Observations on the diurnal Variation of the Magnetic Needle, at the Whale Fish Islands, Davis's Strait. *By Lieutenant* Henry Foster, *R.N. F.R.S.* Read April 13, 1826. [*Phil. Trans.* 1826, Part IV. *p.* 71.]

Magnetical Observations at Port Bowen, &c. A.D. 1824-25, *comprehending Observations on the diurnal Variation and diurnal Intensity of the Horizontal Needle; also on the Dip of the Magnetic Needle at Woolwich, and at different Stations, within the arctic Circle.* *By Captain* W. E. Parry, *R.N. F.R.S. and Lieutenant* Henry Foster, *R.N. F.R.S.* Read April 13, 1826. [*Phil. Trans.* 1826, Part IV. *p.* 73.]

Abstract of the daily Variation of the Magnetic Needle No. 2. *By Lieutenant* Henry Foster, *R.N. F.R.S.* Read April 13, 1826. [*Phil. Trans.* 1826, Part IV. *p.* 118.]

Observations for determining the Dip of the Magnetic Needle. *By Captain* W. E. Parry, *R.N. F.R.S. and Lieutenant* Henry Foster, *R.N. F.R.S.* Read April 13, 1826. [*Phil. Trans.* 1826, Part IV. *p.* 126.]

Observations on the diurnal Changes in the Position of the Horizontal Needle, under a reduced directive Power, at Port Bowen, 1825. *By Lieutenant* Henry Foster, *R.N. F.R.S.* *Communicated January* 12, 1826. Read April 13, 1826. [*Phil. Trans.* 1826, Part IV. *p.* 129.]

A Comparison of the diurnal Changes of Intensity in the Dipping and Horizontal Needles, at Port Bowen. *By Lieutenant* Henry Foster, *R.N. F.R.S.* *Communicated February* 25, 1826. Read April 13, 1826. [*Phil. Trans.* 1826, Part IV. *p.* 177.]

Account of the Repetition of Mr. Christie's *Experiments on the Magnetic Properties imparted to an Iron Plate by Rotation, at Port Bowen, in May and June,* 1825. *By Lieutenant* Henry Foster, *R.N. F.R.S.; together with Mr.* Christie's *Remarks thereon.* Read April 13, 1826. [*Phil. Trans.* 1826, Part IV. *p.* 188.]

In these communications are recorded all the magnetic observations made by Lieutenant Foster, alone or in conjunction with Captain Parry and the other officers of the North Western Expedition, in the years 1824 and 1825; and they embrace a variety of points of prominent interest in the theory of magnetism. They are digested under separate heads, according as they refer to one or other of the following points:—

1. The variation, and its daily and hourly change.
2. The dip, and the changes observed in it.

3. The intensity of the earth's magnetic force, as estimated in a horizontal plane, and that of the dipping-needle, as referred to its natural direction.

The variation of the magnetic needle is the deviation of the direction in which it rests from the astronomical meridian, or the angle between the planes of the magnetic and astronomical meridians. This angle has long been known to be in a constant state of change, and its alterations have been observed not only from year to year, but from day to day. It has been ascertained that, independent of the gradually progressive change by which the magnetic meridian shifts its direction through large arcs in long times, a daily oscillation takes place, which, in these magnetic latitudes, is of small amount, and can only be rendered prominent by neutralizing the principal part of the earth's directive power, according to a method proposed and practised by Mr. Barlow. In the high magnetic latitudes visited by the Expedition, however, the horizontal directive force of the earth is naturally so much weakened by the effect of the dip, as to allow these oscillations to be observed with great distinctness, without artificial aid, by merely suspending the needle by a silk fibre. By this mode of observing, Captain Parry and Lieutenant Foster have found the diurnal change of variation to be seldom less than one degree, and sometimes to have amounted to five or even seven degrees; with this remarkable addition, that the changes in its amount appeared to them to have obvious reference to the position of the sun and, less distinctly, to that of the moon. They decline, however, entering into any investigation of the laws of the influence of these bodies, leaving them professedly to those who are theoretically conversant with these subjects.

In casting our eyes down the table of variations, in which are registered, hourly and frequently half-hourly, from the beginning of December, 1824, to the end of May, 1825, the positions assumed by two needles (whose constructions, &c. are minutely described),—it is impossible not to be struck with the unsteadiness of the needles. They appear to have been in a perpetual state of fluctuation, advancing or receding alternately and by impulses, and in some instances passing their mean positions from side to side as often as nine times in the twenty-four hours. This irregular fluctuation is one of the most remarkable features of this class of the observations.

By an abstract of this table, in which the positions of the sun and moon, the state of the weather, the aurora borealis, &c. are recorded, it appears that the influence of the sun in increasing the diurnal oscillation is much more marked than that of the moon; and that, contrary to received opinion, the aurora borealis seemed to have had no influence. The regular increase of the amplitude of the diurnal oscillations with the advance of the sun to the north is very striking, and not to be mistaken.

A series of observations on the horizontal position of the needle under a directive force, reduced by Mr. Barlow's method, by Lieut. Foster, forms the subject of another part of this communication.

In the course of these observations, the fluctuating state of the directive energy was frequently rendered remarkably obvious, and in one instance not only daily and hourly, but even momentary oscillations were perceived. This observation induced Lieut. Foster to examine the intensity of the magnetism during those oscillations, in which a corresponding fluctuation was detected, and that so rapid, as to compensate itself during the time of the needle performing 60 vibrations, though its effects were very sensible in intervals of only ten. Accordingly, he was induced to refer this fluctuation in position to a fluctuation in intensity as its cause.

The next branch of this inquiry is directed to the dip of the needle at the various stations visited by the Expedition, and especially at Port Bowen; when the mean dip was found, by a series of observations, extending from November 1 to June 27, to be 88° 1′ 23″.

The intensities came next under consideration. The relative intensities at the different stations are first deduced by vibrating various dipping-needles in the plane of the magnetic meridian. This gives the actual, or, as it may be termed, the natural intensity of the earth's directive force, unreduced by the effect of the dip. But besides this, Lieutenant Foster has instituted a separate series of experiments at Port Bowen, in which the same needle, being alternately suspended as a dipping and a horizontal needle, its times of vibration under both circumstances were observed; and from these observations the author thinks himself entitled to conclude that the changes actually observed in the apparent intensity of the horizontal directive force, are not due to any real and general change in the total magnetism of the earth, but arise only from a minute change in the dip itself. He observes that, without entering into minute calculations on the subject, he believes it will be found that if the magnetic pole of the earth be supposed to describe a small circle about its mean position, of about 2′ or $2\frac{1}{2}$′ in radius, it will reconcile to a considerable degree of precision nearly all the observations of the daily variations, both in direction and intensity of the horizontal magnetism, both in Europe and in the arctic circle.

These communications are terminated by an account of the repetition of Mr. Christie's experiments on the magnetic properties communicated to iron plates by rotation, and with a paper of remarks thereon by Mr. Christie himself. The observations are given in an abstracted form, but accompanied with a statement of them in full detail. In the course of these observations the phenomena observed by Mr. Christie on a minute scale, were here, by reason of the advantageous geographical situation of Port Bowen, so strikingly developed as to excite the greatest interest in all who witnessed them. A perfect correspondence was found between the direction of the deviation due to rotation, as observed and as predicted by Mr. Christie; and a numerical agreement in the results, as great as any expectation could warrant, obtained.

The whole of these results, Mr. Christie observes, prove that the phenomena due to rotation are not merely of theoretical but of practical importance, as connected with the problem of correcting the

deviation of the compass on ship-board by an iron plate; for should circumstances require the removal and replacement of the compensating plate in high northern latitudes, its magnetism might be so altered by the effect of rotation as materially to injure its compensating property. The means of avoiding this disagreeable consequence are pointed out.

Observations to determine the Amount of Atmospherical Refraction at Port Bowen in the Years 1824-25. *By Captain* W. E. Parry, *R.N. F.R.S.; Lieutenant* Henry Foster, *R.N. F.R.S.; and Lieutenant* J. C. Ross, *R.N. F.L.S.* Read June 15, 1826. [*Phil. Trans.* 1826, Part IV. *p.* 206.]

The author commences by observing, that on attempting the various methods proposed by astronomers for ascertaining by actual observation the amount of atmospherical refraction at low altitudes, they all proved impracticable at Port Bowen, by reason of the intense cold, which rendered it impossible to use the repeating circle or other similar instruments. The method therefore proposed by Lieutenant Foster, and modified by Captain Parry, which was found successful, was, to place a board edgeways and truly horizontal on that part of the high land behind which a given star set, and observe the moments of its disappearance. Then, determining at leisure the zenith distance of the upper edge of the board on the return of the sun, and in weather better fitted for delicate observations, the stars fixed on were α Aquilæ and Arcturus; and the paper before us gives a detailed account of a series of observations of the moments of disappearance of both these stars, and also of the zenith distances of the boards employed by the several observers enumerated in the title. In some cases also, the reappearance of the star below the board was observed, thus giving an observation at another altitude, and the angular breadth of the board was afterwards measured by a micrometer from the station of observation.

Description of a Percussion Shell, to be fired horizontally from a common Gun. By Lieutenant Colonel Miller, *late of the Rifle Brigade, and now unattached. Communicated by* R. I. Murchison, *Esq. F.R.S.* Read November 16 and 23, 1826. [*Phil. Trans.* 1827, *p.* 1.]

In this paper, the author first considers the theory of rifles, with which the subject of it is intimately connected; and regarding it as an admitted principle, that irregularities in the flight of shot arise from irregularities either in their surface or substance, shows how the rotatory motion of a rifle ball, by presenting every part uniformly to the action of the resisting medium, obviates the effect of these irregularities. The spiral or rotatory motion of the ball in rifles, is generally supposed to arise wholly from the re-action of the grooves in the barrel, or from the indentations made by them in the surface of the ball; but the author, taking into consideration the powerful action of the air on projectiles, is led to conclude that the rotation