I.

OBSERVATIONS

ON THE

INCLINATION AND DECLINATION

OF THE

MAGNETIC NEEDLE.

By LIEUTENANT COLONEL J. A. HODGSON,
Surveyor General of India; and

MONSIEUR DE BLOSSVILLE,
Honorary Member Asiatic Society.

Communicated by Captain J. D. Herbert, *Assistant to the Surveyor General.*

The progress which has latterly been made in the investigation of the magnetic phenomena is remarkable. A new science, that of Electro-magnetism, has been created, and the happy conjecture hazarded by Playfair, that the mysterious properties or powers of matter, which we name gravity, chemical affinity, galvanism, magnetism, electricity, &c. would be one day referred to a single cause, has been almost realized. The very striking facts developed in the thermo-electric experiments have been ably investigated, while the law of the magnetic force has been determined, and the effect of local attraction rigorously calculated. The

curious practical result of these latter investigations leading to the correction of that disturbance, under which the magnetic needle on board ship had till then laboured, from the influence of the iron-work about the vessel—offers an example of that utility which, though it may not always be obvious, yet is assuredly sooner or later the fruit of an assiduous cultivation of science.

Nor have the more ordinary phenomena of magnetism been neglected in this general movement. An immense mass of results have been collected by our voyagers to the north pole, relating to the declination and inclination of the magnetic needle, as well as the intensity or directive power. Other observers have assisted, and as far as Europe and the northern regions are concerned, little, perhaps, remains to be desired in this branch of experimental Physics. But with regard to the other countries of the globe, the facts that have been collected are "few and far between." I am happy, therefore, to be able to communicate the following observations made in this country by two members of this Society. We have not yet had any observations of the kind recorded in India, and I doubt not the Society will receive favorably this attempt to fill up the blank that exists. Let us hope, too, that the publication of these results may stimulate other enquirers; and that, by their exertions, we shall yet have correct determinations of the three elements of magnetic inclination, declination, and intensity, at all the principal places of our Indian empire.

The results now offered comprehend the determination of the declination and inclination of the magnetic needle. The first series made on board the French Corvette *La Chevrette*, is by M. DE BLOSSVILLE. I have not thought it necessary to translate his introductory notice, as preferring to retain his own expressions.

"Les observations que j'ài faites dans les differens lieux on *La*

Chevrette a touchè comprennent tous les elemens du magnetisme terrestre; mais l'etude des plusieurs de ces phénomènes ne pourront fournir des résultats positifs, qu'après avoir repeté a l'observatoire royal de Paris, les épreuves des instrumens qui ont été employés: il ne sera question dans cette notice que de l'inclinaison, et de la declinaison de l'aiguille aimantée. Ce n'est egalement qu'après le retour de la Corvette, qu'on pourra s'occuper de tirer des conclusions des observations météorologiques qui ont été faites d'heure en heure avec des barometres et des thermometres tres exacts, pendant toute la durée du voyage."

"L'inclinaison de l'aiguille a été mesurée avec une boussole et quatre aiguilles qui furent mises pour la premiere fois en expérience a l'Observatoire de Paris, en presence et sous la direction de M. Arago, membre de l'Institut, quelques jours avant notre départ. Dans cette occasion, comme dans toutes les autres, lorsqu'une aiguille a ete observée sur ses deux faces; on a changé ses poles avec de forts carreaux et après avoir obtenu une seconde inclinaison, on a eu, en prenant la moyenne des deux, un résultat exempt des erreurs qu'aurait pu produire un defaut d'equilibre. Pour placer l'aiguille dans la direction meridienne magnetique on a cherché d'abord le plan perpendiculaire, ou le plan de l'equateur dans lequel elle se trouve verticale, ou bien, dans les faibles latitudes, on a orienté la boussole d'aprés une mire bien determinée. Quelque fois ces deux methodes ont été employées concurremment et ont offert l'accord le plus parfait. On trouve dans le tableau le résultat moyen des quatre aiguilles."

"Une description de la boussole declinatoire qui nous avait été fournie par *Le depot des cartes et plans de la marine*, serait trop longue, mais les personnes qui l'ont vue a Calcutta se sont convaincus de l'exactitude de cet instrument, et de tous les moyens de verification qu'il reunissait. Dans toutes les experiences on s'est servi de deux aiguilles qu'on retournait sur leurs chapes au milieu des observations et dont on n'a pas renouvellé

le magnetisme pendant toute la durée du voyage. Les deux aiguilles n'ont jamais differé de plus d'une minute dans le relevement des mires dont la position astronomique a toujours été déterminé au moyen d'une circle de reflexion de Borda, par des series nombreuses d'azimuths pris a l'est et a l'ouest."

I.—TABLEAU DES INCLINAISONS ET DECLINAISONS.

NOMS DES LIEUX.	Declinaison.	Inclinaison.
Paris, ...	22° 24′ 41″ N. O.	67° 51′ 42″ N.
Toulon, ...	19 24 23 N. O.	63 14 0 N.
St. Denis-Ile Bourbon, ...	14 57 48 N. O.	55 05 51 S.
Calcutta, ...	2 38 05 N. E.	26 32 38 N.
Chandernagor, ...	2 39 52 N. E.	26 47 03 N.
Rangoun,*	0 49 52 N. E.	17 51 47 N.
Tringuemalay, ...	1 08 05 N. E.	3 34 10 S.
Jaffnapatam, ...	1 16 00 N. E.	0 39 45 S.
Souliperon, Ceylon, ...	,, ,, ,,	0 36 34 S.
Aripo, Ceylon, ...	,, ,, ,,	2 17 34 S.
Batavia, ...	0 31 08 N. E.	25 50 01 S.
Pondicherry, ...	1 02 13 N. E.	3 46 00 N.
Karikal, ...	1 14 01 N. E.	,, ,, ,,

* Les observations de Rangoun ont ete faites par le Captn. Fabré, et M. Jeanneret.

This Table is an important addition to our knowledge of the magnetic phenomena. The magnetic equator, it appears, passes at no great distance north of the island of Ceylon, and touches the northern extremity of the island Junkseilon. This would give the place of the magnetic pole, as in lat. 80°, long. W. 105°, being very nearly the position assigned to it by the observations made by Captain Parry and his associates*. It does not, however, appear that the magnetic equator must

* First Voyage. Captain Sabine gives the position as being 60° N. Lat. and 80° W. Long.

necessarily be a great circle of the sphere, or the magnetic pole a mathematical point.

The next Table contains the details of some magnetical observations made at the observatory of the Surveyor General's Office, under the direction of Lieutenant-Colonel HODGSON. There being no inclination instrument, or dipping needle, in the depôt, the investigation was necessarily confined to the determination of the declination. The paper gives all the particulars, and details the precautions taken to insure a correct result. One verification which is not touched on in either of the papers I may notice, as it is an important one, and is seldom adverted to.

In making observations with a declination circle—the following is the proceeding. The true azimuth of an object, or its angular distance from the meridian, being determined by other methods, we observe its magnetic bearing by the declination instrument, that is, the angle which the object forms with the direction of the needle. Now this supposes that we can determine the precise point on the limb of the instrument situated in the vertical plane, passing through the line of collimation of the telescope, and also in that passing through the axis of the needle. The first can be done by reversing the telescope, and repeating the intersection of the object, taking the mean of the two readings as the true place of the telescope on the limb. But the second has this difficulty attending it as these instruments are ordinarily made, that the needle being referred to a different set of divisions, unless we are sure that the line marked zero on each accurately correspond, there will be error. This is a point the verification of which is not provided for by any instrument I have seen, although the remedy is obvious enough—that of making the same set of divisions answer for both needle and telescope. This I have understood was the case in M. DE BLOSSVILLE's instrument. To determine the amount of the error, if any, in the instrument used at the Surveyor General's Office, I proceeded as follows :—

A theodolite was set up, and the telescope directed to the declination instrument, which was placed as nearly as could be estimated, so that its plane should be at right angles to the axis of the telescope. The telescope being then made to pass through the 0° and the 180° divisions of the exterior limb was found to form *an angle* with the line of north and south in the compass-box, the wire of the telescope passing to the west of the north end, and to the east of the south end.

It was not easy so to adjust the two instruments that the line described by the cross wires should exactly fall on both 0° and 180°. It was, in fact, found that more satisfactory results were obtained by bringing them on the upper point or 0° by means of the tangent screw, and then estimating the deviation on each of the other three points. As the telescope has a considerable magnifying power, and as the declination circle was within five feet, such an estimate it was found could be performed with tolerable accuracy. To make this clearer, I shall give the detail of one observation:

Cross wires of telescope, on	0°	0′	of outer circle.
passes to West of North,	0	30	inner circle.
——— East of South,	0	12	inner circle.
——— East of 180°	0	10	outer circle.

Here then it is evident, that the cross wires of the telescope, described a line forming an angle of $\frac{0 + 10'}{2} = 5'$, with the line joining 0° and 180° on the outer circle. While it formed an angle of $\frac{30' + 12'}{2} = 21'$, with the line of north and south in the compass-box. Consequently, the latter must have formed an angle with the former of 16′, and by that quantity must the declinations determined by this instrument be erroneous. A second observation gave $15\frac{1}{2}$, a third $13\frac{1}{2}$, a fourth $12\frac{1}{2}$,—mean 14′ 4″.

To understand whether this correction be + or — we are to consider 1st. That the line joining 0° and 180° on the limb, (north end) passed to the east of the line described by the cross wires; 2nd. That the line of north and south in the compass-box (north end) also passed to east, but by a greater quantity. Then the north and south line in the compass-box passed (north end) to east of the line joining 0° and 180° on the outer limb. The point to which the needle should have been adjusted is, consequently, 14′ 24″ west of the point to which it is actually adjusted. Now, let us suppose the magnetic bearing of the meridian taken, it will be 2° 26′ 52″ north-east; but if the point from which the divisions are reckoned, and with it each of the divisions were moved 14′ 24″ west, then the above bearing would be 14′ 24″ more. Adding this quantity to 2° 26′ 52″ we get 2° 41′ 16″ as the correct declination in Calcutta, in February 1828. It is worthy of remark, that M. De Blossville's determination (see Table I.) is 2° 38′, being only 3′ 16″ less. His instrument did not require this correction, as the needle and telescope were referred to the same set of divisions. Whether the circumstance of its having no nonius for reading the sub-divisions will account for the above small difference of 3′ 16″, I cannot pretend to say. It is to be observed, that even with the *same observer and instrument*, the latter furnished with three nonii, two different needles may vary 2′ 24″.

To this cause I am disposed to attribute the discrepancies observable in taking magnetic bearings with different theodolites, which I have found sometimes amounted to 1° 30′. When the magnetic declination is observed with the same theodolite with which the bearings were observed, this becomes a matter of no moment, but it must always be an obstacle in determining the absolute amount of the magnetic declination. For this reason I think no great stress can be laid on the contents of Table III. compiled by Lieutenant Colonel Hodgson, which I, nevertheless, give, as it may attract the attention of the several observers to the subject, and induce them, perhaps, to verify their results in the manner indicated.

Memorandum of Observations made at the Observatory, Surveyor General's Office, Chowringhee, Calcutta, to determine the Magnetic Declination between the 3d February and 24th February, 1828.

" The Declination instrument is made by GILBERT; the azimuth circle is of eight inches diameter, and divided to 30′ subdividing to single minutes; the divisions are read by three verniers, at equal distances, and each observation below noted is the result of twelve readings; i. e., three with the face of the altitude circle to the east, and three to the west, from the north end of the needle, and of as many from the south end. The telescope is of $11\frac{1}{5}$ inches focal length, and $1\frac{2}{5}$ inch aperture, and carries cross wires.

The instrument being placed on a stone pillar at a convenient distance from the transit instrument in the Observatory, out of the influence of iron, and duly adjusted, was correctly laid on the distant meridian mark by causing its centre wire to cover the distant meridian mark, and also the centre wires in the transit telescope, the wire of the declination instrument being reciprocally viewed and covered by the meridian wire of the transit telescope."

The result derived from three Needles, are as follow:

TABLE II.

Date. 1828.		Time.	Barometer by Troughton.	Attached Thermometer.	Detached Thermometer.	Declination East of the North end of the Needle.	Declination West of the South end of the Needle.	Mean Declination East.
		H. M.	Inches.					
February	3	0 40 P. M.				2° 35′ 50″	2° 27′ 30″	
		05 30 P. M.				2 22 00	2 23 50	
	4	09 20 A. M.	29·060	67°	70°	2 25 40	2 28 50	
		00 35 P. M.	29·930	78	79	2 24 00	2 26 20	
		5 15 P. M.	29·864	80	82	2 22 10	2 21 20	
	5	8 55 A. M.	29·962	69	70	2 27 50	2 28 30	
		0 25 P. M.	29·954	77·7	80	2 24 50	2 23 40	
		5 25 P. M.	29·888	80	82	2 22 00	2 28 30	

Date. 1828.		Time.	Barometer by Troughton.	Attached Thermometer.	Detached Thermometer.	Declination East of the North end of the Needle.	Declination West of the South end of the Needle.	Mean Declination East.
		H. M.	Inches.	°	°			
February.	6	8 55 A. M.	30·032	66	69	2° 25′ 50″	2° 30′ 40″	
		0 29 P. M.	30·020	76·5	79	2 21 30	2 26 40	
	7	5 00 P. M.	29·968	82		2 25 30	2 23 00	
	8	8 27 A. M.	30·028	67·5	68	2 22 40	2 28 10	By Needle No. 1.
		0 52 P. M.	30·012	74	77	2 24 40	2 27 20	2° 25′ 22″
		4 40 P. M.	29·970	78	80	2 26 20	2 25 30	
	9	7 35 A. M.	30·032	58·5	61	2 23 40	2 26 30	
		0 30 P. M.	30·000	73	76	2 25 00	2 25 00	
		5 10 P. M.	30·010	75	78	2 19 00	2 27 50	
	10	0 48 A. M.	30·100	65·5	67	2 23 00	2 30 00	
		0 08 P. M.	30·050	73·5	76	2 23 30	2 26 50	
	11	9 10 A. M.	30·054	63	64	2 21 20	2 23 10	
		1 00 P. M.	30·018	72·5	76	2 21 40	2 27 00	
		5 00 P. M.	29·976	73	74	2 25 00	2 30 40	
	12	9 00 A. M.				2 24 50	2 25 00	
		15 15 P. M.	29·970	78	79	2 22 10	2 25 20	
	14	8 40 A. M.	30·088	63	64	2 25 10	2 27 10	
		0 36 P. M.	30·072	75	77	2 23 30	2 26 30	
		5 12 P. M.	29·988	78	79·5	2 25 50	2 24 30	
	15	8 15 A. M.	30·088	64	65·5	2 21 10	2 25 30	By Needle No. 2.
		0 50 P. M.	30·080	77	79	2 27 10	2 26 10	2° 27′ 46″
		5 12 P. M.	30·048	79·5	80·5	2 31 20	2 29 30	
	16	9 00 A. M.	30·060	63	65	2 26 40	2 26 40	
		11 50 A. M.	30·090	73	75·5	2 29 20	2 23 30	
		4 54 P. M.	29·920	79·5	80·5	2 28 00	2 23 00	
	17	8 02 A. M.	30·016	60	66	2 28 40	2 26 20	
	19	8 25 A. M.	30·112	66	68	2 23 20	2 29 00	
	22	9 58 P. M.	00·072	64·5	86	2 25 30	2 22 00	
		4 27 P. M.	30·000	90·5	90	2 29 10	2 29 30	
	23	9 30 A. M.	30·050	73·5	75	2 33 00	2 26 00	By Needle No. 3.
		0 30 P. M.	30·014	83	85	2 29 10	2 26 20	2° 27′ 29″
		5 35 P. M.	29·942	89·5	89·5	2 28 30	2 24 30	
	24	9 30 A. M.	30·030	76·5	77·0	2 29 00	2 26 20	
		9 27 P. M.	29·980	83·5	85·5	2 30 00	2 27 10	
		5 42 P. M.	29·926	89·5	89·0	2 27 40	2 27 20	

Mean of Needle, No. 1, ...	2°	25′	22″
No, 2, ...	2	27	46
No, 3, ...	2	27	29
Mean of three Needles, ...	2	26	52
Add error of Zero in Compass Box, ...		14	24
Declination East, ...	2	41	16

"The following are the results of some Observations for determining the Magnetic Variation lately made at places situated at considerable distances from Calcutta, and from each other."

TABLE III.

Date. Year.	Date. Month.		Place.	Province or District.	Latitude.	Observer.	Declination.
1813	March	23	Sukeet,	Dooab,	27° 26′ 41″. 2 N.	Major Hodgson,	0° 42′ 00″ East.
	April	11	Berouly,	ditto,	28 5 32		0 44 00
	May	10	Sesanna,	ditto,	28 59 00 2		0 31 30
	June	21	Rhadana,	ditto,	29 13 40		0 33 45
	Nov.	8	Coel,	ditto,	27 53 13		0 59 00
			Sookertal,	ditto,	29 28 49 6		1 06 00
	Dec.	2	Chandy Pahar,	ditto,	29 55 29		0 37 00
			Dehrah,	Doon Valley,	30 19 11		0 18 06 E.
1814	April		Senspour,	ditto,	30 23 02		0 28 00
1815	Feb.	8	Bunjary Pokra,	Bettiah,	27 2 29		1 30 13
	May		Distoulia,		26 10 30		1 27 45
1816	March		Seharunpoor,	Dooab,	29 57 10		0 54 00
	April	[illegible]	Mohun,		30 33 20 75		0 30 00
		25 or 26	Chour Station,	Hill States,	30 50 27 33		0 50 55
	Dec.	14	Goverdhunpoor,	Dooab,	29 41 19		0 40 00
1817	Feb.	2	Kasheepoor,	Rohilkhund,	29 11 55		0 47 15
1825	Nov.	7		Sylhet,		Lieut. Fisher,	2 21 18
							2 36 00
1827	Dec.		Idyanuh,	Dehli,	29 21 37	Capt. Oliver,	1 28 00
	Nov.		Calcutta,	Bengal,	22 33 46	Capt. Fabre,	2 38 54
			Surveyor General's Office,	ditto,	22 33 00		2 28 36
			Chandernagore,	ditto,	22 50 00		2 39 52
	Dec.	30	Langtofal,	Muneepoor,	24 45 28	Lt. Pemberton,	3 57 09
1828	Feb.	3	Dhoulpoor,	Agra,	26 40 56 5	Capt. Gerard,	1 25 00
			Agra,	ditto,	27 10 20		1 23 00
		22	Nowagaon,	Scindiah's States,	25 56 30		1 19 00
	March	2	Nurwur Fort,	Malwa,	25 38 34		1 01 00
1828	Jan.	24	Kyranuh,	Dooab,	29 33 58	Lt. W. Brown,	1 31 13
			Bal,	Dehli,	29 33 00	Capt. Oliver,	1 25 00
			Tajmahul,	Agra,	27 10 20	Capt. Gerard,	1 09 00
			Dhoulpour,	ditto,	26 41 00		1 11 00
			Gwalior Residency,	Scindiah's States,	26 16 00		6 40 00
			Ditto Lieut. De Voeux House,	ditto,			4 00 00
			Seronge,	Malwa,	24 06 00		0 57 00
			Bhopaul,	ditto,	23 15 00		0 39 00

As upwards of a year had elapsed since the preceding result had been obtained, I thought it would be interesting to determine again this element, in order to judge what might be the amount, and what the direction of the annual variation if any—Table IV. contains the results of this series of Observations, continued from the 23d May to the 9th June. The Observations were made by the same person, with the same precautions, and using the same instrument as in the preceding year; and therefore we may, I think, receive with every confidence the amount of the variation which for fifteen months appears to be 17′ 6″ west, the declination itself being east, and amounting to 2° 41′ 16″ for 1828, and 2° 24′ 10″ for 1829. If this rate should continue, we may soon expect the needle to point due north at Calcutta, after which, I suppose, it will continue to move westward, so as to occasion a westerly declination.

Observations of the Magnetic Declination made at the Observatory, Surveyor General's Office, Calcutta.

TABLE IV.

Date.	Hour.	Barometer.	Attached Thermometer.	Detached Thermometer.	North End of Needle.	South End of Needle.	Mean.
1829.	H. M.	Inches.	°	°			° ′ ″
May 23d	0 25 P. M.	29·220	95·8	96·0	2° 07′ 40″	2° 08′ 30″	2 08 05·0
	4 43	·768	85·5	85·0	2 08 25	2 10 15	2 09 20·0
24th	9 15 A. M.	·862	88·8	88·8	2 08 40	2 12 40	2 10 40·0
	0 15 P. M.	·780	92·8	94·5	2 04 25	2 11 15	2 07 50·0
25th	9 25 A. M.	·770	90·0	90·6	2 06 40	2 10 40	2 08 40·0
	0 15 P. M.	·738	93·8	95·0	2 10 05	2 10 50	2 10 27·5
	4 30	·650	95·0	94·0	2 07 40	2 12 10	2 09 55·0
26th	9 05 A. M.	·740	89·7	90·3	2 12 25	2 14 45	2 13 35·0
	0 30 P. M.	·686	95·0	96·0	2 07 05	2 10 45	2 08 55·0
	4 18	·604	93·5	93·5	2 09 30	2 14 40	2 12 05·0
27th	9 35 A. M.	·704	90·0	90·0	2 11 35	2 13 25	2 12 30·0
	0 25 P. M.	·636	93·7	94·0	2 07 30	2 11 15	2 09 22·5
	4 20	·560	94·4	93·4	2 10 10	2 13 00	2 11 35·0
28th	9 14 A. M.	·592	86·0	87·0	2 09 25	2 13 20	2 11 22·5
	0 30 P. M.	·548	97·0	97·5	2 07 10	2 08 20	2 07 45·0
	4 05	·530	90·0	90·0	2 11 40	2 16 10	2 13 55·0

Date.	Hour.	Barometer.	Attached Thermometer.	Detached Thermometer.	North End of Needle.	South End of Needle.	Mean.
1829.	H. M.	Inches.	°	°			° ′ ″
May 29th	9 05 P. M.	29·622	85·5	86·8	2° 09′ 46″	2° 11′ 35″	2 10 37·5
	0 10	·588	90·5	91·5	2 06 20	2 08 55	2 07 37·5
30th	9 45 A. M.	·622	87·2	88·0	2 08 35	2 10 55	2 09 45·0
	0 25 P. M.	·612	91·0	93·0	2 04 15	2 10 05	2 07 10·0
	4 15	·546	93·5	94·0	2 11 45	2 14 45	2 13 15·0
31st	9 24 A. M.	·650	85·0	85·5	2 07 55	2 11 50	2 09 52·5
	0 17 P. M.	·636	85·5	90·0	2 07 30	2 12 10	2 09 50·0
June 1st	9 25 A. M.	·636	90.0	90·0	2 06 50	2 13 00	2 09 55·0
	0 35 P. M.	·610	91·2	91·8	2 02 20	2 06 50	2 04 35·0
	4 20	·530	94·0	94·5	2 04 40	2 10 45	2 07 42·5
2d	9 15 A. M.	·540	88·5	89·5	2 08 50	2 12 15	2 10 32·5
	0 17 P. M.	·530	94·5	95·5	2 06 25	2 08 40	2 07 32·5
	4 20	·462	100·0	101·0	2 08 25	2 13 30	2 10 57·5
3d	9 50 A. M.	·506	86·0	87·0	2 08 00	2 12 40	2 10 20·0
	0 20 P. M.	·504	91·5	92·5	2 05 00	2 10 00	2 07 30·0
	4 18	·420	92·5	92·5	2 04 25	2 09 35	2 07 00·0
4th	9 30 A. M.	·490	92·0	93·0	2 08 00	2 11 15	2 09 37·5
	0 20 P. M.	·470	95·5	95·5	2 05 35	2 10 10	2 07 52·5
5th	9 45 A. M.	·488	93·0	94·0	2 04 30	2 12 45	2 09 07·5
	4 20 P. M.	·414	100·0	100·5	2 12 10	2 18 10	2 15 10·0
6th	0 17	·530	96·0	97·0	2 05 30	2 12 30	2 09 00·0
7th	9 10 A. M.	·670	87·0	88·0	2 11 35	2 16 20	2 13 57·5
	0 14 P. M.	·676	92·5	93·5	2 08 35	2 13 15	2 10 55·0
8th	9 35 A. M.	·730	91·0	92·0	2 12 25	2 14 45	2 13 35·0
	0 25 P. M.	·728	96·0	97·0	2 05 20	2 08 50	2 07 05·0
9th	9 25 A. M.	·792	90·5	91·0	2 08 05	2 14 00	2 11 02·5
	0 15 P. M.	·776	95·0	96·0	2 03 40	2 08 05	2 05 52·5
	4 20	·708	100·0	101·5	2 04 05	2 08 40	2 06 22·5

Needle, East of the true Meridian, ...	2° 09′ 46″	Mean.
Add correction for Zero of Compass Box, ...	14 24	
True Declination, Easterly, ...	2 24 10	