A POSSIBLE LUNAR INFLUENCE UPON THE VELOCITY OF THE WIND AT KIMBERLEY.


The object of the present discussion is to determine whether there is a lunar term in the velocity of the wind at Kimberley. A test investigation made on a small scale some years ago established the possibility of such a term; but it is obvious that definite proof of the same could only be furnished from the results of a long series of observations. Because, for one thing, any share of the movement of the air which can depend upon any conceivable lunar influence must be a very small fraction of the share depending upon recognised meteorological factors; and hence our discussion must be on such a scale as will afford a reasonable guarantee that the effects of ordinary meteorological irregularities are lost in the mass.

Reasoning à priori, a lunar term in the velocity of the wind should be expected. If the moon can generate and maintain a tide in the atmosphere, as we know it does, it must also be able, directly or indirectly, to raise the wind. The only question would seem to be whether it can raise it to a measurable amount, and how. The lunar atmospheric tide at Kimberley is of the order 0.003 inch in amplitude with very little establishment. Hence, since the diurnal, thermal, variation of barometric pressure at Kimberley has a range of about 0.09 inch (i.e. thirty times the lunar tide), corresponding to a range of wind velocity of about 3.4 miles an hour, we should expect, for the sake of argument, a lunar variation in the velocity of the wind of about 3.4/30 (= 0.11) miles an hour. We shall see presently that, if the observations are accounted adequate to prove the case, this estimate is too low.

The Kimberley register contains hourly values of the velocity of the wind since 1897, with only an occasional break. The site of the anemometer is none of the best, though perhaps good enough to give a negative or affirmative answer to the simple question whether the moon is of any account at all in the matter of the wind. The automatic records of velocity are easily read to one-tenth of a mile an hour. The average velocity of the wind at Kimberley is in the neighbourhood of five miles an hour, rising occasionally to more than thirty.

For the purposes of this discussion the hourly velocities in the Kimberley register have had to be rearranged in terms of the lunar day. This has been done by arranging the hourly velocities in twenty-five columns, the middle column, containing the velocity for the hour in which the moon made its upper meridian passage (U.M.P.), being accounted lunar noon, the mean of the first and twenty-fifth columns being accounted lunar midnight (L.M.P.).
In the table below, column 1 indicates the hours and column 2 the mean hourly velocities for those hours for the 180 lunations = (5135 lunar days) from April, 1897, to October, 1911. There were two gaps in the period, when the anemometer had to be dismounted for repairs—one, from September 24 to October 8, 1908, being filled up from values obtained during September 26 to October 10, 1916; the other, from July 9 to 23, 1911, being filled up from values obtained during July 13 to 27, 1916.

According to column 2, the curve purporting to show the lunar effect on the velocity of the wind has only one definite maximum and minimum, the former falling about three hours before lunar midnight, the latter about an hour before lunar noon, the range being 20 miles an hour.

Column 3 shows the result for the 2538 days of the period when the moon was south of the equator, and column 4 the result for the 2597 days when the moon was north.

The general inference from column 3 is a maximum velocity near lunar noon and a minimum near midnight, with a range of 32 miles an hour; whereas column 4 gives almost exactly the opposite tendency with a range of 55 miles an hour. These ranges are considerably greater than one would have expected to find. The lesser range for the time when the moon is south is probably partly due to the small secondary minimum shown in column 3 at lunar noon.

If the variations of velocity shown in the table are to be regarded as entirely due to the lunar atmospheric tide, it is not easy to explain why column 2 shows only one maximum and minimum in the lunar day, especially as a preliminary investigation of the variations of velocity at perigee suggests a strong semidiurnal oscillation, with maxima at lunar moon and midnight, and minima near moonrise and moonset. This point, however, is reserved for treatment at some later time. Meanwhile it is easy to see that if, when the moon is in north declination, there is only one maximum of velocity in the lunar day, and that synchronising with the lower meridian passage, there should be, when the moon is in south declination, only one maximum, and that synchronising with the upper meridian passage. For the maximum aerotidal effect of the moon's action is felt in the southern hemisphere near the antipodes of the sublunar point when the moon is in the north, and near the sub-lunar point itself when the moon is in the south. In this connection it is worth notice that when the moon's declination, north or south, is greatest, the semidiurnal lunar atmospheric tide at Kimberley practically disappears, resolving itself into a single oscillation, the phase when the moon is north being nearly the reverse of that when the moon is south.*

The results given in this paper throw no light apparently on the possible

* Corresponding to this diurnal inequality there are indications of an atmospheric swell following the moon to and fro across the equator.
variations of evaporation and rainfall during the course of the lunar day discussed in a recent paper.*

[Note.—My wife, without whose help the great labour of the above investigation could not have been undertaken, has kindly checked the averages given in the table.]

Table showing the Variation and Wind Velocity in Miles an Hour during the Course of the Lunar Day.

<table>
<thead>
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<th>Hour</th>
<th>Mean</th>
<th>Moon south</th>
<th>Moon north</th>
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<td>5.22</td>
<td>5.40</td>
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</table>

Addendum.

Column 2 may be represented pretty closely by the formula—

\[
V = 5.25 + 0.075 \sin (138.4° + n 15°) + 0.019 \sin (264.5° + 2n 15°) + 0.013 \sin (123.0° + 3n 15°) + 0.044 \sin (183.8° + 4n 15°) + \ldots \ldots
\]

The relative magnitude of the fourth harmonic term is remarkable. It gives maximum values at 0430, 1030, 1630, and 2230 of lunar time. The second harmonic term gives maxima about 0600 and 1800.


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