THE EFFECT OF LUNAR DISTANCE ON THE MAGNETIC DECLINATION AT ZI-KA-WEI.

The March 1916 issue of the Journal, pages 25-26, contains an interesting letter by Father de Moidrey, S. J., on the "lunar-diurnal variation of the magnetic declination at Zi-Ka-Wei." The fact which he has brought to light proves, on examination, to be somewhat remarkable and unexpected. It relates to the solar-diurnal¹ amplitude of declination, defined as the difference between the elongations normally occurring towards sunrise and at mid-day (occasional maxima or minima at other times, due to disturbances, are neglected). The values P , A of this diurnal amplitude at the times of lunar perigee and apogee, respectively, were determined from three cycles of 10 or 11 years each. Periods of five days centered at apogee or perigee were taken in two of these cycles, and three days in the third. The following values of P/A were obtained:

1.010, 1.029, 1.023 Mean = 1.023 ± 0.01 ; probable error, ± 0.04

This evidence for a larger diurnal amplitude at perigee than at apogee must be accorded considerable weight.

Father de Moidrey remarks that "these numbers are slightly smaller than those obtained by Dr. Chapman," referring to a recent paper (*Phil. Trans. A*, 215, pp. 161-176, 1915) in which it was shown that the lunar-semidiurnal magnetic variation is larger at perigee than at apogee. The ratio (P'/A' , say) of the latter variation, determined from periods of three or four days about those epochs, was found to be approximately 1.39. The effects disclosed by P'/A' and P/A are consequently of totally different orders of magnitude: but this is not surprising, since they relate to very different phenomena. The lunar-diurnal variation of magnetism appears to result from an atmospheric tide produced by the Moon, and the value 1.39 for P'/A' tends to corroborate this hypothesis, since 1.39 is the ratio of the tide-producing force of the Moon at perigee and apogee. The change from A' to P' takes place quite independently of the solar-hour angle.

The ratio P/A , on the contrary, relates to a magnetic variation depending primarily on solar time. It is natural to examine whether the difference between P and A is due to the superposition of the lunar-diurnal variation, which we know depends largely on the Moon's distance, upon a *constant* solar-diurnal variation. We will confine our attention to the lunar-semidiurnal term, which is much the most important part of the lunar variation; its total amplitude at Zi-Ka-Wei (over the mean of a year) I have found to be approximately $0'.43$.² The *change* in this between apogee and perigee (i. e. 39%) is consequently $0'.16$. Since the declination ranges over its solar-diurnal amplitude ($5'.5$ in the mean of a year) within about six hours, sunrise to mid-day, and since this is nearly one quarter of a lunar day, if the phase of

¹ Not lunar-diurnal, as the title of the letter would indicate.

² More detailed data concerning the lunar-magnetic variation at Zi-Ka-Wei and other observatories will be found in a paper which I hope shortly to publish.

the lunar-semidiurnal variation were favourable and constant, the whole of its perigee-apogee variation might appear in the "diurnal amplitude." In this case we should have

$$\frac{P}{A} = \frac{5'.50 + \frac{1}{2}(0'.16)}{5'.50 - \frac{1}{2}(0'.16)} = \frac{5.58}{5.42} = 1.029$$

which agrees fairly well with the value actually found.

Unfortunately this interpretation of de Moidrey's result must be rejected, simply because the phase of the lunar-semidiurnal variation at apogee or perigee is continually changing, relative to solar time, on account of the difference between the synodical and anomalistic months. If therefore at one time the increased amplitude of the lunar variation at apogee is contributing to the observed excess of P over A , at another time it will be acting in the opposite direction. In the course of ten years this effect on P and A should average out completely.

The effect of lunar distance indicated by P/A would therefore appear to be brought about in some other way; its amount is too small to be referred to a direct tidal action, though it may arise differentially from this or some other direct influence. The difficulty in the way of a resolution of the problem only increases its interest, however, as possibly containing a clue to some unsuspected lunar action. For the same reason further investigation and corroboration of the result are to be desired.

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June 24, 1916.

NOTES

13. *Personalia.* We regret to record the following deaths: on May 17, the eminent geophysicist, *Prince B. B. Galitzine*; on June 18, *Robert H. Scott*, F. R. S., superintendent of the Meteorological Office from 1867 to 1900; on June 12, *Silvanus P. Thompson*, well known for his contributions to physical science and to terrestrial magnetism as well—witness, for example, the amount of time, labor and love bestowed on the translations of "De Magnete" (with accompanying Notes), the epistle of Peter Peregrinus written in 1269, etc.; on September 12, at 80 years of age, *H. Mohn*, the well-known meteorologist and magnetician.

Th. Hesselberg was appointed Director of the Meteorological Institute of Norway from January 1, 1916.