, No. 4 Station. Lat. 20° 36′ 18″ S. Long. 117° 11′ 41′ E.	23 ,,	11 A.M.	2 53·3 E.	23 ,,	3	10.30 A.M.	52 30·5 S.				
Near Red Cliff Point, No. 5 Station. Station on 2-feet rock. Lat. 20° 35′ 36″ S. Long. 117° 12′ 11″ E.	23 ,,	3.30 P.M.	1 4·0 E.	23 ,,	3	2 P.M.	51 35·6 S.				
(10) ROEBUCK BAY.											
Broome Station Lat. 17° 57′ 36″ S. Long. 122° 14′ 32″ E. B.A.T. flagstaff N. 16½ W. distant 200 yards	28 April	8 A.M. 5 P.M.	1 17·0 E. 1 17·3 E.	28 April	3 4 4 3	10 A.M. 11 A.M. 2 P.M. 3 P.M.	46 22·0 S. 46 19·0 S. 46 20·0 S. 46 21·5 S.	28 April 29 ,,	25 a 25 d	noon ,,	·34044 ·34046
(4) BAUDIN ISLAND.											
East Sandy Point Lat. 14° 7′ 50″ S. Long. 125° 36′ 20″ E.	7 May	8.15 A.M. 4 P.M.	2 13·8 E. 2 15·0 E.								

TABLE I.—H.M.S. "Penguin." Table of Magnetic Elements Observed during 1890–93 (continued).

Place of observation.	Date.	Time.	Declination $= \delta$.	Inclination or Dip $= \theta$.				Absolute Horizontal Force.			
				Date.	Needle.	Time.	θ.	Date.	Magnet.	Time.	H.
(18) DAMMA.	1891.		° ′	1891.			° ′	1891.			
N. Side of Koclewatte	7 Nov.	7.40 A.M.	2 14·8 E.	6 Nov.	3	11.30 A.M.	27 40·4 S.	7 Nov.	25 *a*	2 P.M.	·37574
Harbour. Ruined		4.40 P.M.	2 20·7 E.		3	2.30 P.M.	27 43·6 S.		25 *d*	1.30 P.M.	·37572
watch-house bore				9 „	3	11 A.M.	27 40·4 S.	9 „	25 *d*	1.15 P.M.	·37594
N. 85° W. 100 yards					3	2 P.M.	27 39·6 S.				
Lat. 7° 8′ 45″ S.				7 „	4	10 A.M.	27 43·5 S.				
Long. 128° 40′ 18″ E.					4	3 P.M.	27 43·8 S.				
(19) AMBOINA.											
(Same station as	14 Nov.	8 A.M.	2 24·6 E.	14 Nov.	3	10.30 A.M.	21 0·8 S.	14 Nov.	25 *a*	1.40 P.M.	·38381
H.M.S. "Challen-		4.30 P.M.	2 30·6 E.		3	3 P.M.	21 2·7 S.		25 *d*	1 P.M.	·38334
ger" in 1874)	16 „	4.40 P.M.	2 32·3 E.	16 „	3	10 A.M.	21 0·3 S.	16 „	25 *d*	1 P.M.	·38345
Lat. 3° 41′ 40″ S.					4	11 A.M.	21 4·8 S.				
Long. 128° 10′ 7″ E.					4	2 P.M.	21 4·6 S.				
					3	3 P.M.	21 1·0 S.				
(20) TERNATE.											
(Same station as	23 Nov.	7.40 A.M.	2 2·1 E.	23 Nov.	3	10.30 A.M.	11 25·4 S.	23 Nov.	25 *a*	1.30 P.M.	·38413
H.M.S. "Challen-		4.15 P.M.	2 4·1 E.		3	2.30 P.M.	11 22·3 S.		25 *d*	1 P.M.	·38398
ger" in 1874)				24 „	4	10 A.M.	11 25·7 S.	24 „	25 *a*	1.30 P.M.	·38434
Lat. 0° 47′ 25″ N.					3	11 A.M.	11 24·4 S.				
Long. 127° 23′ 15″ E.					3	2 P.M.	11 21·8 S.				
					4	3 P.M.	11 26·6 S.				
(21) SAMBOANGAN.											
(Same position as	30 Nov.	7.20 A.M.	2 4·4 E.	30 Nov.	4	10.20 A.M.	1 36·0 N.	30 Nov.	25 *a*	1.50 P.M.	·38349
H.M.S. "Challen-		4.50 P.M.	2 5·6 E.		3	11.20 A.M.	1 37·3 N.	1 Dec.	25 *a*	1.10 P.M.	·38365
ger," 1874)	1 Dec.	7.20 A.M.	2 2·8 E.		3	2.50 P.M.	1 35·8 N.		25 *d*	0·40 P.M.	·38368
Lat. 6° 54′ 20″ N.					4	3.30 P.M.	1 33·0 N.				
Long. 122° 3′ 51″ E.				1 Dec.	4	10.30 A.M.	1 36·7 N.				
					4	2.20 P.M.	1 33·7 N.				

TABLE I.—H.M.S. "Penguin." Table of Magnetic Elements Observed during 1890–93 (continued).

Place of observation.	Date.	Time.	Declination = δ.	Inclination or Dip = θ.				Absolute Horizontal Force = H.			
				Date.	Needle.	Time.	θ.	Date.	Magnet.	Time.	H.
(22) MANILA.	1891.			1891.				1891.			
(Same position as H.M.S. "Challenger," 1874) Lat. 14° 35′ 25″ N. Long. 120° 58′ 15″ E.	8 Dec.	8.50 A.M.	0 46·8 E.	8 Dec.	4	10.20 A.M.	17 14·7 N.	8 Dec.	25 *a*	2.10 P.M.	·37699
		4.40 P.M.	0 47·8 E.		3	11 A.M.	17 16·2 N.		25 *d*	1.40 P.M.	·37709
	9 ,,	7.50 A.M.	0 47·3 E.		3	3 P.M.	17 15·7 N.	9 ,,	25 *d*	0.30 P.M.	·37717
				9 ,,	4	3.30 P.M.	17 13·9 N.				
					4	10·40 A.M.	17 13·2 N.				
Water line station, 123 yards from principal position	9 ,,	9 A.M.	0 47·9 E.		4	1.20 P.M.	17 13·2 N.				
Inner station, 190 yards inland from principal position		9.20 A.M.	0 45·3 E.								
(23) HONG KONG.	1892.			1892.				1892.			
Observatory. Lat. 22° 18′ 12″ N. Long. 114° 10′ 30″ E.	28 Jan.	5 P.M.	0 35·4 E.	27 Jan.	4	noon	32 3·3 N.	27 Jan.	25 *a*	2 P.M.	·36393
	29 ,,	8.40 A.M.	0 34·5 E.		4	3 P.M.	32 5·2 N.	28 ,,	25 *d*	0.40 P.M.	·36384
		4.20 P.M.	0 35·7 E.	28 ,,	3	10 A.M.	32 2·4 N.	29 ,,	25 *a*	0.30 P.M.	·36401
	4 Feb.	10.30 A.M.	0 37·7 E.		3	3.30 P.M.	32 4·9 N.	4 Feb.	25 *d*	0.50 P.M.	·36393
		3.20 P.M.	0 36·0 E.		2	11 A.M.	32 1·8 N.				
		5 P.M.	0 33·2 E.		2	2.40 P.M.	32 3·3 N.				
				29 ,,	1	10.20 A.M.	32 1·8 N.				
					1	4 P.M.	32 4·2 N.				
				29 ,,	3	11.20 A.M.	32 2·5 N.				
					3	3 P.M.	32 2·8 N.				
KEW OBSERVATORY.	1893.			1893.				1893.			
(Base station.)	5 Sept.	0.50 P.M.	17 38·15 W.	5 Sept.	1	11·40 A.M.	67 26·4 N.	5 Sept.	25 *a*	4.40 P.M.	·18260
	6 ,,	2.20 P.M.	17 34·03 W.	4 ,,	2	10.40 A.M.	67 24·3 N.	6 ,,	25 *a*	0.20 P.M.	·18235
				4 ,,	3	3.20 P.M.	67 27·8 N.		25 *d*	11.50 A.M.	·18257
					4	0.20 P.M.	67 27·1 N.				
					4	0.40 P.M.	67 27·8 N.				

TABLE II.—H.M.S. "Penguin." Table of Magnetic Elements Observed with Relative Instruments during 1890–93.

Place of observation.	Date.	δ.	Date.	θ.	Date.	H.	Z.	Remarks.
SUEZ BAY.	1890.	° ′	1890.	° ′	1890.			
Lat. 29° 50′ 0″ N. Long. 32° 32′ 30″ E.	15 March	4·31 W.						δ obtained by swinging ship in 19 fathoms of water
STRAIT OF BABELMANDEB.								
Lat. 12° 35′ 0″ N. Long. 42° 25′ 0″ E.	27 "	3·25 W.						δ obtained by swinging ship in 19 fathoms of water
PERIM ISLAND.								
Auxiliary Station, No. 1. Lat. 12° 39′ 47″ N. Long. 43° 23′ 35″ E.			31 March	5 4·3 N.	31 March	·35541	·03154	Observed with Fox circle C. 10, compared with two stations at which absolute observations were made
Auxiliary Station, No. 2. Lat. 12° 39′ 47″ N. Long. 43° 24′ 46″ E.			31 "	5 3·7 N.	31 "	·35222	·03120	
Auxiliary Station, No. 3. Lat. 12° 38′ 0″ N. Long. 43° 25′ 40″ E.			2 April	3 30·0 N.	2 April	·35568	·02175	
BAUDIN ISLAND.								
Lat. 14° 0′ 0″ S. Long. 125° 36′ 5″ E.	19 July	2·11 E.						δ obtained by swinging ship in 21 fathoms of water
Lat. 14° 2′ 0″ S. Long. 125° 36′ 0″ E.	1891. 6 May	2·11 E.						δ obtained by swinging ship in 21 fathoms of water
PORT WALCOTT (Cossack.)	1890.							
Lat. 20° 35′ 0″ S. Long. 117° 16′ 0″ E.	5 Nov.	0·15 E.						δ obtained by swinging ship in 8 to 9 fathoms
LAUNCESTON (Tasmania.)	1891.		1891.		1891.			
Lat. 41° 26′ 0″ S. Long. 147° 8′ 35″ E.	5 April		5 April	69 58·6 S.	5 April	·021120	·57958	

TABLE III.—Magnetic Shoal, Port

Abstract of Observations for Declination, Inclination,

Date.	Time.	Number of Observation.	Position of ship. Bezout △. Bearing.	Position of ship. Bezout △. Distance.	Distance of Fox circle from bottom of the sea.	Magnetic direction of ship's head.	Observed Declination.	North seeking end of Needle repelled to	Magnetic direction ship's head by Fox compass.	Observed Inclination or Dip.
			° ′	Miles.	Feet.	°	° ′ ″		° ′	° ′
24th April, 1891.	A.M. 9.10–9.40	1	S. 84 14 W.	2·200	83½	N. 45 E.	5 40 0	E.	N. 45 38 E.	52 31·3
	10.20–10.32	2	S. 82 15 W.	2·128	83½	N. 53 E.	22 44 0	E.	N. 54 3 E.	64 13
	P.M. 12.40	3	S. 79 45 W.	2·188	80½	N. 50 E.	53 25 0	E.	..	74 8
	12.50–1.10	3	S. 79 45 W.	2·188	80½	N. 53 E.	55 56 0	E.	N. 54 3 E.	74 11
	2.20–2.37	4	S. 78 49 W.	2·170	80½	S. 66 E.	1 12 0	E.	N. 115 45 E.	78 53
	3.10–3.29	5	S. 78 28 W.	2·131	83½	S. 20 E.	{26 12 0 / 25 45 0}	W.	N. 160 35 E.	62 30
	5.30–5.50	6	S. 85 12 W.	2·579	83½	N. 12 E.	2 41 0	E.	N. 11 52 E.	52 27
25th April, 1891.	A.M. 6.0–6.10	6*a*	S. 85 12 W.	2·579	83	S. 34 E.	..	..	N. 145 51 E.	55 5
	6.45–7.5	6*b*	S. 85 12 W.	2·579	83	N. 22 E.	..	..	N. 21 19 E.	52 47
	9.13–9.26	7	S. 79 27 W.	2·148	82	N. 22 E.	14 17 0	E.	N. 21 19 E.	80 21
	10.6–10.20	8	S. 78 38 W.	2·240	83½	N. 7 E.	44 34 0	E.	N. 6 32 E.	73 50
	11.0–11.15	9	S. 77 27 W.	2·126	83½	S. 86 E.	19 42 0	W.	N. 94 48 E.	55 5
	11.50–12.2	10	S. 78 27 W.	2·132	83½	S. 78 E.	{25 12 0 / 24 39 0}	W.	N. 102 45 E.	67 5
	P.M. 2.45	11	S. 71 0 W.	2·851	82	S. 60 E.	..	..	N. 121 13 E.	53 56
	2.53	11	S. 71 0 W.	2·851	82	S. 44 E.	12 50 0	W.	N. 137 17 E.	..
	3.7–3.40	12	S. 68 4 W.	3·501	80½	S. 71 E.	15 8 0	E.	N. 110 20 E.	68 39
	4.40	13	S. 66 6 W.	4·330	..	S. 71 E.	..	..	N. 110 20 E.	52 21
	5.45	13*a*	S. 66 6 W.	4·330	..	S. 81 E.	..	..	N. 100 18 E.	53 31
	6.0	13	S. 66 6 W.	4·330	79	North.	2 42 0	E.	..	..
	6.3	13*b*	S. 66 6 W.	4·330	..	N. 9 W.	..	..	N. 10 25 W.	49 19

NOTE.—The letters P, D^1, P^2, D^2, point to the values of the Vertical

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and Total Force with Fox Apparatus C. 10.

Deviation in Inclination for ship's head.	Corrected Dip.	Observed Total Force.	Deviation in Total Force for ship's head.	Corrected Total Force.	Horizontal Force.	Vertical Force.	Disturbances from the Normal.				
							Declination.	Horizontal Force.	Vertical Force.	Number of Observation.	Dip.
° ′	° ′						° ′				° ′
−1 24	51 7	4·5294	+·1775	4·7069	2·9547	3·6640	+ 5 40	−0·218	−0·319	1	+ 0 7
−1 42	62 31	4·2947	+·2038	4·4985	2·0760	3·9908	+ 22 44	−1·116	+0·024	2	+11 31
−1 42	72 26	..	..	..	..	..	+ 53 25	..	..	3	+21 26
−1 42	72 29	5·7713	+·2038	5·9751	1·7984	5·6980	+ 55 56	−1·394	+1·731	3	+21 29
−1 56	76 57	8·3723	+·2619	8·6342	1·9495	8·4114	+ 1 12	−1·243	+4·444 P	4	+25 57
−0 30	62 0	8·0099	+·0484	8·0583	3·7831	7·1154	−{26 12 25 45}	+0·591	+3·148	5	+11 0
−0 12	52 15	4·7556	+·0931	4·8487	2·9683	3·8338	+ 2 41	−0·224	−0·133	6	+ 1 15
−0 55	54 10	4·7542	+·1037	4·8579	2·8440	3·9384	..	−0·348	−0·029	6*a*	+ 3 10
−0 28	52 19	4·7385	+·1116	4·8501	2·9648	3·8384	..	−0·227	−0·129	6*b*	+ 1 19
−0 28	79 53	7·1250	+·1176	7·2426	1·2721	7·1301	+ 14 17	−1·920	+3·163	7	+28 53
0	73 50	6·7405	+·0807	6·8212	1·8992	6·5515	+ 44 34	−1·293	+2·584	8	+22 50
−2 20	52 45	6·6958	+·3020	6·9978	4·2357	5·5702	− 19 42	+1·044	+1·603	9	+ 1 45
−2 18	64 47	7·4109	+·2960	7·7069	3·2835	6·9724	−{25 12 24 39}	+0·091	+3·005	10	+13 47
−1 50	52 6	..	..	..	..	..	..	..	..	11	+ 1 6
..	..	6·5676	+·1531	6·7207	4·1284	5·3029	− 12 50	+0·936	+1·336 D^1	11	..
−2 04	66 35	7·0213	+·2776	7·2989	2·9007	6·6976	+ 15 8	−0·291	+2·731 P^2	12	+15 35
−2 04	50 17	..	..	..	..	..	..	..	..	13	− 0 43
−2 18	51 13	..	..	..	..	..	..	..	..	13*a*	+ 0 13
..	..	4·8856	+·0738	4·9594	3·1690	3·8148	+ 2 42	−0·023	−0·152 D^2	13	..
+0 40	49 59	..	..	..	..	..	..	..	..	13*b*	− 1 01

Force at the position of the corresponding letters on Diagram A.

TABLE IV.—Observations of Declination. Magnetic Shoal, Port Walcott.

Date.	Time.	Position of ship, Bezout Island △. Bearing.	Position of ship, Bezout Island △. Distance.	Bearing of Bezout △ by Standard.	Ship's head by Standard.	Deviation for apparent position ship's head.	Apparent magnetic bearing of Bezout △.	True bearing of Bezout Island △.	Deflection of Standard compass.	North-seeking end of needle repelled to	Remarks.
	A.M.		miles.								
April 22, 1891.	10 5	N. 83° 41′ W.	1·903	N. 82° 0′ W.	N. 22° W.	3° 44′ W.	N. 85° 44′ W.	N. 83° 41′ W.	2° 17′	E.	A correction of 14′ W. index correction has been applied to each of the deflections recorded, and the normal Declination at Bezout Island has been taken = 0
	10 7	N. 85 52 W.	1·924	N. 88 40 W.	N. 15 E.	0 55 E.	N. 87 45 W.	N. 85 52 W.	2 7	E.	
	10 10	N. 87 45 W.	1·940	S. 87 30 W.	N. 27 E.	2 12 E.	S. 89 42 W.	N. 87 45 W.	2 47	E.	
	10 13	S. 89 43 W.	1·932	S. 88 20 W.	N. 20 W.	3 22 W.	S. 84 58 W.	S. 89 43 W.	4 59	E.	
	10 16	S. 86 55 W.	1·929	S. 81 20 W.	N. 32 W.	4 10 W.	S. 77 10 W.	S. 86 55 W.	9 59	E.	
	10 18	S. 86 5 W.	1·923	S. 69 20 W.	N. 19 W.	3 22 W.	S. 65 58 W.	S. 86 5 W.	20 21	E.	
	10 20	S. 83 18 W.	1·917	S. 57 0 W.	N. 23 W.	3 44 W.	S. 53 16 W.	S. 83 18 W.	30 16	E.	
	10 22	S. 81 57 W.	1·917	S. 70 40 W.	N. 4 W.	1 26 W.	S. 69 14 W.	S. 81 57 W.	12 57	E.	
	10 25	S. 79 9 W.	1·934	S. 84 20 W.	N. 11 E.	0 40 E.	S. 85 0 W.	S. 79 9 W.	5 37	W.	
	10 28	S. 75 7 W.	1·963	S. 81 20 W.	N. 7 E.	0 5 W.	S. 81 15 W.	S. 75 7 W.	5 54	W.	
	10 32	S. 71 30 W.	2·001	S. 77 0 W.	N. 2 E.	0 42 W.	S. 76 18 W.	S. 71 30 W.	4 34	W.	
	10 36	S. 68 11 W.	2·035	S. 73 20 W.	N. 10 W.	1 26 W.	S. 71 54 W.	S. 68 11 W.	3 29	W.	
	10 41	S. 63 52 W.	2·079	S. 66 0 W.	N. 8 E.	0 5 W.	S. 65 55 W.	S. 63 52 W.	1 49	W.	
	10 45	S. 58 49 W.	2·169	S. 61 20 W.	N. 3 W.	1 26 W.	S. 59 54 W.	S. 58 49 W.	0 51	W.	
	10 49	S. 54 3 W.	2·285	S. 57 40 W.	N. 4 W.	1 26 W.	S. 56 14 W.	S. 54 3 W.	1 57	W.	
	10 57	S. 57 21 W.	2·640	S. 60 40 W.	S. 9 E.	1 4 W.	S. 59 36 W.	S. 57 21 W.	2 1	W.	
	10 59	S. 58 20 W.	2·640	S. 57 30 W.	S. 23 W.	3 41 E.	S. 61 11 W.	S. 58 20 W.	2 37	W.	
	11 4	S. 62 41 W.	2·476	S. 66 0 W.	S. 7 E.	0 20 W.	S. 65 40 W.	S. 62 41 W.	2 45	W.	
	11 7	S. 65 52 W.	2·404	S. 68 30 W.	S. 6 W.	1 43 E.	S. 69 13 W.	S. 65 52 W.	3 7	W.	
	11 12	S. 72 34 W.	2·299	S. 81 0 W.	S. 9 W.	2 9 E.	S. 83 9 W.	S. 72 34 W.	10 21	W.	
	11 14	S. 75 7 W.	2·271	S. 86 10 W.	S. 13 W.	2 51 E.	S. 89 1 W.	S. 75 7 W.	13 40	W.	
	11 16	S. 77 47 W.	2·237	S. 72 0 W.	South	0 52 E.	S. 72 52 W.	S. 77 47 W.	5 9	E.	
	11 18	S. 79 36 W.	2·196	S. 30 30 W.	S. 44 E.	3 18 W.	S. 27 12 W.	S. 79 36 W.	52 38	E.	
	11 20	S. 81 24 W.	2·189	S. 56 0 W.	S. 33 E.	3 12 W.	S. 52 48 W.	S. 81 24 W.	28 50	E.	
	11 22	S. 84 5 W.	2·178	S. 78 40 W.	S. 8 E.	1 4 W.	S. 77 36 W.	S. 84 5 W.	6 43	E.	
	11 24	S. 86 19 W.	2·171	S. 84 20 W.	S. 16 E.	2 0 W.	S. 82 20 W.	S. 86 19 W.	4 13	E.	
	11 29	N. 89 3 W.	2·192	S. 89 0 W.	S. 1 E.	0 52 E.	S. 89 52 W.	N. 89 3 W.	1 19	E.	
	11 33	N. 82 24 W.	2·187	N. 84 0 W.	South	0 52 E.	N. 83 8 W.	N. 82 24 W.	0 58	E.	
	11 39	N. 74 59 W.	2·214	N. 76 10 W.	South	0 52 E.	N. 75 18 W.	N. 74 59 W.	0 35	E.	
	11 47	N. 82 24 W.	2·339	N. 83 50 W.	North	1 10 W.	N. 85 0 W.	N. 82 24 W.	2 50	E.	
	11 52	N. 88 26 W.	2·354	N. 87 20 W.	N. 18 E.	1 28 E.	N. 85 52 W.	N. 88 26 W.	2 20	W.	
	11 54	S. 88 6 W.	2·377	S. 86 40 W.	N. 10 W.	2 16 W.	S. 84 24 W.	S. 88 6 W.	3 56	E.	
	11 57	S. 82 44 W.	2·328	S. 79 30 W.	North	1 10 W.	S. 78 20 W.	S. 82 44 W.	4 38	E.	

TABLE IV.—Observations of Declination. Magnetic Shoal, Port Walcott (continued).

Date.	Time.	Position of ship, Bezout Island ⚠. Bearing.	Position of ship, Bezout Island ⚠. Distance.	Bearing of Bezout ⚠ by Standard.	Ship's head by Standard.	Deviation for apparent position ship's head.	Apparent magnetic bearing of Bezout ⚠.	True bearing of Bezout Island ⚠.	Deflection of Standard compass.	North-seeking end of needle repelled to	Remarks.
April 22, 1891.	A.M.		miles.								
	12 0	S. 80° 20′ W.	2·344	S. 61° 0′ W.	N. 3° E.	0° 42′ W.	S. 60° 18′ W.	S. 80° 20′ W.	20° 16′	E.	
	12 3	S. 77 9 W.	2·403	S. 37 0 W.	N. 17 W.	3 0 W.	S. 34 0 W.	S. 77 9 W.	43 23	E.	
	12 5	S. 74 1 W.	2·447	S. 83 30 W.	N. 8 E.	0 12 E.	S. 83 42 W.	S. 74 1 W.	9 41	W.	
	12 7	S. 70 27 W.	2·501	S. 74 30 W.	N. 22 E.	1 44 E.	S. 76 14 W.	S. 70 27 W.	5 33	W.	
	12 11	S. 65 19 W.	2·585	S. 69 40 W.	N. 7 W.	1 43 W.	S. 71 23 W.	S. 65 19 W.	5 50	W.	
	P.M.										
	1 37	S. 52 45 W.	3·386	S. 55 0 W.	S. 10 E.	1 4 W.	S. 53 56 W.	S. 52 45 W.	0 57	W.	
	1 43	S. 56 0 W.	3·225	S. 58 30 W.	S. 4 E.	0 13 E.	S. 58 43 W.	S. 56 0 W.	2 29	W.	
	1 47	S. 59 26 W.	3·081	S. 63 20 W.	S. 4 W.	1 18 E.	S. 64 38 W.	S. 59 26 W.	4 58	W.	
	1 52	S. 62 14 W.	2·995	S. 67 40 W.	S. 5 E.	0 14 E.	S. 67 54 W.	S. 62 14 W.	5 26	W.	
	1 55	S. 65 28 W.	2·929	S. 69 40 W.	S. 5 W.	1 43 E.	S. 71 23 W.	S. 65 28 W.	5 51	W.	
	2 0	S. 68 57 W.	2·866	S. 75 30 W.	S. 1 E.	0 52 E.	S. 76 22 W.	S. 68 57 W.	7 11	W.	
	2 4	S. 71 31 W.	2·797	S. 77 30 W.	S. 10 W.	2 35 E.	S. 80 5 W.	S. 71 31 W.	8 20	W.	
	2 7	S. 73 8 W.	2·769	S. 63 30 W.	S. 26 E.	2 55 W.	S. 60 35 W.	S. 73 8 W.	12 47	E.	
	2 10	S. 74 30 W.	2·748	S. 37 50 W.	S. 54 E.	2 43 W.	S. 35 7 W.	S. 74 30 W.	39 37	E.	
	2 14	S. 76 26 W.	2·717	S. 61 20 W.	S. 22 E.	2 49 W.	S. 58 31 W.	S. 76 26 W.	18 9	E.	
	2 18	S. 78 25 W.	2·683	S. 68 30 W.	S. 7 W.	1 13 E.	S. 69 43 W.	S. 78 25 W.	8 56	E.	
	2 22	S. 80 54 W.	2·626	S. 77 30 W.	S. 30 E.	3 6 W.	S. 74 24 W.	S. 80 54 W.	6 44	E.	
	2 26	S. 83 53 W.	2·639	S. 79 10 W.	S. 2 W.	1 28 E.	S. 80 38 W.	S. 83 53 W.	3 29	E.	
	2 35	S. 82 10 W.	3·058	S. 79 40 W.	N. 5 W.	1 43 W.	S. 77 57 W.	S. 82 10 W.	4 27	E.	
	2 40	S. 75 29 W.	3·021	S. 67 0 W.	N. 16 W.	3 0 W.	S. 64 0 W.	S. 75 29 W.	11 43	E.	
	2 43	S. 71 20 W.	3·060	S. 51 0 W.	N. 7 W.	1 43 W.	S. 49 17 W.	S. 71 20 W.	22 17	E.	
	2 46	S. 68 52 W.	3·128	S. 69 20 W.	N. 17 E.	1 28 E.	S. 70 48 W.	S. 68 52 W.	1 42	W.	
	2 49	S. 66 56 W.	3·185	S. 80 30 W.	N. 30 E.	2 12 E.	S. 82 42 W.	S. 66 56 W.	15 32	W.	
	2 50	S. 65 56 W.	3·206	S. 84 40 W.	N. 17 E.	0 45 E.	S. 85 25 W.	S. 65 56 W.	19 15	W.	
	2 51	S. 64 57 W.	3·228	S. 81 30 W.	N. 4 E.	0 42 W.	S. 80 48 W.	S. 64 57 W.	15 37	W.	
	2 55	S. 61 56 W.	3·273	S. 70 40 W.	N. 11 E.	0 40 E.	S. 71 20 W.	S. 61 56 W.	9 10	W.	Correction for I. E. of Standard compass, 14′ W. applies in each case
	3 5	S. 63 13 W.	3·786	S. 62 0 W.	S. 23 E.	2 49 W.	S. 59 11 W.	S. 63 13 W.	4 16	E.	
	3 10	S. 66 22 W.	3·726	S. 46 0 W.	S. 43 E.	3 17 W.	S. 42 43 W.	S. 66 22 W.	23 53	E.	
	3 15	S. 68 36 W.	3·689	S. 50 40 W.	S. 13 E.	1 43 W.	S. 48 57 W.	S. 68 36 W.	19 53	E.	
	3 18	S. 71 12 W.	3·613	S. 59 30 W.	S. 7 E.	0 22 W.	S. 59 8 W.	S. 71 12 W.	12 18	E.	
	3 22	S. 74 50 W.	3·537	S. 68 30 W.	S. 1 W.	0 52 E.	S. 69 22 W.	S. 74 50 W.	5 42		

TABLE IV.—Observations of Declination. Magnetic Shoal, Port Walcott (continued).

Date.	Time.	Position of ship, Bezout Island △. Bearing.	Position of ship, Bezout Island △. Distance.	Bearing of Bezout △ by Standard.	Ship's head by Standard.	Deviation for apparent position ship's head.	Apparent magnetic bearing of Bezout △.	True bearing of Bezout Island △.	Deflection of Standard compass.	North-seeking end of needle repelled to	Remarks.
	P.M.		miles.								
April 22, 1891.	3 26	S. 78° 2′ W.	3·462	S. 76° 20′ W.	S. 14° E.	2° 0′ W.	S. 74° 20′ W.	S. 78° 2′ W.	3° 56′	E.	
	3 29	S. 82 8 W.	3·443	S. 80 0 W.	S. 1 W.	0 52 E.	S. 80 52 W.	S. 82 8 W.	1 30	E.	
	3 33	S. 86 29 W.	3·314	S. 84 40 W.	S. 4 W.	1 18 E.	S. 85 58 W.	S. 86 29 W.	0 45	E.	
	3 36	S. 89 44 W.	3·373	N. 89 40 W.	S. 14 E.	2 0 W.	S. 88 20 W.	S. 89 44 W.	1 38	E.	
	3 48	N. 82 20 W.	3·395	N. 83 20 W.	S. 10 W.	2 35 E.	N. 80 45 W.	N. 82 20 W.	1 21	W.	
	A.M.										
April 23, 1891.	9 24	N. 70 8 W.	1·858	N. 66 40 W.	N. 22 W.	3 44 W.	N. 70 24 W.	N. 70 8 W.	0 30	E.	
	9 28	N. 72 47 W.	1·772	N. 70 20 W.	N. 10 W.	2 16 W.	N. 72 36 W.	N. 72 47 W.	0 3	E.	
	9 31	N. 75 24 W.	1·741	N. 75 0 W.	N. 6 E.	0 5 W.	N. 75 5 W.	N. 75 24 W.	0 5	W.	
	9 34	N. 78 5 W.	1·709	N. 80 0 W.	N. 26 E.	2 0 E.	N. 78 0 W.	N. 78 5 W.	0 9	E.	
	9 38	N. 78 38 W.	1·705	N. 79 40 W.	N. 11 E.	0 40 E.	N. 79 0 W.	N. 78 38 W.	0 36	E.	
	9 40	N. 79 34 W.	1·698	N. 78 0 W.	N. 8 W.	2 0 W.	N. 80 0 W.	N. 79 34 W.	0 40	E.	
	9 44	N. 82 15 W.	1·653	N. 82 10 W.	N. 5 E.	0 5 W.	N. 82 15 W.	N. 82 15 W.	0 14	E.	
	9 49	N. 84 32 W.	1·602	N. 86 40 W.	N. 19 E.	1 28 E.	N. 85 12 W.	N. 84 32 W.	0 54	E.	
	9 53	N. 88 14 W.	1·536	N. 84 20 W.	N. 19 W.	3 22 W.	N. 87 42 W.	N. 88 14 W.	0 18	W.	
	9 57	S. 88 17 W.	1·504	N. 88 0 W.	N. 1 W.	1 10 W.	N. 89 10 W.	S. 88 17 W.	2 19	W.	
	10 1	S. 83 59 W.	1·497	S. 88 40 W.	N. 19 E.	1 28 E.	N. 89 52 W.	S. 83 59 W.	5 55	W.	
	10 6	S. 81 43 W.	1·500	S. 85 10 W.	N. 36 E.	2 57 E.	S. 88 7 W.	S. 81 43 W.	6 10	W.	
	10 10	S. 75 27 W.	1·491	S. 82 50 W.	N. 21 W.	3 44 W.	S. 79 6 W.	S. 75 27 W.	3 25	W.	
	10 16	S. 67 10 W.	1·461	S. 70 40 W.	N. 1 W.	1 10 W.	S. 69 30 W.	S. 67 10 W.	2 6	W.	
	10 21	S. 61 41 W.	1·497	S. 62 30 W.	N. 18 E.	1 28 E.	S. 63 58 W.	S. 61 41 W.	2 3	W.	
	10 29	S. 58 30 W.	1·147	S. 61 20 W.	S. 19 E.	2 33 W.	S. 58 47 W.	S. 58 30 W.	0 3	W.	
	10 33	S. 66 29 W.	1·095	S. 70 50 W.	S. 30 E.	3 6 W.	S. 67 44 W.	S. 66 29 W.	1 0	W.	
	10 35	S. 75 47 W.	1·133	S. 80 40 W.	S. 28 E.	3 0 W.	S. 77 40 W.	S. 75 47 W.	1 39	W.	
	10 38	S. 82 7 W.	1·174	S. 88 30 W.	S. 28 E.	3 0 W.	S. 85 30 W.	S. 82 7 W.	3 9	W.	
	10 42	S. 89 28 W.	1·228	N. 82 10 W.	S. 30 E.	3 6 W.	N. 85 16 W.	S. 89 28 W.	5 2	W.	
	10 45	N. 86 9 W.	1·321	N. 82 0 W.	S. 37 E.	2 47 W.	N. 84 47 W.	N. 86 9 W.	0 18	W.	
	10 48	N. 82 15 W.	1·352	N. 80 0 W.	S. 31 E.	3 6 W.	N. 83 16 W.	N. 82 15 W.	1 15	E.	
	11 7	S. 78 52 W.	2·025	N. 86 50 W.	S. 17 E.	2 15 W.	N. 89 5 W.	S. 78 52 W.	11 49	W.	
	11 9	S. 80 43 W.	2·019	S. 83 30 W.	S. 25 E.	2 54 W.	N. 86 24 W.	S. 80 43 W.	12 39	W.	
	11 10	S. 81 43 W.	2·023	S. 66 10 W.	S. 44 E.	3 16 W.	S. 62 54 W.	S. 81 43 W.	19 3	E.	
	11 12	S. 82 44 W.	2·037	S. 64 10 W.	S. 47 E.	3 3 W.	S. 61 7 W.	S. 82 44 W.	21 51	E.	

TABLE IV.—Observations of Declination. Magnetic Shoal, Port Walcott (continued).

Date.	Time.	Position of ship, Bezout Island △.		Bearing of Bezout △ by Standard.	Ship's head by Standard.	Deviation for apparent position of ship's head.	Apparent magnetic bearing of Bezout △.	True bearing of Bezout Island △.	Deflection of Standard compass.	North-seeking end of needle repelled to	Remarks.
		Bearing.	Distance.								
April 23, 1891.	A.M. 11 17	S. 81° 24′ W.	miles. 2·164	S. 57° 30′ W.	N. 31° W.	4° 10′ W.	S. 53° 20′ W.	S. 81° 24′ W.	28° 18′	E.	
	11 18	S. 80 26 W.		S. 70 0 W.	N. 42 W.	4 22 W.	N. 65 38 W.	S. 80 26 W.	15 2	E.	
	11 18½	S. 79 31 W.	Slowly crossing the trough of vanishing repulsion near the focus, but not fixing	S. 80 0 W.	N. 9 W.	2 0 W.	S. 78 0 W.	S. 79 31 W.	1 8	E.	
	11 19	S. 78 54 W.		N. 82 0 W.	N. 11 E.	0 40 E.	N. 81 20 W.	S. 78 54 W.	19 32	W.	
	11 25	S. 76 55 W.	2·275	S. 88 0 W.	S. 11 E.	1 43 W.	S. 86 17 W.	S. 76 55 W.	9 8	W.	
	11 26	S. 78 29 W.	..	S. 39 0 W.	S. 57 E.	2 32 W.	S. 36 28 W.	S. 78 29 W.	42 15	E.	
	11 27	S. 79 10 W.	..	S. 37 20 W.	S. 59 E.	2 25 W.	S. 34 55 W.	S. 79 10 W.	44 29	E.	
	11 40	S. 78 30 W.	2·270	S. 41 0 W.	N. 77 W.	2 6 W.	S. 38 54 W.	S. 78 30 W.	40 16	E.	
	11 41	S. 77 43 W.	2·290	S. 37 50 W.	N. 80 W.	2 6 W.	S. 35 44 W.	S. 77 43 W.	42 13	E.	
	11 42	S. 76 27 W.	2·321	West	N. 27 W.	4 1 W.	S. 85 59 W.	S. 76 27 W.	9 18	W.	
	11 47	S. 71 52 W.	2·520	S. 83 20 W.	S. 27 E.	3 0 W.	S. 80 20 W.	S. 71 52 W.	8 14	W.	
	11 49	S. 73 0 W.	2·529	S. 85 40 W.	S. 21 E.	2 49 W.	S. 82 51 W.	S. 73 0 W.	9 37	W.	
	11 50	S. 74 23 W.	2·541	S. 84 20 W.	S. 24 E.	2 54 W.	S. 81 26 W.	S. 74 23 W.	6 49	W.	
	11 51	S. 74 48 W.	2·546	S. 81 20 W.	S. 28 E.	3 0 W.	S. 78 20 W.	S. 74 48 W.	3 18	W.	
	11 52	S. 75 13 W.	2·550	S. 76 40 W.	S. 33 E.	3 12 W.	S. 73 28 W.	S. 75 13 W.	1 59	E.	
	11 53	S. 75 38 W.	2·553	S. 63 0 W.	S. 49 E.	3 7 W.	S. 59 53 W.	S. 75 38 W.	15 59	E.	
	11 54	S. 76 3 W.	2·558	S. 45 0 W.	S. 69 E.	2 4 W.	S. 42 56 W.	S. 76 3 W.	33 21	E.	
	11 55	S. 76 40 W.	2·569	S. 38 0 W.	S. 77 E.	1 32 W.	S. 36 28 W.	S. 76 40 W.	40 6	E.	
	11 56	S. 77 17 W.	2·579	S. 47 50 W.	S. 71 E.	1 56 W.	S. 45 54 W.	S. 77 17 W.	31 37	E.	
	11 59	S. 79 0 W.	2·637	S. 73 20 W.	S. 57 E.	2 32 W.	S. 70 48 W.	S. 79 0 W.	8 26	E.	
	P.M. 1 35	S. 78 49 W.	3·771	S. 73 20 W.	N. 13 E.	0 56 E.	S. 74 16 W.	S. 78 49 W.	4 47	E.	
	1 40	S. 76 13 W.	3·771	S. 74 40 W.	N. 24 W.	3 52 W.	S. 70 48 W.	S. 76 13 W.	5 39	E.	
	1 42	S. 73 44 W.	3·764	S. 66 0 W.	N. 10 E.	0 40 E.	S. 66 40 W.	S. 73 44 W.	7 18	E.	
	1 48	S. 69 36 W.	3·909	S. 60 0 W.	N. 8 E.	0 12 E.	S. 60 12 W.	S. 69 36 W.	9 38	E.	
	1 51	S. 68 39 W.	4·009	S. 59 40 W.	N. 6 E.	0 5 W.	S. 59 35 W.	S. 68 39 W.	9 18	E.	

TABLE IV.—Observations of Declination. Magnetic Shoal, Port Walcott (continued).

Date.	Time.	Position of ship, Bezout Island △.		Bearing of Bezout △ by Standard.	Ship's head by Standard.	Deviation for apparent position of ship's head.	Apparent magnetic bearing of Bezout △.	True bearing of Bezout Island △.	Deflection of Standard compass.	North-seeking end of needle repelled to	Remarks.
		Bearing.	Distance.								
	P.M.		miles.								
April 23, 1891.	1 55	S. 64° 53′ W.	4·062	S. 57° 40′ W.	N. 2° W.	1° 26′ W.	S. 56° 14′ W.	S. 64° 53′ W.	8° 53′	E.	
	1 57	S. 62 43 W.	4·149	S. 58 50 W.	N. 1 W.	1 10 W.	S. 57 40 W.	S. 62 43 W.	5 17	E.	
	2 0	S. 60 9 W.	4·261	S. 57 30 W.	N. 1 E.	1 10 W.	S. 56 20 W.	S. 60 9 W.	4 3	E.	
	2 4	S. 56 20 W.	4·363	S. 55 0 W.	N. 4 E.	0 42 W.	S. 54 18 W.	S. 56 20 W.	2 16	E.	
	2 8	S. 52 41 W.	4·523	S. 53 20 W.	N. 4 W.	1 43 W.	S. 51 37 W.	S. 52 41 W.	1 18	E.	
	2 16	S. 56 13 W.	4·966	S. 56 0 W.	S. 6 E.	0 20 W.	S. 55 40 W.	S. 56 13 W.	0 47	E.	
	2 20	S. 57 49 W.	4·908	S. 60 0 W.	S. 37 E.	2 47 W.	S. 56 13 W.	S. 57 49 W.	1 50	E.	
	2 23	S. 59 3 W.	4·872	S. 56 40 W.	S. 8 W.	2 10 E.	S. 58 50 W.	S. 59 3 W.	0 27	E.	
	2 26	S. 59 55 W.	4·756	S. 58 10 W.	S. 4 W.	1 18 E.	S. 59 28 W.	S. 59 55 W.	0 41	E.	
	2 30	S. 61 27 W.	4·647	S. 60 50 W.	S. 5 E.	0 20 W.	S. 60 30 W.	S. 61 27 W.	1 11	E.	
	2 33	S. 63 44 W.	4·548	S. 64 30 W.	S. 16 E.	2 0 W.	S. 62 30 W.	S. 63 44 W.	1 30	E.	
	2 36	S. 65 7 W.	4·524	S. 66 40 W.	S. 30 E.	3 6 W.	S. 63 34 W.	S. 65 7 W.	1 47	E.	
	2 38	S. 65 48 W.	4·562	S. 67 30 W.	S. 35 E.	3 12 W.	S. 64 18 W.	S. 65 48 W.	1 44	E.	
	2 41	S. 67 5 W.	4·534	S. 66 0 W.	S. 3 E.	0 16 E.	S. 66 16 W.	S. 67 5 W.	1 3	E.	
	2 44	S. 68 52 W.	4·472	S. 68 20 W.	S. 8 E.	0 20 W.	S. 68 0 W.	S. 68 52 W.	1 6	E.	
	2 48	S. 71 16 W.	4·420	S. 72 0 W.	S. 15 E.	2 0 W.	S. 70 0 W.	S. 71 16 W.	1 30	E.	
	2 52	S. 74 17 W.	4·348	S. 72 50 W.	S. 6 W.	1 43 E.	S. 74 33 W.	S. 74 17 W.	0 2	W.	
	2 55	S. 76 20 W.	4·254	S. 74 50 W.	S. 6 W.	1 43 E.	S. 76 33 W.	S. 76 20 W.	0 1	E.	
	3 1	S. 78 57 W.	4·131	S. 77 50 W.	S. 2 W.	1 18 E.	S. 79 8 W.	S. 78 57 W.	0 3	E.	
	3 7	S. 77 3 W.	3·898	S. 78 0 W.	N. 22 W.	3 44 W.	S. 74 16 W.	S. 77 3 W.	3 1	E.	
	3 11	S. 72 54 W.	3·878	S. 70 20 W.	N. 18 W.	3 0 W.	S. 67 20 W.	S. 72 54 W.	5 48	E.	
	3 13	S. 70 22 W.	3·864	S. 65 30 W.	N. 36 W.	4 0 W.	S. 61 30 W.	S. 70 22 W.	9 6	E.	
	3 16	S. 67 39 W.	3·802	S. 58 50 W.	N. 29 W.	4 0 W.	S. 54 50 W.	S. 67 39 W.	13 3	E.	
	3 18	S. 66 38 W.	3·861	N. 54 30 W.	N. 14 W.	2 38 W.	S. 51 52 W.	S. 66 38 W.	15 0	E.	
	3 25	S. 62 46 W.	3·935	S. 65 0 W.	N. 22 W.	3 44 W.	S. 61 16 W.	S. 62 46 W.	1 44	E.	
	3 29	S. 58 54 W.	3·971	S. 60 20 W.	N. 10 W.	2 16 W.	S 58 4 W.	S. 58 54 W.	1 4	E.	
	3 33	S. 54 49 W.	4·170	S. 56 50 W.	N. 13 W.	2 38 W.	S. 54 12 W.	S. 54 49 W.	0 51	E.	
	3 37	S. 50 38 W.	4·275	S. 53 10 W.	N. 19 W.	3 22 W.	S. 49 48 W.	S. 50 38 W.	1 4	E.	
	3 49	S. 55 51 W.	4·354	S. 52 30 W.	S. 30 W.	4 12 E.	S 56 42 W.	S. 55 51 W.	0 37	W.	
	3 55	S. 60 31 W.	4·252	S. 55 40 W.	S. 22 W.	3 41 E.	S. 59 21 W.	S. 60 31 W.	1 24	E.	
	3 59	S. 61 59 W.	4·033	S. 57 30 W.	S. 19 W.	3 8 E.	S. 60 38 W.	S. 61 59 W.	1 35	E.	
	4 2	S. 62 4 W.	3·876	S. 58 20 W.	S. 44 W.	4 27 E.	S. 62 47 W.	S. 62 4 W.	0 29	W.	
	4 3	S. 63 9 W.	3·807	S. 55 20 W.	S. 44 W.	4 27 E.	S. 59 47 W.	S. 63 9 W.	3 36	E.	

TABLE IV.—Observations of Declination. Magnetic Shoal, Port Walcott (continued).

Date.	Time.	Position of ship, Bezout Island △. Bearing.	Position of ship, Bezout Island △. Distance.	Bearing of Bezout △ by Standard.	Ship's head by Standard.	Deviation for apparent position of ship's head.	Apparent magnetic bearing of Bezout △.	True bearing of Bezout Island △.	Deflection of Standard compass.	North-seeking end of needle repelled to	Remarks.
April 23, 1891.	P.M. 4 5	S. 63° 13′ W.	miles. 3·711	S. 53° 20′ W.	S. 45° W.	4° 27′ E.	S. 57° 47′ W.	S. 63° 13′ W.	5° 39′	E.	
	4 6	S. 63 28 W.	3·630	S. 63 20 W.	S. 35 W.	4 22 E.	S. 67 42 W.	S. 63 28 W.	4 0	W.	
	4 8	S. 63 46 W.	3·546	S. 69 40 W.	S. 54 W.	4 21 E.	S. 74 21 W.	S. 63 46 W.	10 21	W.	
	4 10	S. 64 4 W.	3·479	S. 69 20 W.	S. 59 W.	4 0 E.	S. 73 20 W.	S. 64 4 W.	9 2	W.	
	4 13	S. 64 21 W.	3·350	S. 75 20 W.	S. 45 W.	4 27 E.	S. 79 47 W.	S. 64 21 W.	15 12	W.	
	4 16	S. 64 35 W.	3·218	S. 80 20 W.	N. 86 W.	1 19 W.	S. 79 1 W.	S. 64 35 W.	14 12	W.	
	4 19	S. 64 18 W.	3·073	S. 67 40 W.	S. 46 W.	4 27 E.	S. 72 7 W.	S. 64 18 W	7 35	W.	
	4 22	S. 64 46 W.	2·942	S. 65 50 W.	S. 55 W.	4 19 E.	S. 70 9 W.	S. 64 46 W.	5 9	W.	
	4 25	S. 65 47 W.	2·680	S. 65 50 W.	S. 38 W.	4 25 E.	S. 70 15 W.	S. 65 47 W.	4 14	W.	
April 24, 1891.	A.M. 7 21	S. 62 2 W.	1·039	S. 65 50 W.	N. 9 W.	2 0 W.	S. 63 50 W.	S. 62 2 W.	1 34	W.	
	7 26	S. 63 46 W.	1·455	S. 69 10 W.	S. 65 E.	2 11 W.	S. 66 59 W.	S. 63 46 W.	2 59	W.	
	7 30	S. 63 13 W.	1·540	S. 68 30 W.	N. 23 W.	3 44 W.	S. 64 46 W.	S. 63 13 W.	1 19	W.	
	7 34	S. 60 44 W.	1·761	S. 65 0 W.	S. 70 E.	2 11 W.	S. 62 49 W.	S. 60 44 W.	1 51	W.	
	7 38	S. 60 36 W.	1·880	S. 62 20 W.	N. 2 E.	0 52 W.	S. 61 28 W.	S. 60 36 W.	0 38	W.	
	7 40	S. 57 5 W.	2·055	S. 58 0 W.	N. 67 E.	2 48 E.	S. 60 48 W.	S. 57 5 W.	3 29	W.	
	7 44	S. 57 22 W.	2·250	S. 57 30 W.	N. 7 E.	0 15 W.	S. 57 15 W.	S. 57 22 W.	0 21	E.	
	7 50	S. 57 36 W.	2·482	S. 60 50 W.	S. 73 E.	1 48 W.	S. 59 2 W.	S. 57 36 W.	1 12	W.	
	7 52	S. 57 51 W.	2·591	S. 59 30 W.	N. 2 W.	1 26 W.	S. 58 4 W.	S. 57 51 W.	0 1	E.	
	7 57	S. 57 15 W.	2·763	S. 61 30 W.	S. 75 E.	1 40 W.	S. 59 50 W.	S. 57 15 W.	2 21	W.	
	8 1	S. 57 7 W.	2·903	S. 63 0 W.	N. 23 W.	3 44 W.	S. 59 16 W.	S. 57 7 W.	1 55	W.	
	8 6	S. 56 39 W.	3·153	S. 62 30 W.	S. 62 E.	2 18 W.	S. 60 12 W.	S. 56 39 W.	2 19	W.	
	8 9	S. 57 14 W.	3·276	S. 60 30 W.	N. 10 W.	2 16 W.	S. 58 14 W.	S. 57 14 W.	0 46	W.	
	8 12	S. 55 52 W.	3·430	S. 63 0 W.	S. 71 E.	1 56 W.	S. 61 4 W.	S. 55 52 W.	4 58	W.	
	8 16	S. 55 34 W.	3·516	S. 59 10 W.	N. 14 W.	2 38 W.	S. 56 42 W.	S. 55 34 W.	0 54	W.	
	8 20	S. 55 17 W.	3·738	S. 59 50 W.	S. 51 E.	2 55 W.	S. 56 55 W.	S. 55 17 W.	1 24	W.	
	9 26	S. 84 14 W.	2·200	S. 75 34 W.	N. 42 E.	3 13 E.	S. 78 47 W.	S. 84 14 W.	5 40	E.	
	10 30	S. 82 15 W.	2·128	S. 56 57 W.	N. 58 E.	2 48 E.	S. 59 45 W.	S. 82 15 W.	22 44	E.	

TABLE IV.—Observations of Declination. Magnetic Shoal, Port Walcott (continued).

Date.	Time.	Position of ship, Bezout Island △. Bearing.	Position of ship, Bezout Island △. Distance.	Bearing of Bezout by Standard.	Ship's head by Standard.	Deviation for apparent position of ship's head.	Apparent magnetic bearing of Bezout △.	True bearing of Bezout Island △.	Deflection of Standard compass.	North-seeking end of needle repelled to	Remarks.
April 24, 1891.	P.M. 1 9	S. 79° 45′ W.	miles. 2·188	S. 23° 28′ W.	N. 51° E.	3° 6′ E.	S. 26° 34′ W.	S. 79° 45′ W.	53° 25′	E.	
	2 2	S. 79 36 W.	Heaving in the port cable	S. 22 20 W.	N. 56 E.	2 48 E.	S. 25 8 W.	S. 79 36 W.	54 42	E.	
	2 5	S. 79 28 W.		S. 24 8 W.	N. 69 E.	1 36 E.	S. 25 44 W.	S. 79 28 W.	53 58	E.	
	2 8	S. 79 13 W.		S. 35 35 W.	N. 79 E.	0 30 E.	S. 36 5 W.	S. 79 13 W.	43 22	E.	
	2 10	S. 79 11 W.		S. 32 42 W.	N. 74 E.	1 14 E.	S. 33 56 W.	S. 79 11 W.	45 29	E.	
	2 13	S. 79 10 W.	Veering the starboard	S. 34 20 W.	N. 79 E.	0 30 E.	S. 34 50 W.	S. 79 10 W.	44 34	E.	
	2 14	S. 79 9 W.		S. 54 0 W.	S. 81 E.	1 21 W.	S. 52 39 W.	S. 79 9 W.	26 44	E.	
	2 16	S. 79 7 W.	2·169	S. 53 22 W.	S. 88 E.	1 0 W.	S. 52 22 W.	S. 79 7 W.	26 59	E.	
	2 17	S. 79 5 W.	Heaving in port	S. 62 10 W.	S. 73 E.	1 48 W.	S. 60 22 W.	S. 79 5 W.	18 59	E.	
	2 19	S. 79 4 W.		S. 74 28 W.	S. 65 E.	2 4 W.	S. 72 24 W.	S. 79 4 W.	6 54	E.	
	2 21	S. 78 49 W.	2·170	S. 80 5 W.	S. 67 E.	2 4 W.	S. 78 1 W.	S. 78 49 W.	1 12	E.	
	2 49	S. 78 47 W.	Heaving in port cable	S. 89 10 W.	S. 40 E.	2 55 W.	S. 86 15 W.	S. 78 47 W.	7 14	W.	
	2 53	S. 78 47 W.		N. 80 30 W.	S. 29 E.	3 0 W.	N. 83 30 W.	S. 78 47 W.	17 29	W.	
	2 55	S. 78 43 W.		N. 77 40 W.	S. 27 E.	3 0 W.	N. 80 40 W.	S. 78 43 W.	20 23	W.	
	2 58	S. 78 39 W.		N. 74 50 W.	S. 24 E.	2 54 W.	N. 77 44 W.	S. 78 39 W.	23 23	W.	
	2 59	S. 78 37 W.	Veering the starboard cable	N. 73 30 W.	S. 22 E.	2 49 W.	N. 76 19 W.	S. 78 37 W.	25 10	W.	
	3 4	S. 78 35 W.		N. 72 50 W.	S. 21 E.	2 49 W.	N. 75 39 W.	S. 78 35 W.	25 32	W.	
	3 6	S. 78 31 W.		N. 72 30 W.	S. 19 E.	2 33 W.	N. 75 3 W.	S. 78 31 W.	26 12	W.	
	3 11	S. 78 28 W.	2·131	N. 73 0 W.	S. 20 E.	2 33 W.	N. 75 33 W.	S. 78 28 W.	25 45	W.	
	4 12	S. 79 30 W.	2·188	S. 21 50 W.	N. 67 E.	1 58 E.	S. 23 48 W.	S. 79 30 W.	55 56	E.	
	4 42	S. 85 12 W.	2·579	S. 85 40 W.	S. 40 E.	2 55 W.	S. 82 45 W.	S. 85 12 W.	2 41	E.	
	A.M. 9 14	S. 79 27 W.	2·148	S. 63 40 W.	N. 22 E.	1 44 E.	S. 65 24 W.	S. 79 27 W.	14 17	E.	
	10 6	S. 78 38 W.	2·240	S. 35 0 W.	N. 4 E.	0 42 W.	S. 34 18 W.	S. 78 38 W.	44 34	E.	
	11 1	S. 77 27 W.	2·126	N. 81 28 W.	S. 83 E.	1 9 W.	N. 82 37 W.	S. 77 27 W.	19 42	W.	
	11 44	S. 78 27 W.	2·132	N. 73 0 W.	S. 48 E.	3 7 W.	N. 76 7 W.	S. 78 27 W.	25 12	W.	
	11 53	S. 78 27 W.		N. 75 0 W.	S. 76 E.	1 40 W.	N. 76 40 W.	S. 78 27 W.	24 39	W.	
	P.M. 2 51	S. 71 0 W.	2·851	S. 87 20 W.	S. 42 E.	3 16 W.	S. 84 4 W.	S. 71 0 W.	12 50	W.	
	3 24	S. 68 4 W.	3·501	S. 54 50 W.	S. 76 E.	1 40 W.	S. 53 10 W.	S. 68 4 W.	15 8	E.	
	4 41	S. 66 6 W.	4·330	S. 66 10 W.	S. 58 E.	2 32 W.	S. 63 38 W.	S. 66 6 W.	2 42	E.	

Appendix A.

Geological Observations at Red Cliffs, near Cossack, N.W. Australia.

On April 25, 1891, I landed at the "Red Cliffs," between Cape Lambert and Reader Head, near Cossack, N.W. Australia, and made the following notes on their geological structure:—

(1.) The cliff runs in a general N.W. and S.E. direction for about a quarter of a mile, and is about 30 feet in average height; the face is very rugged, but it being almost entirely free from vegetation, some very excellent sections are presented.

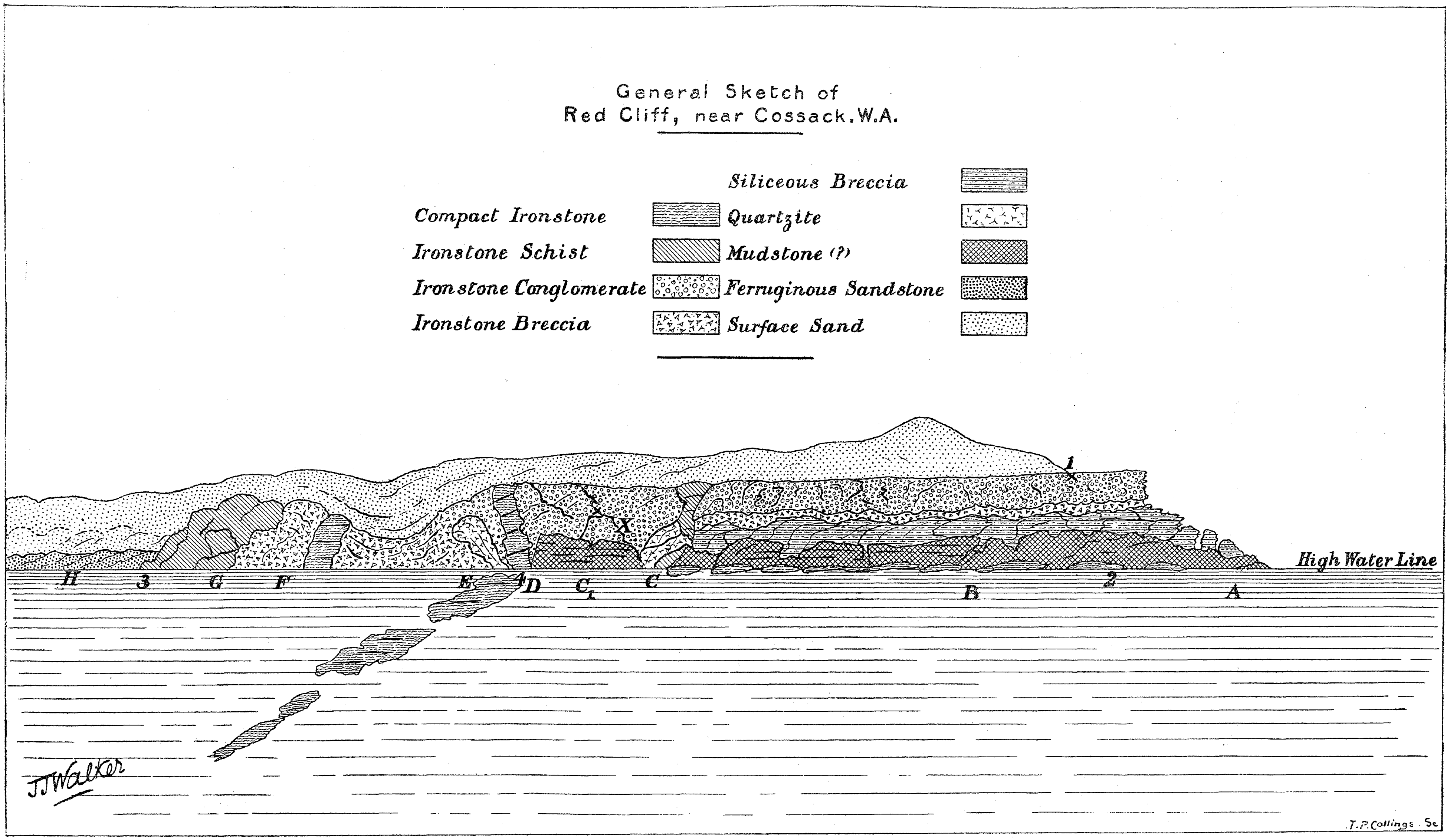
(2.) At the N.W. end (A in the general sketch), the beach is strewn with huge blocks of breccia and ironstone conglomerate, fallen from the cliffs above. Commencing from high-water-mark (it being unfortunately nearly high tide when I landed), there is first a layer of yellowish sandstone (?), about 10 feet thick, the bedding of which is nearly horizontal. On this rests another bed of the same thickness of a siliceous breccia, crowded with angular fragments of various forms of quartzite. At the top of this layer, the paste in which the fragments are embedded becomes highly ferruginous, and passes into a cap of "ironstone conglomerate," consisting of rounded nodules of (apparently) brown hæmatite embedded in a reddish-brown paste, which effervesces strongly when treated with hydrochloric acid.

(3.) Proceeding along the cliff to (B), large masses of compact ironstone (? brown hæmatite) *in situ* are seen, cropping out of the beach at high-water-mark.

(4.) At (C) is a small gap in the cliff, just beyond which is a well-marked dyke-like mass of quartz, about 4 feet wide, in layers alternately light and dark coloured, and bedded almost vertically. The "strike" of these layers is approximately N.E. and S.W. On the north side of the dyke-like mass is a narrow platform of ferruginous sandstone, having the same dip and strike. At (C) is a small mass or vein (marked X in general sketch) of a curious whitish soft mineral, which I am not able to name.

(5.) At (D) the cliffs are intersected by a very remarkable dyke-like mass, or vein, of compact ironstone, about 20 feet in width, nearly vertical, strike about N.N.E. and S.S.W. It appears to be continued out to sea in the same direction in a series of reefs, awash at low water. Just beyond it, at (E), is another dyke-like mass of quartzite, similar to that at (C), but the layers are better defined, and in places much more contorted; the width of this dyke-like mass is about 10 feet. Here the cap of ironstone conglomerate ceases.

(6.) A little further on, in a small hollow or glen in the cliff, another massive dyke-like mass of ironstone, similar to that at (D), crops out. Then comes, at (F), a mass of "ironstone breccia" (fragments of quartzite embedded in a highly ferruginous paste), which passes at (G) into what I venture to call "ironstone schist," consisting of alternate layers of whitish quartzose stone and ironstone, about an inch in average


General Sketch of
Red Cliff, near Cossack, W.A.
Compact Ironstone
Ironstone Schist
Ironstone Conglomerate
Ironstone Breccia
Siliceous Breccia
Quartzite
Mudstone (?)
Ferruginous Sandstone
Surface Sand
High Water Line
H
3
G
F
E
4
D
C1
C
X
X
1
B
2
A
J.J. Walker
T.P. Collings. Sc

thickness, dipping at an angle of 85°, and striking approximately N.E. and S.W. In many places, however, the beds are much contorted.

(7.) The cliff ceases at (H) and is succeeded by a sandy beach resting on a platform of coarse ferruginous sandstone.

(8.) The summit of the cliff from (A) to (D) is nearly level and strewn with fragments and nodules of ironstone. Further inland the country is very barren and sandy, with scanty grass and a few low shrubs. A quartz dyke-like mass, probably a continuation of that at (C), was noticed about a quarter of a mile inland from the edge of the cliff.

(9.) Magnetical observations were taken at positions (1), (2), (3), and (4) on the general sketch. A series of the most characteristic rocks and minerals were collected by me and are forwarded with these notes.

(Signed) J. J. Walker,
Chief Engineer,
H.M.S. "Penguin."

Appendix B.

The whole of the geological specimens forwarded from H.M.S. "Penguin" have been examined by Professor Rücker, F.R.S. Of these, the undermentioned list specially refers to positions in the vicinity of Bezout and Baudin Islands of special magnetic interest.

1*a*, 2*b*, 3*c*, 4*d*. Bezout Island, near Cossack.

5. Reader Hill, Cossack.

6. Sand, Cossack—Reader Hill bearing (true) N. 81° E., 760 yards.

18. Broome, Roebuck Bay.

19. Sand, 3 feet below surface. Magnetic observation spot, Broome.

21. Sand, from surface of place of magnetic observation, Broome.

22. Sand, east side of Baudin Island, off Cape Voltaire.

24. Sand, from magnetic shoal off Port Walcott, in 8 fathoms; lat. 20° 31′ 35″ S. long. 117° 13′ 2″ E.

25. Baudin Island, off Cape Voltaire.

26. Baudin Island, off Cape Voltaire (basement).

Of the above list of specimens, Nos. 25 and 26 only are magnetic, their respective values of k in C.G.S. units being 0·000217 and 0·000529.