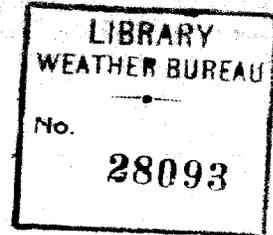


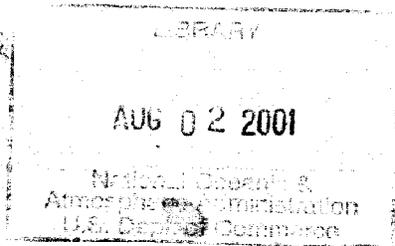
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THE



KINGSTON ANEMOMETER,



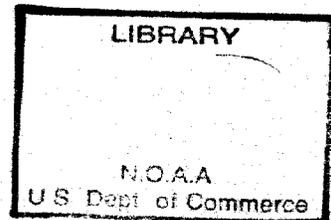
OR

Record of observations upon the hourly Velocity and Force of the Wind throughout the three years—March 1892, to February 1895,—with other Notes, including Tables and Diagrams.

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THE KINGSTON ANEMOMETER.

From the time of the establishment of the Weather Service in Jamaica observations on the force of the wind in Kingston have been confined solely to the fixed hours for noting other meteorological phenomena, and these had to be obtained principally by eye-readings upon the instruments, or by estimation; there being no self-recording apparatus for securing a continuous record of the velocity of the wind, in miles per hour, beyond that of the pressure plate attachment on the Osler's anemometer.

As it was considered very desirable to arrive at some data appertaining to the number of miles of wind travelled during each of the twenty-four hours, and for each month of the year, to enable their means to be deduced; likewise to determine any other special feature connected with the wind movements—in March 1892, advantage was taken to employ the Robinson's cup anemometer which had been recently re-erected on the roof of the Public Works Office in the Parade, Kingston. This instrument stands about 40 feet from the ground, and 80 feet above sea-level. It being already provided with a contact device so as to close an electric circuit for a short period upon the completion of each mile of wind travelled, all that was then left to be done was to lead suitable wires from the instrument to the ground floor below, and provide an arrangement to perform an automatic registration.

The sliding table, or chronograph, attached to the Osler's anemometer recorder was found to be well adapted to simultaneously include this further record: there being ample space left at the side of the sheet to permit of this; so that on the same chart we would have direction, pressure, and number of miles side by side.

The principle upon which this addition was accomplished was in having alongside the sliding table an electro-magnet which governed a lever, with a lead pencil attached that would be pulled back in order to give a mark at the completion of every mile of wind. The sheet of paper is so divided that a space of about three quarters of an inch covers one hour. Wind travelling even up to twenty five miles in one hour could with ease be read off on the Register.

The measurements are taken to the tenth part of a mile, for the hour division marks invariably intersect the last mile so that a fraction falls on each side of the hour line: these two fractions added together total up to one mile. The means for the month are taken to the *second* decimal place.

As it would have been almost impossible to determine the exact rate which the wind travels at the instant of any hour, in consequence of the rapid fluctuation of pressure arising from large and small gusts, the method therefore here adopted is to total up the number of miles of wind which have been registered in the course of the hour; this will give, nearly, the rate at the intermediate, or half-hour point; supposing then that twelve miles had been recorded between one and two p.m., this rate would then apply to 1.30 p.m., so that in constructing the diagrams the half-hour points are plotted to represent the ordinates of the curve. The diurnal curve for the twenty-four hours is then made to pass through these points, which will very nearly give the mean rate of travel at any instant of the day.

These observations extend over a period dating from March 1892 to February, 1895. The hourly means for each of the thirty-six months have been arrived at separately as given in tables I, II, and III.

The year's means, for convenience' sake, terminate in February and are then compiled up to that month so as to enable the results for each of the three years to be compared. Table VI gives the grand mean obtained from Tables I, II, III.

To permit of a comparison being made between the means of each of the months, Table IV., has been prepared, which deals with each month, separately, and the months are transposed so as to fall in consecutive order. It is from the mean results of this Table that the diagrams, given in Figs. 1 to 12, have been constructed. That for the full year, Fig. 13, is derived from Tables V., VI.

During the three years for which this registration has been kept there had been no passing Cyclone that would have disturbed the normal rate of wind velocity, hence for the purposes of any deductions the data herein given will bear a nearer approach to absolute accuracy.

In Table V., the average velocity, shown in the last column, is given for each month, but this appertains to the mean of the 24 individual hour figures, as appear in the table. In reality when *pressure* becomes a factor the mean value is somewhat greater. For example in the month of January we have in Table V., the average rate per hour as 3.73, whereas by taking the mean pressure in lbs., from Table IX., as .085 for the day, we get a corresponding velocity of 4.12 miles: the ratio not being the same in both cases. Wind with a velocity of 5 miles gives .125 lbs., and of 10 miles .500 lbs., per square foot—so that when the mean of the pressure for the 24 hours is taken, and the velocity be deduced, we get a higher result.

REMARKS UPON THE DIURNAL VARIATION, &c.

By simply glancing over the figures in the various Tables very little, comparatively, will be gained, it is only upon reference to the diagrams that some conception can be formed of the character and action of the wind throughout the twenty-four hours, for any particular month.

The following are notes relating to the diagrams:—

It will be seen that in nearly all the months, except May and September, there is a decided drop in the velocity just at about sunrise, in most cases perceptibly commencing some hours before. This would appear to be due to the gradual cessation of the land breeze just before the temperature begins to rise, and to when the sea breeze sets in. The sea-breeze which is south-easterly for Kingston would appear to commence as a light wind (in most cases starting westerly and south-westerly) at about the following hours, during the respective months:—

January 8 a.m.	July 7 a.m.
February 7 a.m.	August 7.30 a.m.
March 7.30 a.m.	September 7 a.m.
April 7.30 a.m.	October 7 a.m.
May 7.00 a.m.	November 8 a.m.
June 5.00 a.m.	December 8.30 a.m.

Starting from a minimum rate of about 2 miles until it arrives at its maximum at about midday. The times when this minimum occurs appear to some extent to be governed by the time of sunrise, because in the months when the time of day-break is late, as towards the end of the year it takes place at 8.00 and 8.30 a.m., whereas towards the middle of the year we get into the earlier hours. The mean curve for the year gives the time for this abrupt change of velocity as 7.30 a.m.: about 1½ hours after mean sunrise. The same cannot be said to occur at the time of sunset in any instance; the sea breeze continuing for a longer period after the sun disappears and quickly followed by the land wind coming from the north.

There are several remarkable features with respect to the behaviour of the wind as figured in the diagrams. From sunrise until it arrives at its maximum the acceleration of velocity is somewhat greater than the downward trace: in both cases this portion of the curve forms a more graceful sweep. During the night on the other hand when the land breeze blows there is much irregularity of pressure to be seen, and the curves show several decided rises and falls. It may however be noted that the night wind gives a mean annual velocity of about 2 miles per hour; whereas the mean maximum of the sea-breeze is a quantity four times as great.

It has been found that the maximum frequency of rainfall in Kingston takes place at about 3 or 4 p.m., but no where on the diagrams does this appear to influence the rate of wind travel.

Nor is there any very marked departure in the curves for May and October: being the "seasons" for Rain.

The most interesting portion of these investigations lies in the time for the arrival of the maximum velocity; great care has been taken to lay down the apex of the diurnal curve in each diagram so as to enable this point to be reliably obtained, and the actual time of occurrence of this phenomenon may be accurately located.

With the aid of Table VII., and Figure 14 the data arrived at can be better followed. Table VII. gives the time of the mean maximum velocity for each month of the three year period, as well as the extent of the mean max. velocity in miles per hour, corresponding to such time. The diagram Fig. 14 shows the lower curve C. D. as representing the mean time of Apparent Noon or, otherwise, the time when the sun gets on the meridian of Kingston, whether *before*, or *after*, the mean Noon. The upper curve A. B., gives the time, based upon the same scale, of the occurrence of the maximum velocity, in relation to mean time, and to the sun's position about the mean Noon line. It appears quite evident that there is an unmistakable tendency for the max. velocity of the wind to arrive *late* when the sun is late for the meridian passage, and *early* when the sun passes the meridian before mean Noon. There are then two instances of early, and likewise two of late for the year, this arises from the fact that the equation of time changes at the periods of the equinoxes and solstices. The diagram is calculated upon the *mean time for the whole month*, both for the equation of time as well as for the mean wind max. The mean result for the year indicates that the greatest force of wind takes place just 1h., 05 mins. after the meridian passage of the sun.

For the purpose of enabling a better comparison to be made, a dotted line following A. B., has been traced, in order to smooth down the curve for the wind max. The relationship is therefore more clearly demonstrated. The variations of the two curves then become more parallel.

There is also a suspicion that the effect of the sun's declination has some influence upon the time of arrival of the max., for on examining the dotted curve along A. B., with that of the apparent sun C. D., there is a somewhat broader margin perceptible towards the end of the year when the Z. D. of the sun at meridian passage is some 40° south, (for our latitude of 18°N) pointing to a further retardation of this maximum than in June when the sun passes almost overhead, but this point can only be settled by a longer period than three years of observation.

Table VIII relates to the greatest number of miles of wind travelled during one hour, for each month of the three years. The maximum sea breeze gives 17 miles for April, 1892, June, 1892, March, 1893, and Norther 17. 1 in December, 1894.

During squalls and heavy blows we can obtain from the records of the pressure plate of the Osler's anemometer the force of wind in pounds per square foot, these exceptional pressures last merely a few seconds, but much destructive effect can be experienced even in so short a space of time.

The following table gives the greatest pressure registered for each month during the period. Care was taken before hand to test the pressure plate by means of a spring balance, so that a proper scale could be prepared:—

Maximum pressure registered in pounds per square foot.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July,	Aug.	Sept.	Oct.	Nov.	Dec.
1892	...	...	5.0	6.5	5.6	10.7	8.2	5.0	9.0	5.5	3.0	4.5*
1893	5.0	5.3	7.0	5.4	6.0	6.5	5.2	5.0	7.0	1.6	2.0	4.0
1894	4.0	6.0	6.7	4.8	4.0	6.0	7.5	4.5	4.5	7.0	4.5	6.0*
1895	4.0	5.0	...	...	...	...	...	...	...	...	...	...
Means	4.3	5.4	6.2	5.6	5.2	7.7	7.0	4.8	6.8	4.7	3.2	4.5

* Northers.

It will be seen that in June, 1892 the greatest pressure is 10.7 lbs., per square ft., this is equivalent to wind blowing at 46 miles per hour; it occurred at 4.45 p.m., on June 30th, south-easterly direction. In nearly all the cases given they relate to the sea-breeze.

THE MINIMUM.

On referring to fig 13 it will be noticed that the mean minimum for the whole year occurs at about 11.30 p.m., but viewing the months separately there is a difference plainly visible throughout—they however more or less give the time at about midnight. This is of course neglecting the drop of about sunrise.

THE DYNAMICAL EFFECT OF THE WIND.

When the wind is employed as a motive power it may be of service to furnish some data giving the average pressure in pounds per square foot of surface throughout the year; Table IX. of means has been compiled so as to have the corresponding value of such pressure, based upon the velocities mentioned in table V., they extend over each hour of the day, and for each month. The formula

$$P = 0.0049 V^2$$

where P = Pressure in lbs., per square foot.

V = Velocity of wind in miles per hour.

The highest average pressure of wind, for the space of one hour occurs in the month of June between 1 and 2 p.m., where 0.559 lb is obtained, this is equal to a mean velocity of 10.58 miles per hour representing 0.0034 H.P., per square foot, so that a wind motor of 300 square feet area would drive with a force of about one H. P. for that particular time. This, then, will be also the most favourable period for the sail in the Harbour of Kingston. In the Kingston harbour, however, the wind undoubtedly maintains a greater rate of travel as compared with the station, which is less exposed, where these observations were made, and which is situated centrally in Kingston.

In the last column of this table will be found the average horse-power per square foot developed throughout the whole 24 hours. These figures are computed from the H. P. represented by each hour's pressure, the mean result only being given, and not from the mean pressure for the day, for the same reason as that given for the relation between velocity and pressure on page 3. The ratio being different as will be seen by the formula to obtain the H. P.

$$H P = \frac{\sqrt{\frac{P}{0.00228}}}{1.080.000}^3$$

H. P. = horse-power.

P = Pressure in lbs. per square foot.

So that in obtaining the mean H. P. for the day, the horse-power for each hour is computed from the pressure table and their means taken. This gives a value of about 33 per cent higher than if it were taken from the average pressure for the 24 hours.

CHARACTER OF THE APEX OF THE DIAGRAMS.

In studying the diagrams it will be seen to occur that the several months are by no means similar with respect to the manner in which the maximum is attained. In some cases the apex is arrived at, and returns, very abruptly giving a comparatively acute turn at the ascent and descent of the curve; others are slow in arriving at the apex, and the order by which these are traced is as follows:—

1 July	7 March
2 August	8 January
3 May	9 October
4 September	10 November
5 June	11 February
6 April	12 December

Commencing from No. 1, July, we have an abrupt arrival for the maximum, then in the months following we find that the apex becomes more and more rounded or blunt, until we get to No. 12. This peculiarity seems to be attributable to the value of the average maximum for the month; it is found that the mean maximum for the first six cases gives 9.38 miles, and in the last six 7.10 miles, showing appreciably that where a high maximum has to be attained the wind accelerates more speedily than in cases where the mean max. is small, as we find in November and December.

GREATEST AND LEAST AVERAGE TRAVEL.

The month which gives the greatest average travel of wind is June, and the least is that of November, calculating only upon these three years' observations. June has an average hourly velocity of 5.22 miles, and November 2.81 miles.

NORTHERS.

It has been demonstrated that there is a regular diurnal variation of the wind velocity relating to the sea-breeze, therefore, perhaps, some knowledge of the character of Northers which take place at lesser intervals, may lead to forming some analogy. To arrive at any reliable results it would be useless to

accept a Table unless the complete 24 hours could be procured. On referring to the charts there are but eight instances in three years when a norther blew from midnight to the following midnight. The figures for the hourly velocity are given in Table X. The mean result indicates the time for the arrival of the maximum as about 11.30 a.m. Now as the majority of cases occur in December when the sun's meridian passage takes place at about 11.55 a.m., (mean for the month), we have then the maximum for a Norther taking place some 25 minutes *before* the sun and unlike the sea-breeze; but until this can be accepted it may need a greater number of cases so as to arrive at a proper mean.

DESCRIPTION OF TABLES.

- I. Means for year 92-93.
- II. " " " 93-94.
- III. " " " 94-95.
- IV. Combined monthly means for 3 years.
- V. Three year hourly means.
- VI. Synopsis of means of Tables I. II. III.
- VII. Time of maximum velocity, &c.
- VIII. Greatest number of miles in an hour.
- IX. Dynamical effect of the wind.
- X. Northers.

DIAGRAMS.

Figs. 1 to 12 give the diurnal curves for the twelve separate months, and Fig. 13 is the three-year mean; Fig. 14 shows in diagram form the times of the maximum velocity in relation to the sun.

It might not be out of place here to mention that for the purpose of arriving at the means, the task of obtaining the velocity for each hour for a period of 36 months had to be met, this entailed over 26,000 separate measurements.

GENERALLY.

The diurnal variation curves at different places vary with one another, depending upon the configuration of the surrounding country, as well as elevation of the land, or their situation in point of latitude. It has been shown by some authorities that the hourly variation of the pressure of the wind over the sea in mid ocean is almost nothing, and that upon high mountain peaks the variation is almost quite the opposite, for the *maximum* then occurs in the early morning and the *minimum* about, or just *after* Noon. But as a rule on land of low elevation the maximum generally takes place between 1 and 2 p.m. in places even widely separated.

The instrument for registering the hourly velocity in Kingston has continued to be kept in operation since 1st March, 1895, and it is to be hoped that by the end of February 1898 we may secure another set of three years to enable comparisons to be made.

J. F. BRENNAN.

Spanish Town, May 25th, 1896.

TABLE I.—One year Means, giving the mean number of Miles of Wind recorded between each hour of the day, for each month, for year 1892-93.

	A.M.												P.M.												Average for the 24 hours.
	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11		12
March 1892	2.18	2.47	2.72	2.78	3.02	3.26	2.93	2.46	3.42	6.00	7.46	8.42	9.47	9.33	8.91	8.59	8.24	6.66	5.22	3.55	3.24	2.92	2.35	2.35	118.07
April "	2.47	2.21	2.36	2.30	2.10	2.41	2.48	2.46	3.64	5.42	7.11	8.65	9.29	8.58	8.62	7.49	6.86	6.08	4.09	4.09	3.21	2.41	2.35	2.18	107.28
May "	2.05	2.06	1.94	2.17	1.97	2.37	2.58	2.59	3.31	5.11	6.82	8.69	9.72	9.57	9.11	8.49	7.26	5.61	4.03	2.88	2.25	1.58	1.44	1.69	105.32
June "	3.28	3.02	3.52	3.68	3.61	3.86	4.00	4.49	6.23	8.62	10.23	10.74	10.88	10.77	9.90	9.51	8.32	7.24	5.67	5.08	3.58	3.24	3.38	3.19	145.42
July "	1.86	1.84	1.91	1.90	1.79	1.67	1.94	2.06	3.54	5.73	8.61	10.35	11.36	12.02	11.22	10.68	9.13	7.47	5.35	3.17	1.91	1.41	1.83	1.72	120.47
August "	1.37	1.43	1.62	1.53	1.65	1.48	1.51	1.55	2.67	4.75	7.19	8.54	9.59	9.65	8.56	7.25	6.13	3.94	2.46	1.84	1.61	1.37	1.43	1.31	90.35
September "	1.12	1.12	1.26	1.12	1.02	1.23	1.40	1.61	2.63	4.41	6.80	8.07	8.92	8.61	7.67	7.08	5.74	4.10	3.38	2.63	2.16	1.80	1.31	1.17	86.26
October "	1.67	1.99	1.97	1.86	1.88	2.24	1.99	2.13	2.65	4.01	5.24	6.01	6.41	6.43	5.78	4.89	3.81	3.00	2.38	2.57	2.27	1.67	1.93	1.78	76.56
November "	1.89	1.84	2.10	2.18	2.34	2.48	2.52	2.30	2.07	3.09	4.37	4.69	5.15	5.33	5.19	4.85	3.70	3.32	2.67	2.73	2.39	2.35	2.27	2.15	73.57
December "	2.15	2.48	2.69	2.35	2.29	2.14	2.39	2.35	2.12	2.39	3.86	4.62	5.54	5.54	5.68	5.35	4.44	3.30	2.98	2.65	2.64	2.74	2.45	2.23	77.50
January, 1893	2.87	3.07	3.04	2.90	2.77	2.67	2.77	2.28	2.64	4.15	5.42	6.27	7.52	7.79	7.87	7.36	6.04	4.82	3.68	3.39	2.97	2.87	2.86	2.70	100.72
February "	2.43	2.59	2.55	2.47	2.30	2.16	2.09	2.11	2.57	4.91	6.55	7.91	8.75	9.06	8.81	8.34	7.83	6.45	4.43	3.27	2.63	2.31	2.30	2.34	107.05
Mean	2.11	2.23	2.31	2.27	2.23	2.31	2.39	2.35	3.11	4.91	6.64	7.75	8.55	8.56	8.10	7.49	6.46	5.13	3.91	3.08	2.50	2.21	2.13	2.07	100.30

TABLE II.—One year Means, giving the mean number of Miles of Wind recorded between each hour of the day, for each month, for year 1893-94.

	A.M.												P.M.												Average for the 24 hours.
	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11		12
March 1893	2.73	2.64	2.66	2.47	2.49	2.73	2.72	2.68	4.39	6.33	7.51	8.62	9.37	9.46	8.94	8.22	7.15	6.08	5.24	4.11	3.07	2.92	2.64	2.57	117.74
April "	1.46	1.46	1.53	1.48	1.59	1.17	1.47	1.46	3.15	5.33	7.07	8.21	8.95	8.96	8.31	7.61	6.30	4.83	3.36	2.36	1.87	1.59	1.31	1.24	92.07
May "	0.96	0.96	1.26	1.37	1.39	1.35	1.51	1.98	3.56	5.68	7.69	9.03	9.46	8.71	7.91	6.97	5.29	5.09	3.99	2.87	1.92	1.74	1.29	0.99	93.97
June "	1.61	1.32	1.43	1.41	1.39	1.35	1.77	2.49	4.12	6.29	8.01	9.41	9.78	9.98	9.08	8.56	7.32	6.16	4.42	2.64	2.04	1.73	1.73	1.82	106.81
July "	1.28	1.24	1.31	1.43	1.64	1.95	2.17	1.97	2.78	4.70	6.20	8.40	9.12	9.64	8.43	7.57	6.24	4.82	3.19	2.23	1.56	1.27	1.03	0.98	91.14
August "	1.79	1.94	1.79	2.49	2.30	2.00	1.99	1.86	2.58	4.19	5.74	7.93	8.54	8.22	7.81	6.68	5.33	3.93	2.89	1.70	1.66	1.62	1.17	1.64	88.48
September "	1.47	1.52	1.59	1.70	2.06	2.10	2.15	2.15	2.62	4.23	6.65	6.75	7.09	7.50	7.01	6.48	5.61	3.85	2.81	2.41	2.10	1.55	1.38	1.37	83.15
October "	0.96	1.01	0.98	0.90	0.83	0.90	0.97	0.76	1.38	2.36	4.36	5.27	5.56	5.14	4.46	4.12	3.54	2.63	1.64	0.83	1.08	1.26	1.02	0.93	53.70
November "	1.12	1.23	1.25	1.42	1.63	1.66	1.55	1.26	1.91	3.19	3.49	4.35	5.23	5.19	4.88	4.11	3.23	2.32	1.58	1.29	1.45	1.17	1.14	1.02	64.82
December "	1.35	1.52	1.52	1.45	1.26	1.06	1.41	1.31	1.06	1.99	3.37	3.75	4.51	5.02	4.87	4.92	3.98	2.57	2.47	2.13	1.70	1.66	1.25	1.52	67.65
January 1894	1.76	1.76	1.87	2.15	2.13	1.92	1.81	1.68	1.79	2.59	3.91	4.14	5.64	6.18	6.24	5.86	4.42	3.12	2.55	1.95	1.60	1.83	1.77	1.75	70.48
February "	1.76	1.80	2.17	2.15	1.92	1.77	1.81	1.58	1.95	3.52	5.39	7.26	7.56	8.74	8.99	8.77	8.05	6.02	4.10	2.49	2.17	1.72	1.68	1.38	95.74
Mean	1.51	1.58	1.61	1.70	1.72	1.67	1.78	1.77	2.56	4.17	5.70	6.93	7.65	7.73	7.24	6.66	5.62	4.29	3.19	2.25	1.85	1.67	1.50	1.43	83.73

TABLE III.—One year Means, giving the mean number of Miles of Wind recorded between each hour of the day, for each month, for year 1894-95.

	P.M.												Average for the 24 hours.												
	12	1	2	3	4	5	6	7	8	9	10	11		12											
March 1894	1.75	2.01	2.04	2.13	2.17	1.92	1.98	2.08	2.87	5.15	7.33	8.32	9.06	8.96	8.75	7.93	6.66	5.05	4.38	3.30	2.42	2.12	1.89	1.89	103.06
April "	1.46	1.62	1.91	2.03	1.96	1.98	1.61	1.61	3.03	4.78	6.91	6.97	7.80	7.65	7.11	6.93	5.48	4.15	2.93	2.36	1.97	1.72	1.25	1.38	85.81
May "	2.58	2.56	2.56	2.53	2.51	2.83	2.75	2.87	3.79	4.86	6.32	7.05	7.94	8.10	7.19	6.84	6.11	5.31	4.13	3.28	2.67	2.39	2.29	2.37	101.83
June "	2.38	2.48	2.31	2.35	2.19	2.71	2.71	3.47	4.49	5.66	8.19	10.25	10.32	10.97	10.09	9.24	8.00	6.42	4.49	3.34	2.83	2.33	2.41	2.46	123.63
July "	1.68	1.80	1.84	1.95	2.03	2.34	2.36	2.39	3.20	5.61	7.56	9.00	9.90	10.06	8.84	8.00	6.73	5.35	3.95	2.66	1.91	1.54	1.56	1.78	104.00
August "	1.21	1.31	1.48	1.57	1.53	1.65	1.77	1.76	2.30	4.26	7.08	8.49	9.78	9.81	9.20	8.24	7.07	5.08	2.73	1.51	1.33	1.40	1.15	1.02	92.73
September "	1.75	1.93	2.08	2.03	2.08	2.39	2.23	2.39	3.13	5.24	6.44	7.84	8.30	8.12	7.44	6.15	5.04	3.97	3.09	2.25	2.19	1.77	1.80	1.86	91.44
October "	2.51	2.25	2.09	2.05	2.29	2.25	2.27	2.31	2.73	4.18	5.76	6.11	6.48	6.41	5.71	5.75	5.76	2.35	2.03	2.31	2.00	2.00	2.05	2.11	79.76
November "	2.30	1.97	1.97	2.18	2.00	2.07	1.88	1.70	1.81	3.12	4.39	5.45	6.32	6.60	6.18	5.70	4.31	2.63	2.19	2.02	1.89	1.66	1.86	2.05	74.25
December "	2.90	2.85	2.90	2.90	3.21	3.05	3.15	2.84	2.71	3.61	5.02	6.99	6.06	6.14	5.50	4.40	3.89	3.79	3.62	3.74	2.85	2.74	2.83	2.76	89.08
January 1895	2.35	2.55	2.75	2.76	2.72	2.75	2.62	2.64	2.33	3.40	5.60	6.84	7.55	7.73	7.26	7.04	6.23	4.83	3.75	3.49	2.93	2.70	2.42	2.28	97.43
February "	1.96	2.19	2.56	2.48	2.57	2.49	2.68	2.96	3.06	4.98	6.59	7.41	8.50	8.48	7.88	7.63	6.52	5.28	4.54	3.82	2.93	2.39	2.32	1.85	104.17
Mean	2.06	2.12	2.20	2.25	2.27	2.37	2.35	2.41	2.96	4.65	6.35	7.48	8.23	8.25	7.59	6.99	5.82	4.50	3.49	2.81	2.32	2.06	1.99	1.99	95.60

TABLE IV.—Giving the Means for each Month, for the three years; from March 1892, to February 1895, inclusive.

	P.M.												Average for the 24 hours.												
	12	1	2	3	4	5	6	7	8	9	10	11		12											
January 1892-1894	2.87	3.07	3.04	2.90	2.77	2.67	2.77	2.28	2.61	4.15	5.42	6.27	7.53	7.79	7.87	7.35	6.04	4.82	3.68	3.39	2.97	2.87	2.86	2.70	100.72
February 1892-1894	1.76	1.76	1.87	2.16	2.13	1.92	1.81	1.68	1.79	2.59	3.91	4.14	5.64	6.18	6.24	5.88	4.42	3.12	2.55	1.95	1.60	1.83	1.77	1.75	70.43
Mean	2.33	2.46	2.56	2.61	2.54	2.45	2.40	2.17	2.25	3.38	4.98	5.75	6.90	7.23	7.12	6.75	5.56	4.26	3.33	2.94	2.50	2.47	2.35	2.24	89.52
March 1892-1894	2.43	2.59	2.55	2.47	2.30	2.16	2.09	2.11	2.57	4.91	6.50	7.91	8.75	9.06	8.81	8.34	7.83	6.45	4.42	3.27	2.63	2.21	2.30	2.34	107.05
April 1892-1894	1.75	1.80	2.17	2.15	1.92	1.77	1.81	1.58	1.95	3.62	5.39	7.26	8.66	8.79	8.99	8.77	8.06	6.02	4.10	2.49	2.17	1.72	1.63	1.38	96.74
Mean	1.96	2.19	2.55	2.48	2.57	2.49	2.68	2.95	3.06	4.98	6.59	7.41	8.60	8.48	7.88	7.63	6.52	5.28	4.54	3.82	2.93	2.39	2.32	1.85	104.17
May 1892-1894	2.06	2.19	2.42	2.37	2.26	2.14	2.19	2.21	2.53	4.47	6.18	7.53	8.64	8.78	8.56	8.25	7.47	5.92	4.35	3.19	2.58	2.11	2.08	1.86	102.33
June 1892-1894	2.18	2.47	2.72	2.78	3.02	3.26	2.93	2.46	3.42	6.00	7.46	8.42	9.47	9.33	8.91	8.69	8.24	6.66	5.22	3.66	3.24	2.92	2.86	2.35	118.07
July 1892-1894	2.73	2.64	2.66	2.47	2.49	2.73	2.72	2.68	4.39	6.33	7.51	8.62	9.37	9.46	8.94	8.22	7.15	6.08	5.24	4.11	3.07	2.92	2.64	2.57	117.74
Mean	1.75	2.01	2.04	2.13	2.17	1.92	1.98	2.08	2.87	5.15	7.33	8.32	9.06	8.96	8.75	7.93	6.66	5.05	4.38	3.30	2.42	2.12	1.89	1.89	103.06
August 1892-1894	2.22	2.37	2.47	2.46	2.56	2.64	2.54	2.41	3.56	5.83	7.43	8.45	9.30	9.25	8.87	8.25	7.35	6.23	4.95	3.69	2.91	2.65	2.30	2.27	112.96
September 1892-1894	2.47	2.21	2.36	2.30	2.10	2.41	2.46	2.46	3.64	5.42	7.11	8.65	9.29	8.58	8.62	7.49	6.86	6.03	4.83	3.36	2.36	2.41	2.35	1.96	107.28
October 1892-1894	1.46	1.46	1.53	1.48	1.59	1.17	1.47	1.46	3.15	5.33	7.07	8.21	8.95	8.96	8.31	7.61	6.03	4.83	3.36	2.36	1.87	1.59	1.31	1.24	92.07
Mean	1.46	1.62	1.91	2.03	1.96	1.98	1.81	1.61	3.03	4.78	6.91	6.97	7.80	7.65	7.11	6.93	5.48	4.15	2.93	2.36	1.97	1.72	1.25	1.38	85.81
January 1895	1.79	1.76	1.93	1.94	1.88	1.85	1.92	1.84	3.27	5.18	6.70	7.94	8.68	8.40	8.01	7.34	6.21	5.00	3.66	2.64	2.08	1.89	1.61	1.60	95.02

TABLE IV.—Giving the Means for each Month, for the three years, from March, 1892, to February, 1895, inclusive,—continued.

	(In Miles per hour)												Average for the 24 hours.										
	12	1	2	3	4	5	6	7	8	9	10	11		12									
May	1892—2.05	1.86	1.94	2.17	1.97	2.37	2.58	3.34	5.11	6.82	8.63	9.72	9.57	9.11	8.49	7.26	6.61	4.03	2.88	2.25	1.58	1.44	1.69
"	1893—0.96	0.96	1.26	1.37	1.39	1.35	1.51	1.98	3.55	5.68	7.69	9.03	9.46	8.71	7.91	6.97	5.09	3.09	2.87	1.92	1.74	1.29	0.93
"	1894—2.68	2.56	2.56	2.53	2.51	2.83	2.75	2.87	3.79	4.86	6.32	7.06	7.94	8.10	7.19	6.84	6.11	4.13	3.28	2.67	2.39	2.29	2.37
Mean	—	1.86	1.94	2.02	1.96	2.18	2.28	2.48	3.56	5.22	6.94	8.26	9.06	8.80	8.07	7.43	6.55	5.31	3.01	2.28	1.90	1.67	1.68
June	1892—3.24	3.62	3.62	3.68	3.61	3.06	4.00	4.49	6.23	8.62	10.23	10.74	10.86	10.77	9.90	9.51	8.32	7.24	5.67	5.08	3.24	3.38	3.19
"	1893—1.51	1.32	1.43	1.41	1.39	1.35	1.77	2.49	4.12	6.29	8.01	9.41	9.78	9.98	9.08	8.56	7.32	6.16	4.42	2.64	1.73	1.78	1.82
"	1894—2.36	2.48	2.31	2.35	2.19	2.71	2.71	3.47	4.40	6.58	8.19	10.25	10.92	10.57	10.09	9.21	8.00	6.42	4.49	3.34	2.83	2.41	2.46
Mean	—	2.39	2.47	2.48	2.40	2.67	2.83	3.48	4.95	7.16	8.81	10.13	10.52	10.58	9.69	9.10	7.88	6.61	4.86	3.69	2.82	2.43	2.49
July	1892—1.86	1.84	1.91	1.91	1.79	1.67	1.94	2.05	3.54	5.73	8.61	10.35	11.36	12.02	11.22	10.66	9.13	7.47	5.35	3.17	1.94	1.41	1.83
"	1893—1.28	1.24	1.31	1.43	1.64	1.95	2.17	1.97	2.78	4.70	6.20	8.40	9.12	9.64	8.43	7.67	6.24	4.82	3.19	2.22	1.56	1.27	1.03
"	1894—1.58	1.80	1.84	1.95	2.03	2.34	2.36	2.89	3.25	5.61	7.56	9.00	9.90	10.06	9.06	8.64	8.00	6.73	5.35	3.95	1.91	1.54	1.78
Mean	—	1.57	1.63	1.76	1.82	1.99	2.16	2.14	3.19	5.35	7.46	9.25	10.13	10.56	9.60	8.74	7.37	5.88	4.16	2.68	1.80	1.41	1.47
August	1892—1.37	1.43	1.62	1.53	1.65	1.48	1.61	1.55	2.67	4.75	7.19	8.54	9.59	9.66	8.68	7.26	6.13	3.94	2.46	1.84	1.51	1.37	1.43
"	1893—1.79	1.94	1.79	3.49	2.30	2.09	1.99	1.86	2.68	4.19	5.74	7.93	8.54	8.22	7.81	6.68	5.33	3.93	2.89	1.70	1.61	1.62	1.77
"	1894—1.21	1.31	1.48	1.57	1.53	1.65	1.77	1.76	2.30	4.26	7.08	8.49	9.78	9.81	9.20	8.24	7.07	5.08	2.73	1.51	1.53	1.40	1.15
Mean	—	1.46	1.56	1.63	1.86	1.83	1.74	1.76	2.62	4.40	6.67	8.32	9.31	9.23	8.52	7.39	6.18	4.32	2.69	1.68	1.50	1.46	1.32
September	1892—1.12	1.12	1.20	1.12	1.02	1.23	1.40	1.61	2.63	4.41	6.80	8.07	8.92	8.61	7.67	7.08	5.74	4.10	3.38	2.63	2.16	1.80	1.31
"	1893—1.47	1.61	1.59	1.76	2.06	2.10	2.15	2.15	2.92	4.23	5.65	6.75	7.09	7.50	7.01	6.48	5.61	3.85	2.81	2.4	2.10	1.55	1.37
"	1894—1.76	1.93	2.08	2.03	2.08	2.39	2.23	2.39	3.15	5.24	6.44	7.84	8.30	8.12	7.44	6.15	5.04	3.97	3.09	2.25	2.12	1.77	1.80
Mean	—	1.45	1.52	1.64	1.62	1.72	1.91	1.93	2.96	4.63	6.30	7.56	8.09	8.08	7.37	6.57	5.46	3.97	3.09	2.43	2.13	1.71	1.50
October	1892—1.67	1.59	1.57	1.86	1.88	2.24	1.99	2.13	2.65	4.01	5.24	6.01	6.41	6.43	5.78	4.89	3.81	3.00	2.38	2.57	2.27	1.67	1.93
"	1893—0.96	1.01	0.98	0.90	0.83	0.90	0.97	0.76	1.38	3.26	4.36	5.27	5.66	5.14	4.46	4.12	3.54	2.63	1.64	0.83	1.08	1.26	1.02
"	1894—2.51	2.25	2.69	2.65	2.29	2.25	2.27	2.31	2.73	4.18	5.76	6.11	6.48	6.41	5.71	5.75	3.76	2.35	2.03	2.31	2.00	2.06	2.11
Mean	—	1.71	1.75	1.68	1.60	1.67	1.80	1.74	1.73	2.25	3.82	5.12	5.80	6.16	5.39	4.92	3.70	2.66	2.02	1.90	1.78	1.64	1.61
November	1892—1.89	1.84	2.10	2.18	2.34	2.48	2.52	2.30	2.07	3.09	4.37	4.69	5.15	5.38	5.19	4.85	3.70	2.92	2.67	2.73	2.39	2.35	2.27
"	1893—1.11	1.23	1.25	1.42	1.63	1.66	1.56	1.26	1.31	1.96	3.40	4.35	5.22	5.19	4.88	4.11	3.22	2.32	1.68	1.29	1.45	1.17	1.14
"	1894—2.30	1.97	1.97	2.18	2.00	2.07	1.88	1.70	1.81	3.12	4.39	5.45	6.32	6.60	6.18	5.70	4.31	2.63	2.9	2.02	1.89	1.66	1.86
Mean	—	1.77	1.68	1.77	1.93	1.99	2.07	1.98	1.75	2.72	4.08	4.83	5.67	5.70	5.42	4.89	3.74	2.62	2.15	2.01	1.91	1.73	1.76
December	1892—2.15	2.48	2.69	2.36	2.29	2.14	3.39	2.35	2.12	2.69	3.86	4.82	5.54	5.64	5.68	5.38	4.44	3.30	2.98	2.55	2.64	2.74	2.45
"	1893—1.36	1.52	1.52	1.46	1.26	1.06	1.41	1.31	1.06	1.99	3.37	3.75	4.51	5.02	4.87	4.92	3.98	2.57	2.47	2.19	1.70	1.66	1.25
"	1894—2.80	2.85	2.90	2.90	3.21	3.05	3.15	2.84	2.71	3.61	5.02	5.99	6.06	6.14	5.50	4.40	3.89	3.79	3.62	3.37	2.85	2.74	2.88
Mean	—	2.13	2.28	2.37	2.23	2.25	2.08	2.32	2.17	1.96	2.76	4.08	4.79	5.37	5.58	5.32	4.90	4.10	3.22	3.02	2.68	2.40	2.38

TABLE V.—Three year means : giving the number of miles of wind recorded between each hour of the day, for each month.

Month.	A.M.												P.M.												Average for the day.	Average per hour.
	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11			12
January	2.33	2.46	2.65	2.61	2.64	2.45	2.46	2.17	2.25	3.38	4.98	5.75	6.90	7.23	7.12	6.75	5.56	4.21	3.33	2.94	2.50	2.47	2.35	2.24	89.52	3.73
February	2.05	2.19	2.42	2.37	2.26	2.14	2.19	2.2	2.53	4.47	6.18	7.53	8.64	8.78	8.56	8.25	7.47	5.92	4.36	3.19	2.58	2.11	2.08	1.86	102.33	4.26
March	2.22	2.37	2.47	2.46	2.56	2.64	2.64	2.41	3.56	5.83	7.43	8.45	9.30	9.25	8.87	8.25	7.35	6.23	4.95	3.69	2.91	2.63	2.30	2.27	113.96	4.71
April	1.79	1.73	1.93	1.94	1.88	1.85	1.92	1.94	3.37	5.18	6.70	7.94	8.68	8.40	8.01	7.34	6.21	5.04	3.66	2.64	2.08	1.89	1.61	1.60	96.02	3.96
May	1.86	1.86	1.92	2.02	1.96	2.18	2.28	2.48	3.56	5.22	6.94	8.35	9.55	8.80	8.07	7.43	6.56	5.34	4.05	3.01	2.28	1.90	1.67	1.68	100.37	4.18
June	2.39	2.47	2.42	2.48	2.40	2.67	2.83	3.48	4.95	7.16	8.81	11.13	10.52	10.58	9.65	9.10	7.88	6.61	4.86	3.69	2.82	2.43	2.52	2.40	125.28	5.22
July	1.67	1.63	1.69	1.76	1.82	1.99	2.16	2.14	3.19	5.55	7.46	9.35	10.13	10.56	9.50	8.74	7.37	5.88	4.16	2.68	1.80	1.41	1.47	1.49	106.20	4.98
August	1.46	1.56	1.63	1.86	1.85	1.74	1.76	1.72	2.52	4.40	6.67	8.92	9.31	9.23	8.62	7.39	6.18	4.32	2.69	1.68	1.50	1.41	1.47	1.32	90.62	3.77
September	1.45	1.52	1.64	1.62	1.72	1.91	1.93	2.05	2.75	4.63	6.30	7.55	8.09	8.08	7.37	6.57	5.46	3.97	3.09	2.43	2.13	1.71	1.50	1.47	80.95	3.62
October	1.71	1.75	1.68	1.60	1.67	1.80	1.74	1.73	2.25	3.82	5.12	6.80	6.16	5.99	5.32	4.92	3.70	2.66	2.02	1.90	1.78	1.64	1.67	1.61	70.94	2.92
November	1.77	1.68	1.77	1.93	1.99	2.07	1.98	1.75	1.73	2.72	4.08	4.63	5.57	5.70	5.42	4.89	3.74	2.62	2.15	2.01	1.91	1.73	1.76	1.74	67.55	2.81
December	2.13	2.28	2.37	2.23	2.25	2.08	2.32	2.17	1.96	2.76	4.08	4.79	6.37	5.58	5.32	4.90	4.16	3.22	3.02	2.68	2.40	2.38	2.18	2.17	74.74	3.11
Means	1.80	1.96	2.04	2.07	2.07	2.12	2.17	2.18	2.88	4.56	6.23	7.38	8.14	8.18	7.65	7.06	5.97	4.67	3.53	2.71	2.22	1.98	1.87	1.83	93.37	3.89

TABLE VI.—Mean results from the means arrived at in Tables I. II. III. for the three complete years.

Year.	A.M.												P.M.												Average for the 24 hours.
	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11		12
1892-93. I.	2.11	2.23	2.31	2.27	2.23	2.31	2.39	2.35	3.11	4.91	6.64	7.75	8.55	8.56	8.10	7.49	6.46	5.13	3.91	3.08	2.50	2.21	2.13	2.07	100.80
1893-94. II	1.61	1.63	1.61	1.70	1.72	1.67	1.78	1.77	2.66	4.17	5.70	6.93	7.65	7.73	7.24	6.66	5.62	4.29	3.19	2.26	1.86	1.67	1.50	1.43	83.73
1894-95. III.	2.06	2.12	2.20	2.25	2.27	2.37	2.35	2.41	2.96	4.65	6.35	7.48	8.23	8.25	7.59	6.99	5.82	4.59	3.49	2.81	2.32	2.06	1.99	1.90	95.60
Means	1.89	1.96	2.04	2.07	2.07	2.12	2.17	2.18	2.88	4.58	6.23	7.38	8.14	8.18	7.65	7.05	5.97	4.67	3.53	2.71	2.22	1.98	1.87	1.83	93.37

TABLE VII.—Time p.m. of occurrence of the mean maximum velocity of Wind for each month of the three year period recorded (derived from diagrams prepared for each month.)

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Mean for the year.
—	p.m. 1.48	p.m. 1.16	p.m. 1.00	p.m. 12.30	p.m. 12.45	p.m. 1.15	p.m. 1.18	p.m. 1.00	p.m. 1.06	p.m. 12.35	p.m. 1.08	p.m. 1.16	p.m. 1.06
Three year mean	7.24	8.80	9.36	8.69	9.06	10.62	10.57	9.40	8.17	6.17	5.75	5.62	8.29

Mean maximum Velocity in miles per hour.

TABLE VIII.—Greatest number of Miles recorded in one hour, and their means for the Month.

MONTHS.	1892.	1893.	1894.	1895.	Mean.
January ...	.	15.0	12.2	14.9	14.0
February ...	.	14.5	14.6	15.4	14.8
March ...	15.2	<u>17.0</u>	16.7	.	16.3
April ...	<u>17.0</u>	15.5	13.8	.	15.4
May ...	15.9	14.0	15.5	.	15.1
June ...	<u>17.0</u>	15.2	14.4	.	15.5
July ...	15.8	14.4	15.5	.	15.2
August ...	14.7	15.0	14.0	.	14.6
September ...	16.0	14.5	13.1	.	14.5
October ..	14.0	10.2	12.5	.	12.2
November ...	11.3	11.0	12.9	.	11.7
December ...	13.5	11.5	<u>17.1</u>	.	14.0

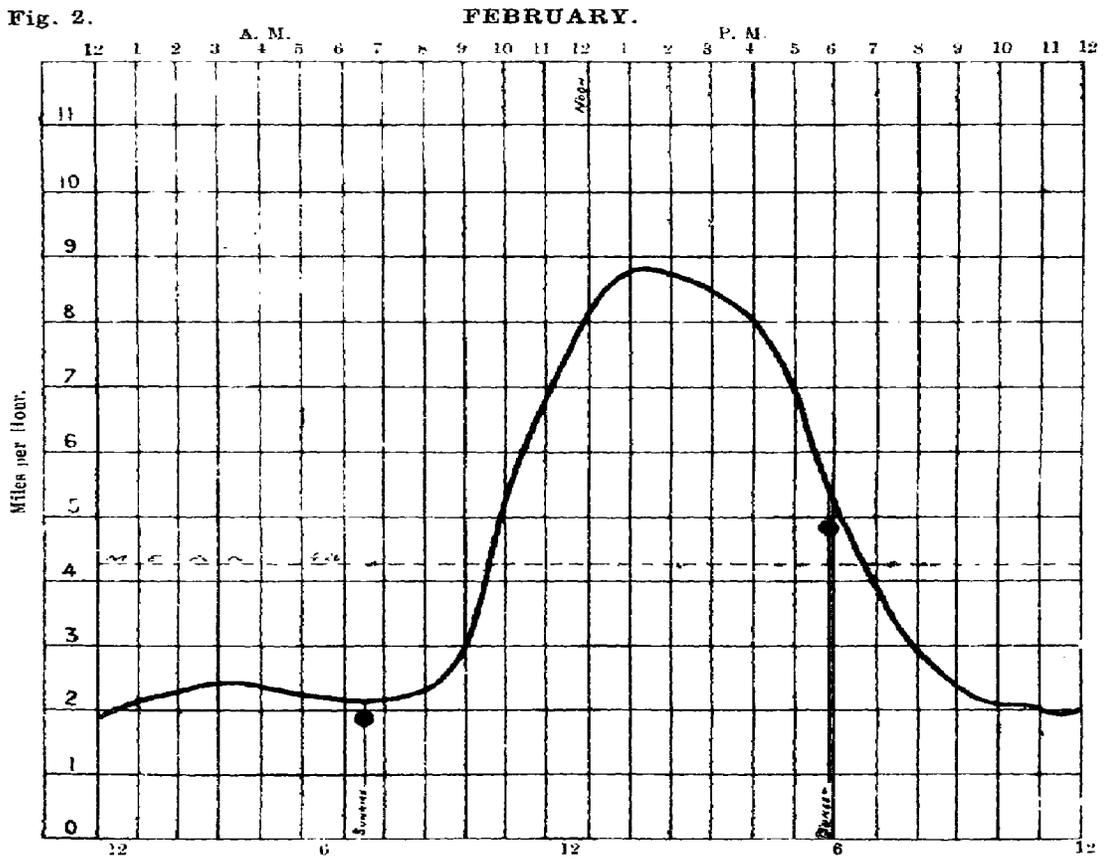
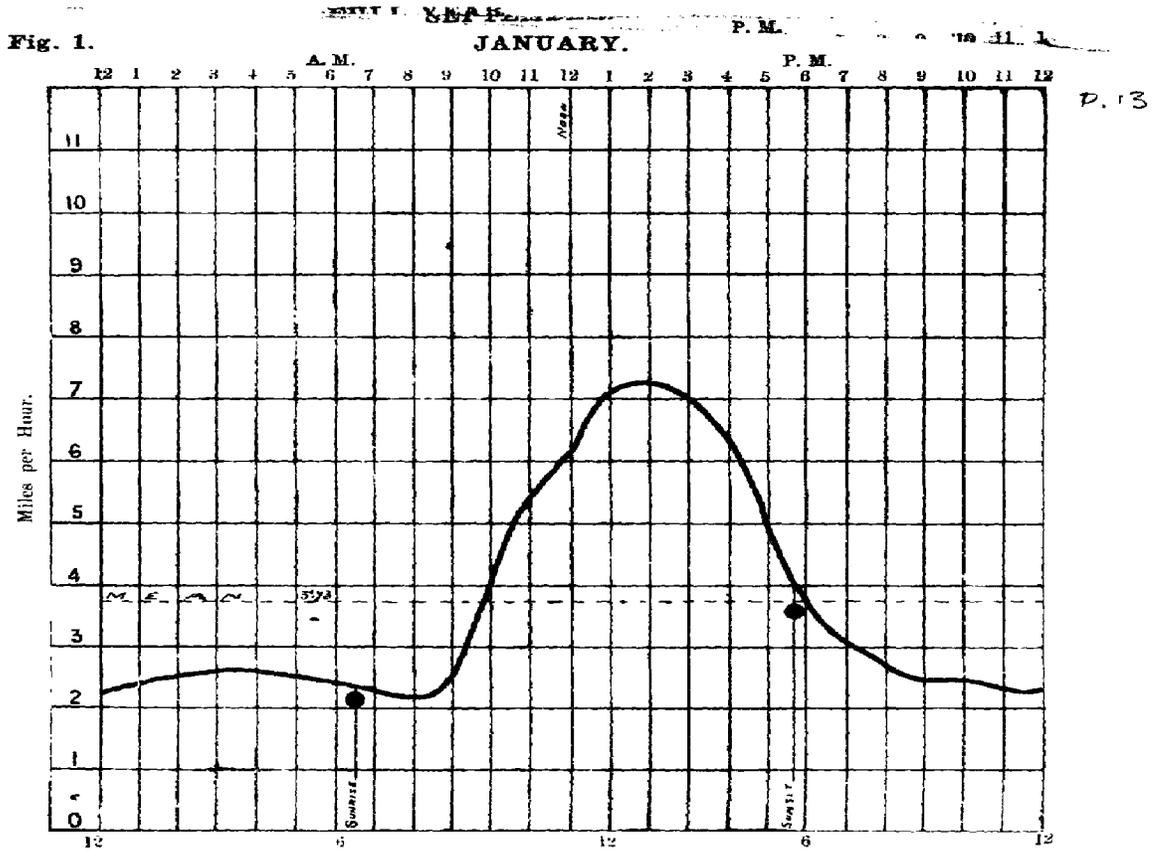
TABLE IX.—Dynamical effect of Wind.

Month.	Average Pressure in lbs. per square foot during each hour.												Average pressure for the 24 hours	Average horse-power per square foot.	
	12	1	2	3	4	5	6	7	8	9	10	11			12
January	.027	.030	.032	.034	.032	.030	.029	.024	.025	.027	.024	.028	.025	.085	.00028
February	.021	.024	.029	.028	.025	.023	.024	.024	.032	.030	.024	.024	.022	.017	.00051
March	.025	.028	.030	.030	.032	.035	.032	.029	.033	.034	.027	.027	.026	.026	.00063
April	.016	.016	.019	.019	.018	.017	.018	.017	.053	.034	.024	.024	.018	.013	.00045
May	.017	.017	.018	.020	.020	.024	.026	.031	.053	.035	.021	.021	.018	.014	.00051
June	.028	.030	.029	.031	.023	.033	.040	.061	.122	.256	.388	.278	.218	.031	.00060
July	.012	.013	.014	.016	.017	.020	.023	.023	.051	.143	.278	.427	.513	.011	.00072
August	.011	.012	.013	.017	.017	.015	.015	.015	.032	.097	.222	.346	.433	.011	.00049
September	.016	.012	.013	.013	.016	.018	.019	.021	.038	.107	.198	.285	.327	.011	.00036
October	.015	.015	.014	.013	.014	.016	.015	.015	.025	.073	.131	.168	.189	.013	.00016
November	.016	.014	.016	.019	.020	.021	.020	.015	.015	.037	.083	.117	.155	.019	.00013
December	.023	.026	.028	.028	.025	.022	.027	.024	.019	.038	.083	.115	.144	.024	.00014

* Means derived from H. P. for each hour. The mean H. P. for the whole year = .00044 per square ft.

TABLE X.—Northerly—Velocity in Miles per hour.

Date.	Miles per hour												Total Meaning for the day.												
	Midnight	1	2	3	4	5	6	7	8	9	10	11		Midnight											
1892 Nov. 12th	4.3	3.7	4.3	4.6	5.1	4.7	3.4	3.9	2.0	1.5	5.0	5.3	3.5	2.0	5.7	5.3	4.6	4.4	1.8	2.4	2.3	93.0			
" Dec. 29	5.2	6.8	6.3	7.0	8.5	8.2	8.8	13.5	11.3	12.2	11.5	12.5	13.0	12.0	9.5	9.3	6.7	4.0	3.0	3.7	2.0	6.5	186.5		
1893 Mar. 11	3.5	3.2	1.8	1.7	4.7	4.9	3.7	5.0	6.7	11.0	11.3	11.2	13.0	10.0	7.0	7.0	5.5	3.5	3.4	7.6	5.2	6.1	148.5		
" Mar 30	2.3	0.7	1.3	2.5	1.9	1.6	1.9	6.0	8.2	9.6	8.9	6.6	4.7	6.1	6.4	4.8	8.8	7.2	9.2	10.3	10.2	9.6	7.8	140.4	
1894 Dec 17	5.5	3.8	4.1	3.9	2.8	2.8	1.8	1.2	1.0	3.2	6.8	8.2	9.0	10.0	9.0	7.0	6.4	7.0	6.6	6.8	8.3	1.8	3.5	119.1	
" Dec 18	7.7	7.8	6.1	6.6	6.5	5.2	4.5	6.4	3.2	8.2	11.2	11.6	8.0	7.0	4.3	2.3	2.8	3.6	4.4	4.1	3.9	3.6	6.0	6.1	140.1
" Dec 19	8.3	5.8	5.6	3.7	3.4	4.5	3.9	3.7	4.5	7.3	8.2	11.1	7.9	6.3	6.6	6.7	5.9	6.7	8.8	6.8	4.1	3.6	3.2	146.1	
" Dec 29	4.2	6.0	7.3	6.4	10.4	11.4	12.6	13.2	17.1	16.0	15.5	17.0	14.1	16.4	14.0	12.0	10.8	9.0	7.8	5.6	4.0	4.5	8.6	244.8	
Means	5.1	4.7	4.6	4.5	5.4	5.4	5.1	6.6	6.7	8.6	9.8	10.3	9.1	8.7	7.7	6.8	6.5	5.6	6.1	6.5	4.4	4.0	4.0	152.2	



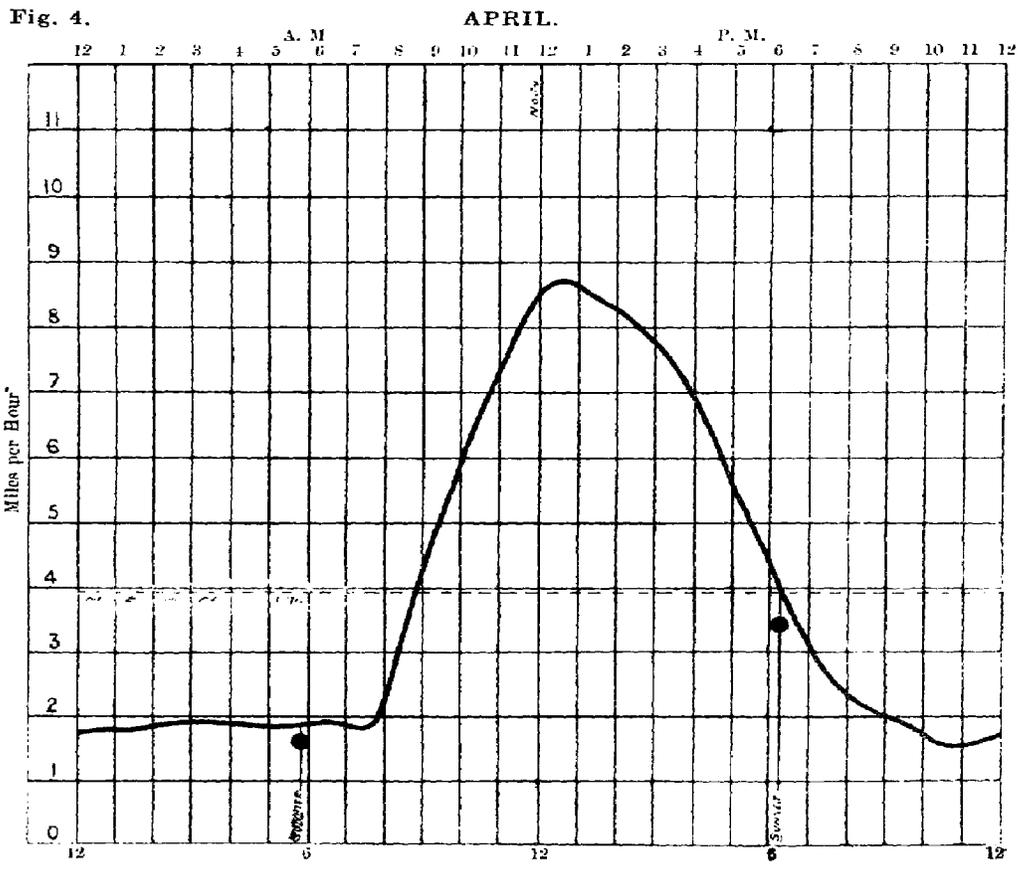
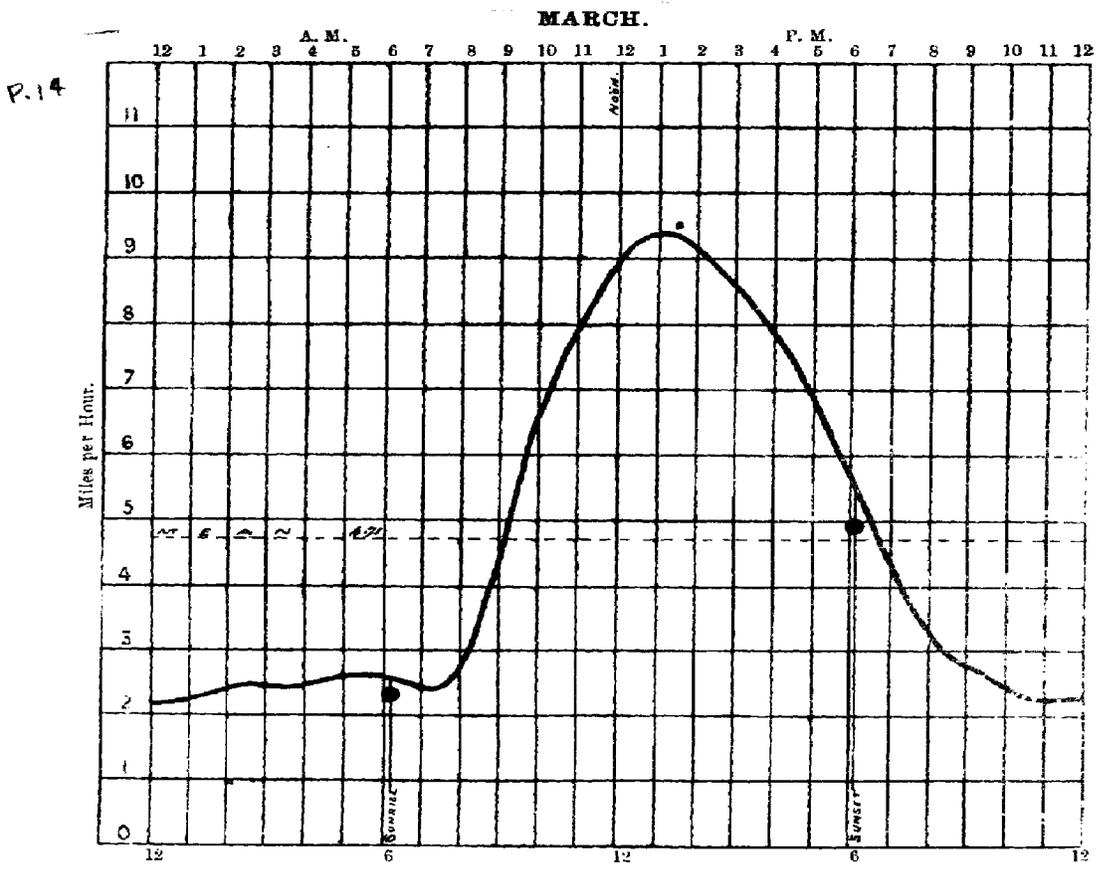
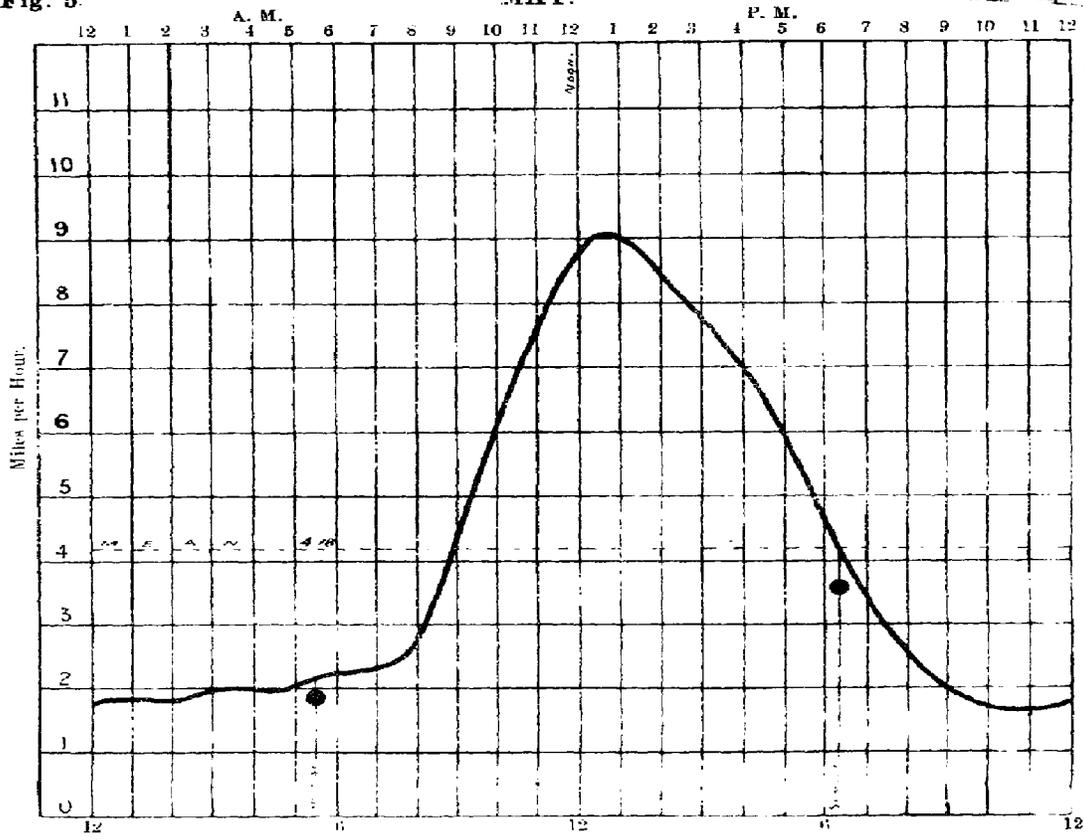


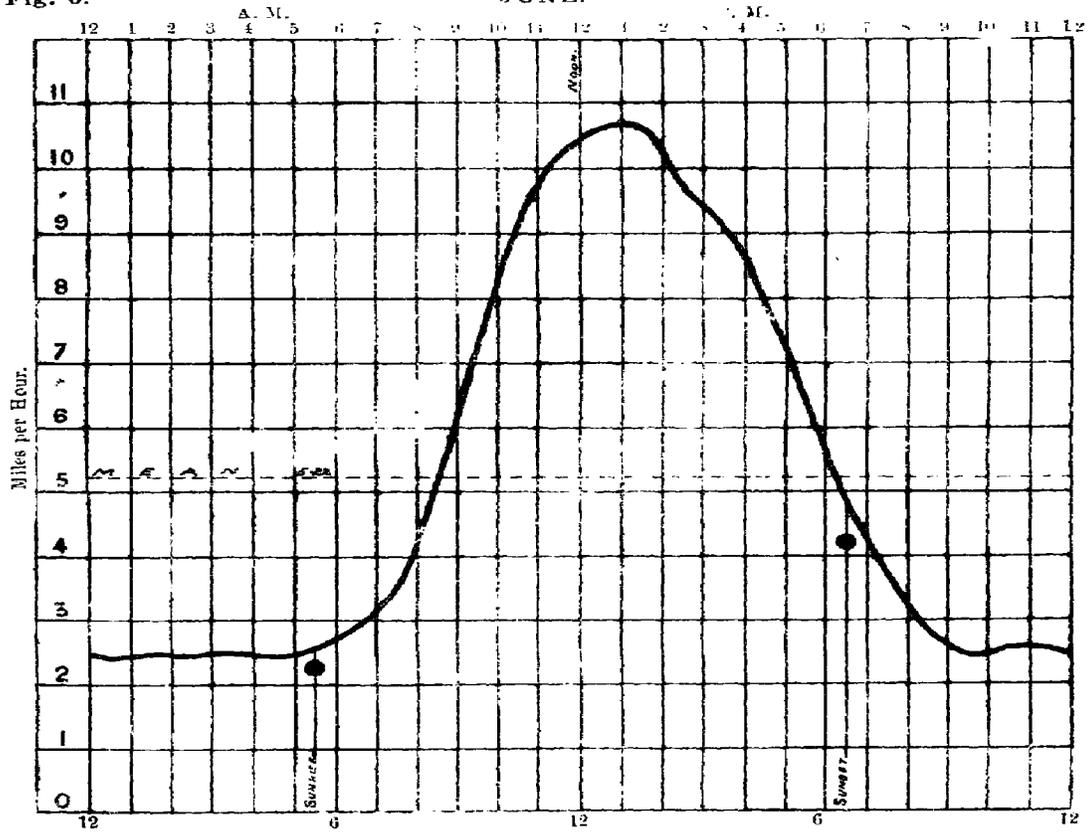
Fig. 4.

Fig. 5. ~~1911~~ YEAR. MAY. P. M. 10 11 12



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Fig. 6. JUNE. P. M.



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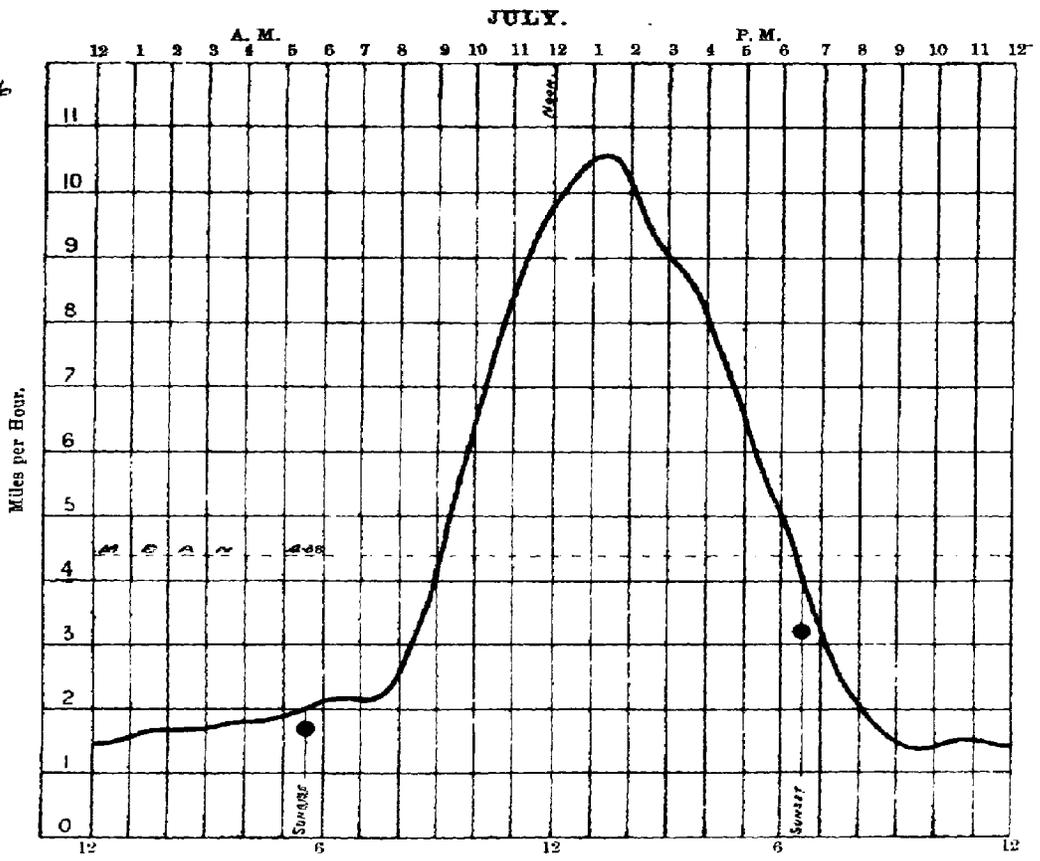


Fig. 8.

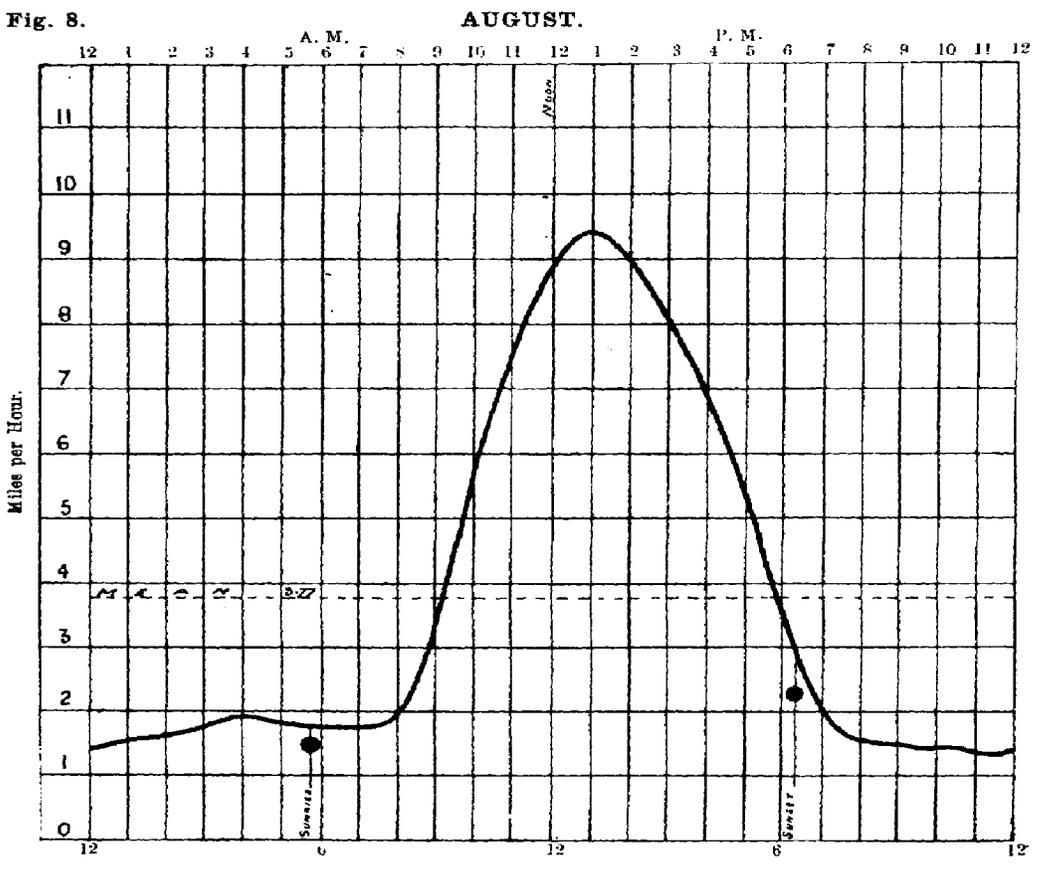


Fig. 9.

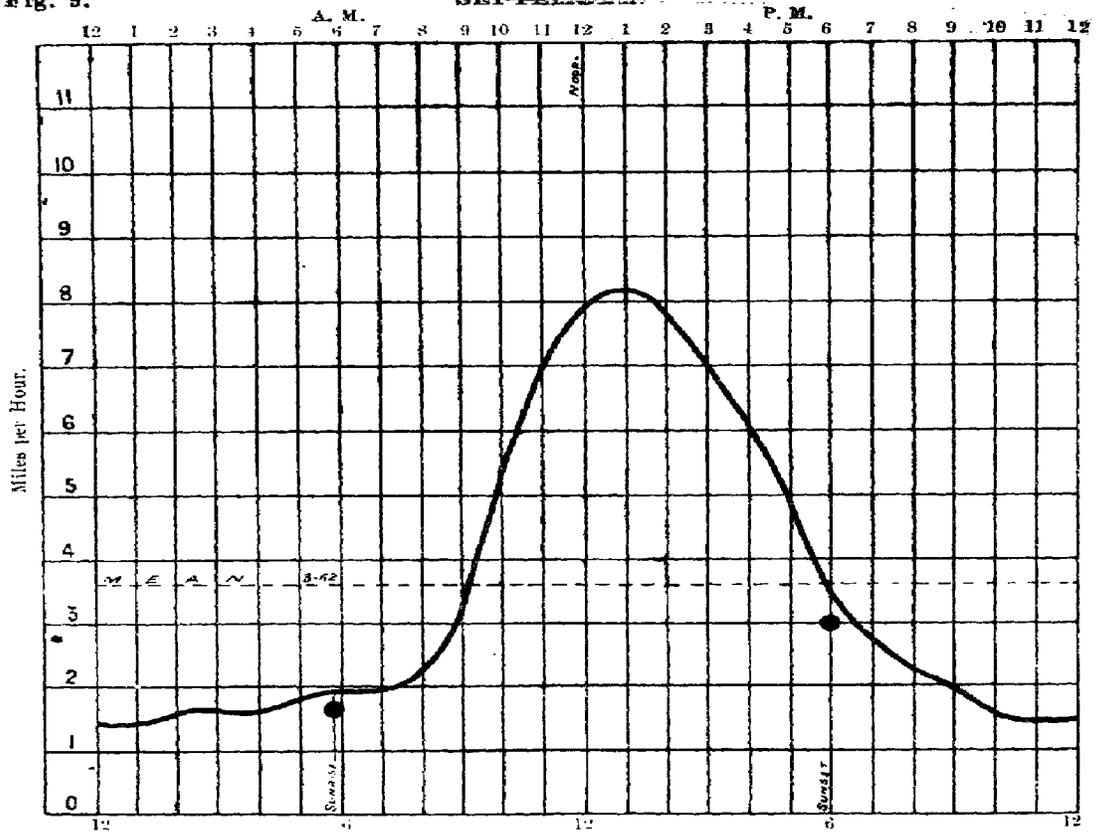
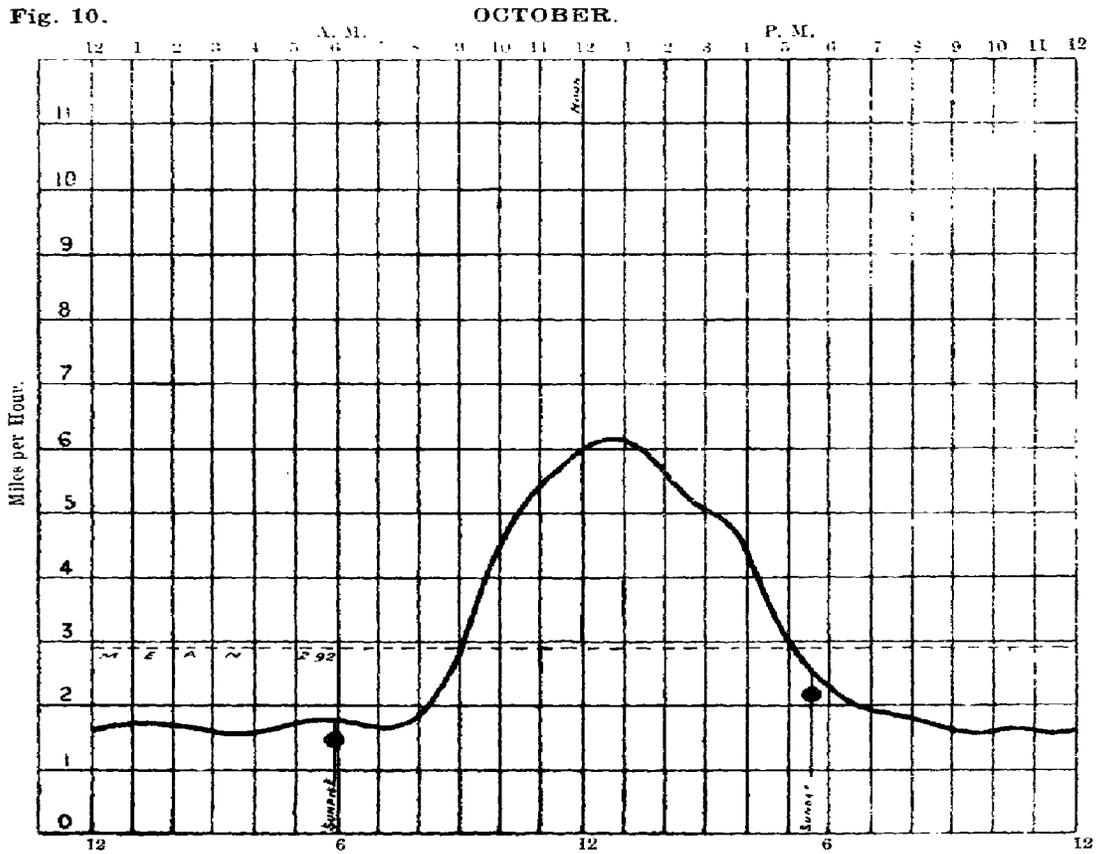


Fig. 10.



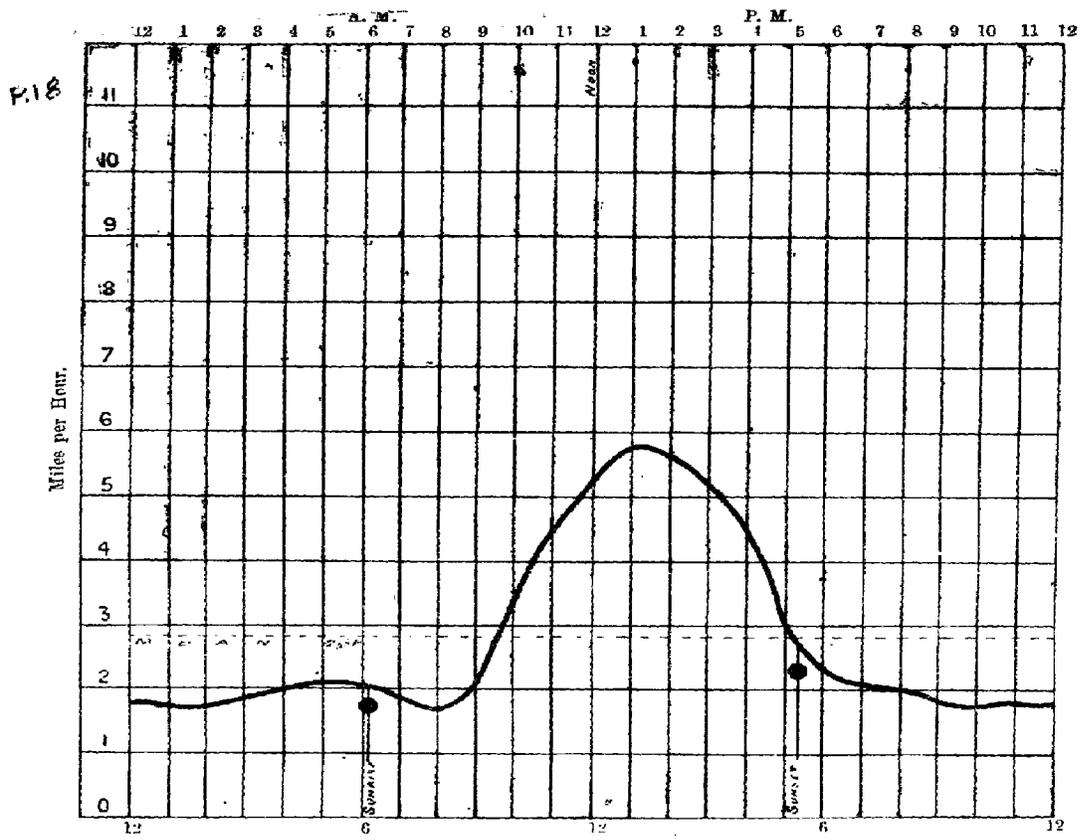


Fig. 12.

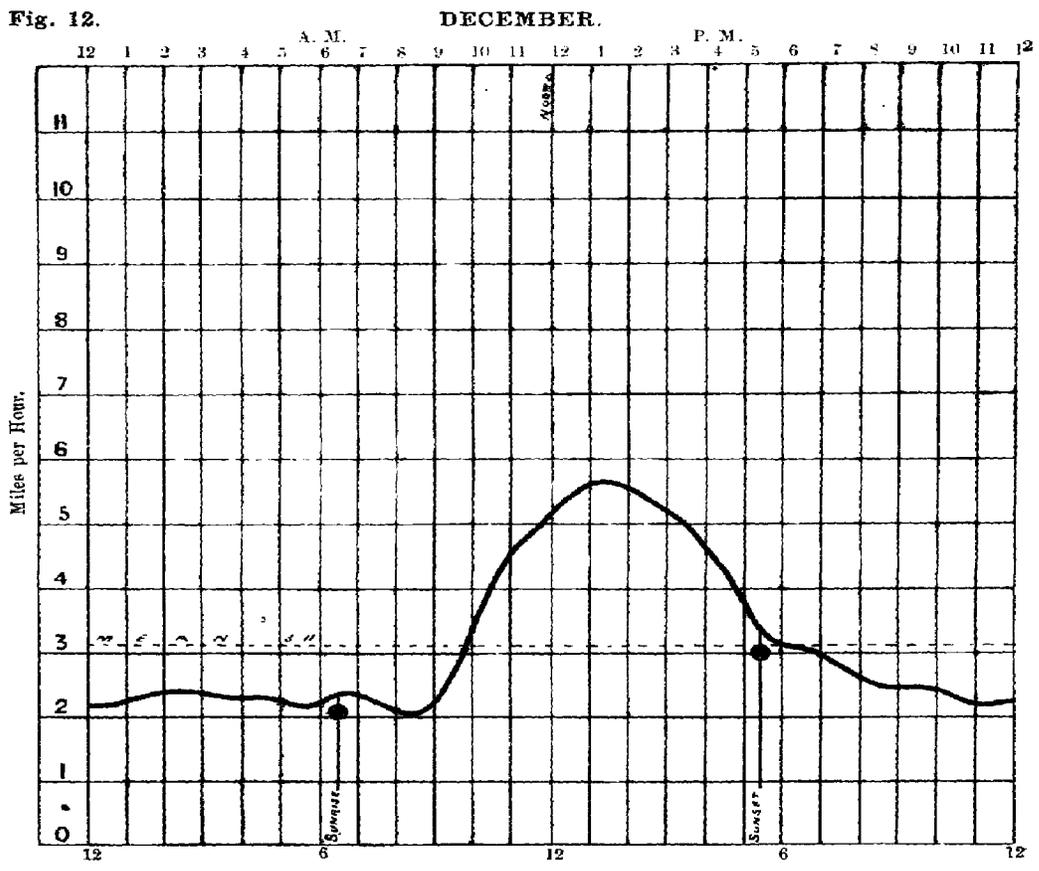


Fig. 13.

FULL YEAR.

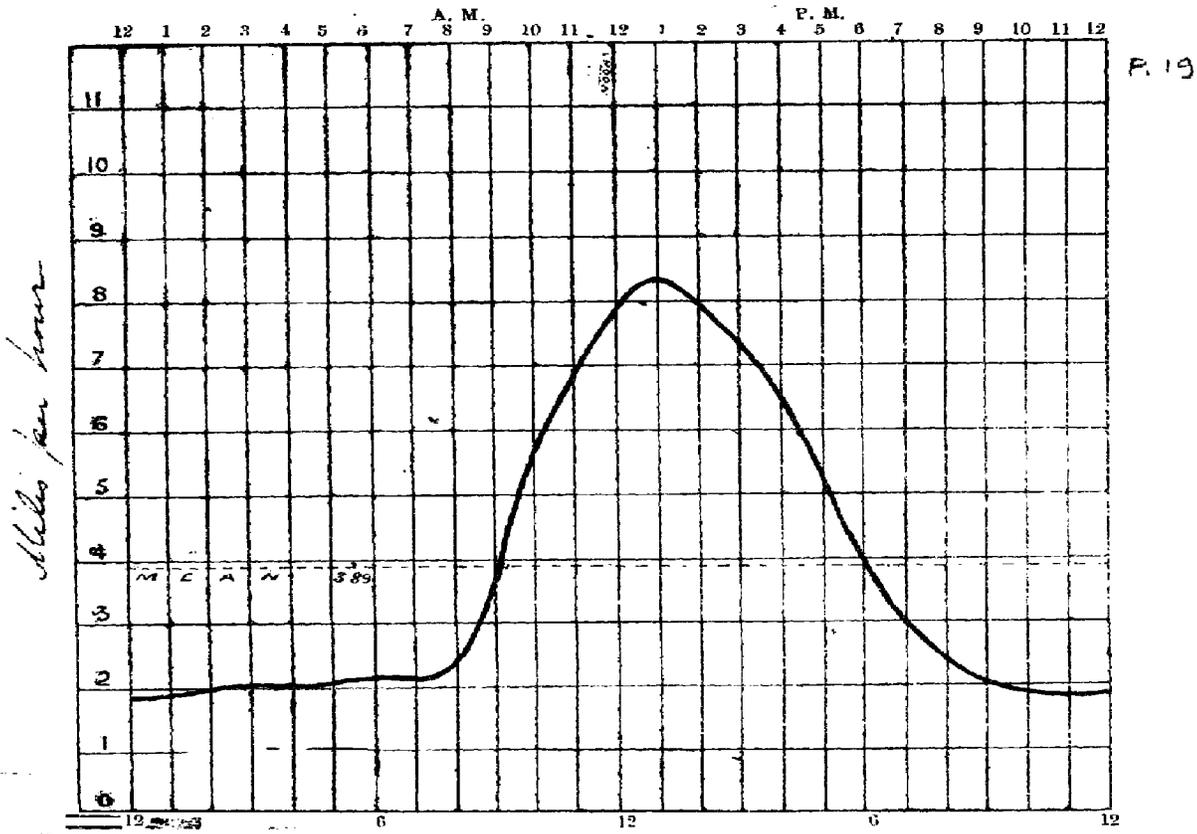


Fig. 14.—Mean Time of occurrence of the Maximum Velocity of the Wind, as compared with the Mean Time of apparent Noon.



A.B.—Time of Wind Maximum.
C.D.—Time of apparent Noon.