in 1896 there was plenty of rain and sunshine and the westward march was resumed; in 1900 Ellis County was the limit, but now the plowman has crossed the boundary of Colorado.

Mr. Curtis adds that there are many theories in regard to the increase of rainfall in Kansas. The popular impression is that the plowing of the ground increases the evaporation and therefore increases the precipitation, but as he very properly states there is nothing to prove that there has really been any increase of rainfall. The records cover too short a period and are neither accurate nor complete. The comparison of the records shows great variations but no increase, the greatest precipitation is in Greenwood County and the least at Dodge City in Ford County. In the extreme northwestern corner of the State, in Wallace County, the records for the past twelve years show some good rainy seasons and some dry years. We quite agree with the author when he says that:

"It is useless for anyone to assert that the cultivation of the soil has increased the rainfall."

On the other hand, there have been some remarkable changes; 25 years ago nothing would grow at Dodge City, where the soldiers at the military post tried in vain to make a garden. But the experiments were repeated from year to year, each time with better success, until now very fair crops are harvested. In 1867 old Fort Hays was the center of the Great American Desert, and to have imported a plow or a sickle would have been a matter of public ridicule. Now it is within the richest part of the grain belt. At Winona, within 40 miles of the border of Colorado, it was supposed that nothing but buffalo grass would grow, but within five or ten years dry farms have been cultivated and profitable crops harvested, and now several train loads of wheat are shipped annually. In fact, there is very little land left in Kansas that has not been taken up by farmers.

There can be no doubt but that the successful settlement and agriculture of Kansas are due primarily to the natural necessity that is imposed upon intelligent man of learning how to overcome the difficulties of his situation. It is not the increase of rainfall or the change in climate that has made Kansas habitable any more than it is the diminution of rainfall that has made Syria a desert. In the one case intelligent man has conquered the desert, in the other case ignorant men and oppressive rulers have allowed the desert climate to conquer them. As a rule, even without artificial irrigation, a good crop plant, such as wheat or maize, suitable to desert conditions can be evolved by a proper system of selection; when irrigation comes in to help, the sunny desert becomes a more profitable garden field than the moist climate of the seashore or the Tropics. As a rule, grain crops require plenty of sunshine, a soil of the right physical properties, and a very careful, systematic application of water. Formerly, the ideal wheat fields were in Egypt, with abundance of sunshine, a fine soil for retaining the water, and a periodic inundation and irrigation, regulated by the river Nile. Almost the same conditions prevail throughout the basins of the Mississippi, Missouri, Saskatchewan, and Mackenzie. The fertility of this great region is a matter that depends wholly on human industry, and not on any change of climate.

EXPLORATIONS OF THE UPPER ATMOSPHERE BY THE BLUE HILL OBSERVATORY.

Referring to the Monthly Weather Review for November, 1904, page 521, and May, 1905, page 209, we find some additional interesting information in Science for July 14, 1905, from which we quote the following:

During the months of January, February, and March, 1905, nine more ascents were made at St. Louis; every balloon but one was found and, with the attached instrument, was returned to Blue Hill in accordance with the instructions on each. Like the previous balloons all of these fell within the eastern half of a circle having its center at St. Louis and a radius of 285 miles.

On January 25, when a high barometric pressure prevailed at the ground, a temperature of -111° F. (-80° C.) was recorded at a height of 48,700 feet, this being one of the lowest natural temperatures ever observed. The experiments last winter were conducted by Mr. Clayton, under the direction of Mr. Rotch, and their success induced Professor Langley, Secretary of the Smithsonian Institution, to grant Mr. Rotch $1000 from the Hodgkins Fund, in order to continue the experiments this summer at St. Louis. These, like the first, will be conducted by Mr. Fergusson, of the Blue Hill Observatory staff. Soundings of the atmosphere made at different seasons should reveal the annual variation of temperature at great heights above the American Continent, which is at present unknown.

The above-mentioned low temperature is lower than any that has hitherto been recorded in the highest balloon ascensions in Europe up to altitudes far greater than were attained in America, and emphasizes the fact that when balloon work is carried on as extensively as it ought to be by American meteorologists the conditions over our interior valley will be found to be extreme in the highest degree.

The lesson to be learned from this observation is the fact that in an area of high pressure with very cold air at the surface of the ground we also have very cold air at great altitudes and yet that same upper air at the altitude of 48,700 feet when brought down to the surface of the ground ought by compression to attain a temperature of considerably above 100° F. The difference between this high temperature and the one actually observed at the surface of the ground on January 25 (which, according to the daily weather map, was 20° F. as a minimum on January 25, and 12° F. as a minimum on January 26) must be accounted for almost wholly by the radiation of heat from the air in course of its slow descent from a height of 48,700 feet to the ground. This slow descent of air, giving time for the cooling effect, cooperates with a slow horizontal movement of the still colder air from the north. The air within our areas of high pressure must have a general slow descending motion from the north southward correlated with an ascent of warm, moist air from the surface as has so often been explained in the Monthly Weather Review.

The inversion of temperature which is a widespread and almost normal phenomenon somewhere between the altitudes of 5000 and 30,000 feet must, we think, be attributed to the fact that some layer of cloud having dropped its rain and having also intercepted the sunlight has for both these reasons acquired an extra quantity of heat that can only be slowly lost by radiation.

AN OLD REFERENCE TO THE KITE IN METEOROLOGY.

Speaking of the winds Louis Cotte[1] says:

Even the children have made the wind contribute to their amusement, since it is by means of the mechanism similar to that of the sails of a wind-mill that they have found out how to force it to raise up a species of frame work covered with paper which they call *Cervolans*. The cord with which they hold this framework is always attached to it in such a way that the plane of the framework presents itself obliquely to the direction of the wind, and thus the impulse of the air tends continually to make it rise by describing the arc of a circle which has for its radius the twine which they hold in their hands.[2]

WINDS AND WAVES.

A wave progressing over deep water does not travel alone; waves always occur in groups. The center of the group is the largest or principal wave. It is preceded and followed by a series of gradually diminishing waves. The smaller waves advance more slowly than do the larger ones. The central, biggest wave is continually overtaking and swallowing up smaller waves in front of it while at the same time starting

[1] L. Cotte, Traite de la Meteorologie, Paris, 1774. Page 304.

[2] Essais de Physique de Musschenbroek, tome II, page 912.

Lecons de Physique de M. L'Abbé Nollet, tome III, page 500.

new ones far in front of them; it is also running ahead of the small waves behind it and leaving them to die away. The average velocity of the whole group of waves is therefore smaller than the velocity of the central or principal wave. This is true of gravity waves on the surface of the water no matter whether they start by a sudden impulse as an ocean earthquake wave or are maintained by the wind as an ordinary storm wave. The ordinary earthquake wave is not a gravity wave but one of compression and dilatation, or an elastic wave passing through a medium that is not homogeneous but has in general three axes of elasticity, and therefore behaves in a manner analogous to the action of many crystals on a beam of light.

With regard to the storm waves, a committee of the British Association for the Advancement of Science, of which Dr. Vaughn Cornish is secretary, publishes the following paragraph, on page 313 of the report for 1903:

ON THE SIZE OF WAVES AS RELATED TO THE RATE OF ADVANCE OF A CYCLONE.

The greatest waves will be developed in that part of the cyclone in which the direction of the wind coincides with the direction of advance of the cyclone, and I wish to call attention to the fact that, along this line of action, of all the waves which the velocity of the wind is capable of increasing, that length will enjoy superior opportunities for growth *whose group velocity is equal to the rate of advance of the cyclone*, the storm either outrunning or lagging behind the transmission of energy in waves of any other length. The velocity of the group in deep water is half the velocity of the individual waves.

It was pointed out in the last report that the period of the longest recorded swells corresponds to a wave velocity about equal to that of the greatest recorded hourly velocity of the wind (the velocity of the dominant wave in storms being much lower).

It may be added that no records of swells have been met with having periods approaching those appropriate to a deep sea velocity equal to that attained during the gusts of a storm.

Mathematical investigations have pointed to a tendency of the wind finally to produce steep waves of velocity equal, or almost equal, to that of the wind. When, however, we come to compare the observed velocities of wind, the observed dimensions of cyclonic storms, and the lengths of waves of velocity equal, or nearly equal, to that of the strongest winds, we find that we rapidly approach a condition of things when the stretch of water subject at any one time to such wind is only a small multiple of the wave length; a condition in which steep waves could not be maintained.

DIURNAL VARIATION OF ATMOSPHERIC HUMIDITY.

It is so rare that observers have the patience to make frequent observations of dew-point, relative humidity, or vapor tension, and it is so difficult to maintain correct self-registering apparatus for this important fundamental datum, that our knowledge of the diurnal variation of atmospheric vapor is far less satisfactory than our knowledge of the variations of pressure and temperature. We may therefore call attention to two series of observations, the results of which are published in the Annuaire of the Meteorological Society of France for April and May, 1905. The first series is that made by Dechevrens on the island of Jersey, where the diurnal variation apparently differs decidedly from that observed at most other maritime or littoral stations. With reference to this series Angot says that at Paris the vapor tension has in January only a single diurnal maximum and minimum, while in July it has a double diurnal oscillation, and he adds that this double diurnal oscillation in the summer time belongs to relatively low stations, where the diurnal variation of temperature is quite large; but at sea and in the neighborhood of coasts and on the summits of mountains we find at all seasons of the year only a single oscillation like that of the winter season at Paris, having only a single minimum and a single maximum. Dechevrens states that the island of Jersey is an exception to this rule at all seasons of the year. Eight observations daily of the tension of aqueous vapor made during the two months January and July, during the ten years 1894–1903, gave him the following values of the hourly departures from the general average of the respective months, which were 5.667 for January and 11.004 for July.

TABLE 1.—*Diurnal periodicity of vapor pressure at Jersey.*

Hour.	January.	July.	Hour.	January.	July.
	mm.	*mm.*		*mm.*	*mm.*
Midnight	+0.027	+0.068	Noon	−0.002	+0.006
1 a. m	+0.018	−0.014	1 p. m	−0.020	−0.026
2 a. m	+0.005	−0.069	2 p. m	−0.007	−0.094
3 a. m	+0.004	−0.121	3 p. m	+0.014	−0.145
4 a. m	−0.012	−0.105	4 p. m	+0.035	−0.169
5 a. m	−0.028	−0.049	5 p. m	+0.023	−0.149
6 a. m	−0.039	+0.062	6 p. m	+0.003	−0.072
7 a. m	−0.037	+0.116	7 p. m	−0.023	+0.008
8 a. m	−0.014	+0.139	8 p. m	−0.023	+0.061
9 a. m	+0.010	+0.104	9 p. m	−0.009	+0.100
10 a. m	+0.028	+0.061	10 p. m	+0.014	+0.118
11 a. m	+0.019	+0.053	11 p. m	+0.026	+0.118

In the Annuaire for May, 1905, M. Th. Moureaux gives a summary of the observations of atmospheric moisture at the observatory at Parc St. Maur during the 30 years, 1874–1903. From his tables we quote the following general results as to the secular variations and the annual and diurnal periodicities :

TABLE 2.—*Annual mean values of atmospheric moisture at Parc St. Maur.*

Year.	Relative humidity.	Vapor pressure.	Year.	Relative humidity.	Vapor pressure.
	Per cent.	*mm.*		*Per cent.*	*mm.*
1874	78.1	7.49	1890	78.7	7.31
1875	79.3	7.72	1891	79.1	7.41
1876	78.8	7.75	1892	76.2	7.26
1877	80.8	7.85	1893	74.4	7.38
1878	82.3	7.96	1894	77.9	7.60
1879	84.2	7.47	1895	77.1	7.42
1880	78.6	7.76	1896	78.3	7.31
1881	78.7	7.37	1897	80.0	7.96
1882	81.2	7.69	1898	79.8	7.88
1883	79.2	7.46	1899	74.8	7.49
1884	79.1	7.70	1900	75.6	7.63
1885	77.2	7.13	1901	75.8	7.22
1886	79.4	7.86	1902	78.8	7.44
1887	78.8	6.97	1903	77.9	7.52
1888	80.7	7.26			
1889	79.9	7.47	Mean	78.7	7.53

TABLE 3.—*Normal annual periodicity of moisture at Parc St. Maur.*

Month.	Relative humidity.	Vapor pressure.	Month.	Relative humidity.	Vapor pressure.
	Per cent.	*mm.*		*Per cent.*	*mm.*
January	87.2	4.90	August	74.3	10.97
February	82.7	5.07	September	80.5	10.04
March	74.8	5.30	October	85.2	7.83
April	69.1	6.11	November	86.8	6.32
May	69.9	7.64	December	88.6	5.12
June	72.7	10.03			
July	72.5	10.97	Year	78.7	7.53

TABLE 4.—*Diurnal periodicity of moisture as shown by the average departures from the annual mean at Parc St. Maur.*

Hour.	Relative humidity.	Vapor pressure.	Hour.	Relative humidity.	Vapor pressure.
	Per cent.	*mm.*		*Per cent.*	*mm.*
1 a. m	+10.0	− 0.06	1 p. m	−15.0	+ 0.02
2 a. m	+11.0	− 0.12	2 p. m	−16.0	− 0.02
3 a. m	+11.8	− 0.19	3 p. m	−15.7	− 0.06
4 a. m	+12.5	− 0.26	4 p. m	−14.0	− 0.04
5 a. m	+12.6	− 0.28	5 p. m	−10.9	0.00
6 a. m	+11.3	− 0.22	6 p. m	− 6.9	+ 0.09
7 a. m	+ 8.6	− 0.09	7 p. m	− 2.5	+ 0.19
8 a. m	+ 4.5	+ 0.04	8 p. m	+ 1.1	+ 0.20
9 a. m	− 9.5	+ 0.13	9 p. m	+ 3.7	+ 0.17
10 a. m	− 5.4	+ 0.15	10 p. m	+ 5.8	+ 0.11
11 a. m	− 9.5	+ 0.11	11 p. m	+ 7.4	+ 0.06
Noon	−12.8	+ 0.06	Midnight	+ 8.9	0.00

In addition to the elaborate tables, of which we have given only the monthly means, Moureaux gives some very interesting data relative to the extreme values. Thus the relative humidity was as low as 8 per cent on the 27th of March, 1899; 10 per cent on March 30, 1893; 11 per cent on April 1, 1892, April 24, 1893, April 2, 1894, and April 14, 1898; 12 per cent on August 18, 1892, February 26 and 27, 1899, and April 21, 1901.