The maximum depletion indicated under these conditions is 60,000,000,000 gallons.

Actual gagings of the four Catskill streams under consideration have been made by the United States Geological Survey more or less continually since 1901. The results of these gagings are set forth in the various water supply and irrigation papers published by the survey. Unfortunately, no rainfall observations were made contemporaneously with these gagings. A careful examination of practically all of the gagings made by the Geological Survey in New York, New Jersey, Pennsylvania, and New England since 1902 has caused us to use them as a general guide only.

CONCLUSIONS.

Our studies, therefore, lead us to the belief that the most probable mean annual rainfalls on the Catskill watersheds are as follows: Esopus, 44 inches; Schoharie, 41 inches; Rondout, 48 inches; Catskill, 38 inches.

## VARIATION OF PRECIPITATION IN THE ADIRONDACK REGION.

By ALFRED J. HENRY, Professor of Meteorology. Dated April 17, 1907.

Mr. R. E. Horton, C. E., has worked out very clearly the relative distribution of precipitation in the Adirondack region for the five years, 1901-1905. The chart which accompanies Mr. Horton's article[1] shows a region of maximum precipitation (55 inches and upward) on the southwestern slope of the Adirondacks, particularly on the foothills in Lewis, Oneida, and Herkimer counties.

The writer was recently engaged on a study of the average annual precipitation over the watershed of Lake Ontario, which includes a portion of the area considered by Mr. Horton. The epoch used in this work was 1871–1906, altho the record at a number of the observing stations covered a much longer time. It is possible, therefore, to compare the mean values for the lustrum 1901–1905 with those of the much longer epoch, 1871–1906. Accordingly there will be found in the table below a statement showing the average annual precipitation for a few stations in the Adirondack region and contiguous territory for both the long and the short periods.

*Comparative averages of precipitation.*

| Stations. | Length of record. | Whole period, 1871–1906. | Five years, 1901–05. | Departure. |
|---|---|---|---|---|
| | *Years.* | *Inches.* | *Inches.* | *Inches.* |
| Oswego | 54 | 37.4 | 40.0 | +2.6 |
| Lowville | 40 | 36.3 | 44.3 | +8.0 |
| Utica | 40 | 41.7 | 50.7 | +9.0 |
| Cooperstown | 53 | 39.9 | 45.3 | +5.4 |
| Keene Valley | 15 | 35.6 | 40.7 | +5.1 |

It is clearly apparent from the above table that the lustrum 1901–1905 was one of heavy precipitation in the Adirondacks; the greatest departure, about 22 per cent of the mean annual fall, occurred near the center of the region of maximum precipitation hereinbefore mentioned. The writer has found elsewhere[2] that the extreme variation in the interior of this continent for a 10-year period is as high as 20 per cent. The variation for a 5-year period in this country has not been determined; in Germany, however, Dr. G. Hellmann[3] has found that the average maximum variation of a 5-year period for 14 stations in North Germany is 116 per cent, and for a 10-year period 109 per cent. The maximum variation for a single station for a 5-year period was 128 per cent, or 6 per cent greater than for the two stations in the Adirondack region, but the majority of the German stations showed a smaller variation. What little work has been done on this subject in the United States tends to show that the variation of the precipitation, especially in the interior, is greater than in England or Germany.

[1] Monthly Weather Review, January, 1907, Vol. XXXV, pp. 8-11.
[2] Weather Bureau Bulletin D, p. 9.
[3] Die Niederschläge in den norddeutschen Stromgebieten.

In conclusion it is proper to call attention to the fact that the chart of rainfall distribution compiled by Mr. Horton probably represents very closely the maximum amount of rain that may be expected for a 5-year period in the region under consideration. Readers of the REVIEW should be careful, however, not to be misled by supposing that the chart purports to give the average or normal values for the Adirondack region, such as would result from a century of observations.

## THE TEMPERATURE IN THE FRONT AND IN THE REAR OF ANTICYCLONES, UP TO AN ALTITUDE OF 12 KILOMETERS, COMPARED WITH THE TEMPERATURE IN THE CENTRAL AREA.

By HENRY HELM CLAYTON. Dated Blue Hill Observatory, Hyde Park, Mass., March 5, 1907.

Within the two years between the summer of 1904 and that of 1906, a series of observations with *ballons-sondes* were obtained at St. Louis, Mo., under the direction of Prof. A. Lawrence Rotch, by Mr. S. P. Fergusson and myself. These small balloons carried light instruments recording temperature and pressure, and occasionally reached heights of 17 kilometers or about 11 miles. These are the only data of this kind gathered in America up to the present time, and are of much interest and value in their bearing on the problems of the upper air. One of the problems of great interest is that of the distribution of temperature in cyclones and anticyclones. In a discussion of these observations published by me in the Beiträge zur Physik der freien Atmosphäre, Band II, Heft 2, 1906, the lowest temperatures (at the earth's surface) in the anticyclones were found in the central and southeastern portions, but this distribution was so changed at the height of 8 kilometers that the lowest temperature was found in the northern quadrant of the anticyclone. The reverse of this statement is true in regard to the cyclone in which the highest temperature was found in the eastern quadrant at the ground, but in the northern quadrant at the height of 8 kilometers. This matter is one of importance in studying the mechanism of these meteors and I give in the accompanying Table 1 some of the results in the individual cases where anticyclones past centrally over the region surrounding St. Louis. In this table the temperature at any height on the day in which the maximum pressure occurred at St. Louis is taken as the standard for that height and the departures from this of the temperatures at the same heights for the day preceding and the day following are given in so far as the observations permit. In each case the observations were obtained in the evening within an hour or two of 7 p. m. The tracks of the centers of maximum pressure are given on an accompanying chart, fig. 1. On this chart a circle of 300 miles radius (about 500 kilometers) is drawn around St. Louis, and it may be seen that all the given dates of maximum pressure at St. Louis are found within this area, while the dates of the preceding and following days are found outside the circle. In every case, except that of July 24 and 25, 1905, the general direction of motion was from northwest to southeast, so that observations on the day preceding were in the southeastern half of the anticyclone and on the day following in the northwestern half. The amounts in the table showing how much the temperatures in the front and in the rear of the anticyclone differed from those in the central area are plotted graphically in the accompanying diagram, fig. 2, which shows that in general it is colder in front of the anticyclone than in the central area, up to about 8 kilometers, above which altitude it becomes warmer. Of the two cases where the temperature in the rear was compared with that in the central area, in one case, January 26, 1905, it was warmer in the rear up to about 6 kilometers, and in the other case, May 10, 1906, it was warmer in the rear up to about 10 kilometers. Above these heights the rear was colder than the central area. The most instructive case is that of May 8 to

TABLE 1.—*Temperatures at successive altitudes within anticyclones; (a) temperatures on the day of maximum pressure at St. Louis, Mo.; (b) the departures from these temperatures for the preceding day; and (c) the departures for the following day.*

| Number. | Date. | Pressure at 7 p. m. | Temperatures at altitudes above the earth's surface. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0 km. | 1 km. | 2 km. | 3 km. | 4 km. | 5 km. | 6 km. | 7 km. | 8 km. | 9 km. | 10 km. | 11 km. |
| | 1904. | mm. | ° C. | ° C. | ° C. | ° C. | ° C. | ° C. | ° C. | ° C. | ° C. | ° C. | ° C. | ° C. |
| I—(a) | November 26 | 772.7 | 5.3 | ..... | ..... | — 2.9 | — 8.9 | —17.3 | —24.7 | —31.8 | —39.7 | —47.3 | —52.8 | —52.8 |
| I—(b) | November 25 | 770.4 | + 0.8 | ..... | ..... | ..... | ..... | — 5.3 | — 4.7 | — 4.5 | — 1.7 | + 0.8 | + 5.5 | ..... |
| I—(c) | | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| | 1905. | | | | | | | | | | | | | |
| II—(a) | January 25 | 784.6 | —11.1 | —12.7 | —17.9 | —18.7 | —22.5 | —29.8 | —32.3 | —40.6 | —50.1 | —54.8 | —54.0 | ..... |
| II—(b) | January 24 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| II—(c) | January 26 | 776.2 | + 7.5 | + 6.0 | +10.1 | + 8.1 | + 5.9 | + 4.8 | — 2.6 | — 5.1 | — 6.7 | ..... | ..... | ..... |
| | 1905. | | | | | | | | | | | | | |
| III—(a) | July 24–25 | 765.2 | 24.4 | 17.5 | 9.1 | 6.9 | 2.3 | — 2.7 | — 8.1 | —16.0 | —24.1 | —32.8 | —42.5 | ..... |
| III—(b) | July 23 | 763.0 | + 0.6 | — 0.3 | + 1.2 | — 2.6 | — 1.0 | — 0.6 | — 2.2 | — 2.3 | — 1.7 | + 0.2 | ..... | ..... |
| III—(c) | July 26 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| | 1906. | | | | | | | | | | | | | |
| IV—(a) | May 9 | 769.0 | 15.0 | 10.5 | 1.2 | — 6.8 | —10.5 | —14.6 | —21.1 | —29.3 | —39.1 | —49.3 | —53.2 | —53.2 |
| IV—(b) | May 8 | 769.8 | — 4.8 | — 8.1 | — 6.3 | — 3.2 | — 7.1 | — 6.0 | — 2.0 | — 0.7 | — 0.3 | + 2.9 | + 5.7 | + 6.3* |
| IV—(c) | May 10 | 765.3 | + 5.0 | + 3.8 | + 6.8 | + 9.3 | + 4.7 | + 1.0 | + 2.3 | + 3.0 | + 3.7 | + 7.1 | + 1.8 | — 5.8 |

* Extrapolated; the temperature difference at 10.5 kilometers is +6.1°.

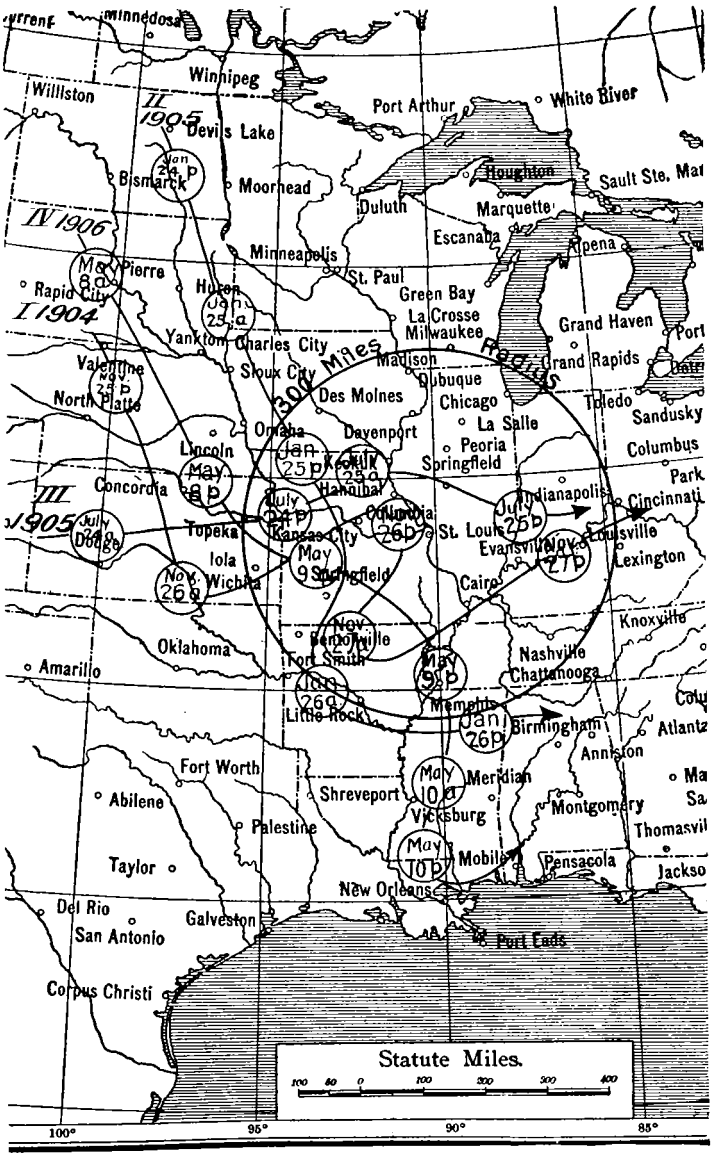


FIG. 1.—Tracks of centers of anticyclones passing near St. Louis at times of flights of *ballons-sondes* from that city.

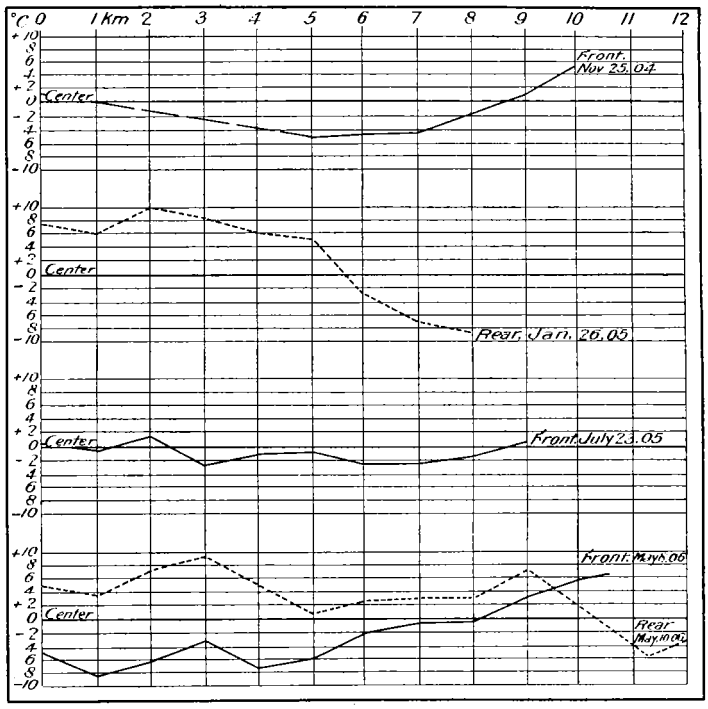


FIG. 2.—Departures of temperatures in front and rear of anticyclones from the temperatures at the same altitudes in the central area.

10, when observations were obtained on three successive days, namely, when St. Louis was respectively in the front of the central area, within the central area, and in the rear of the central area of the anticyclone. The diagram, fig. 2, shows that, up to about 8 kilometers altitude, the temperature was lower in front and higher in the rear than it was in the central area; between 8 and 10 kilometers the central area was colder than either the front or the rear; while above 10 kilometers the lowest temperature was in the rear of the anticyclone and the highest in front, this condition being the reverse of that near the earth's surface.

The explanation of these facts which suggests itself to me is that the cold air in the northern part of the anticyclone is moving more rapidly than the anticyclone toward the southeast and, on account of its greater specific weight compared with the surrounding air, sinks toward the earth's surface, the center of the anticyclone being about midway between the northwestern and southeastern limits of the inclined stratum of cold air. The circulation of air around a central area is confined to a stratum within about 2 kilometers of the earth's surface.

In the second diagram, fig. 3, are shown the movements of

the air at different heights both in anticyclones and cyclones, as derived from the observations of cloud movements at the Blue Hill Observatory. This is reproduced from the Beiträge zur Physik der freien Atmosphäre, Band II, Heft 2, 1906, being

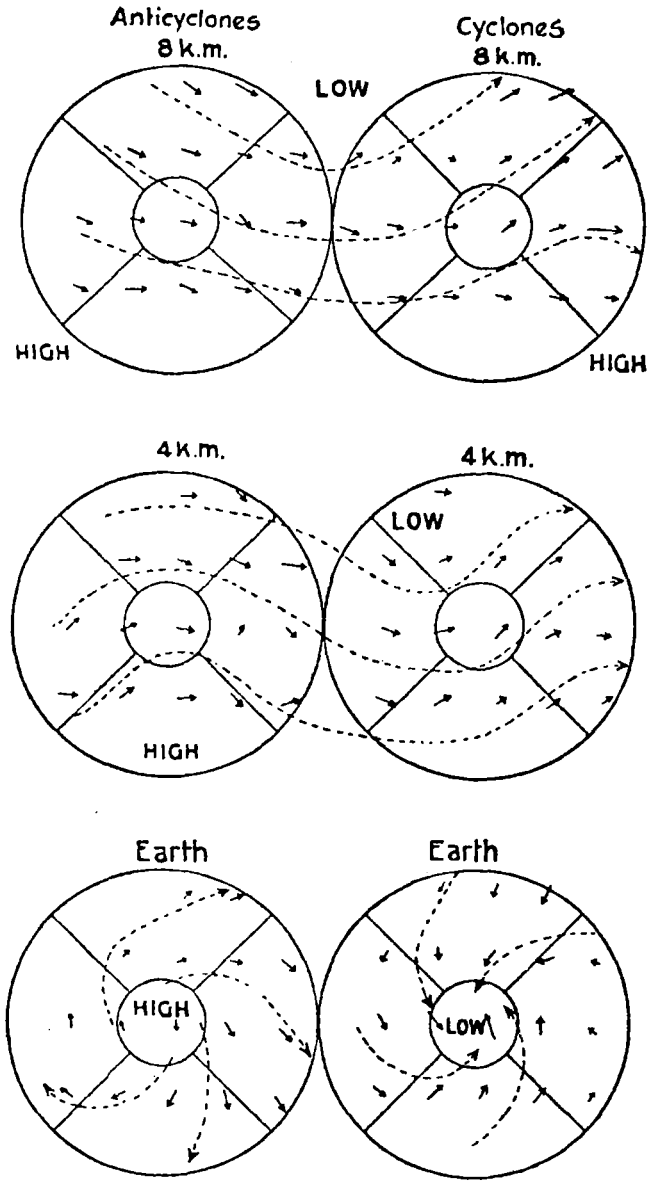


FIG. 3.—Movement of the air at different heights in anticyclones and cyclones.

slightly modified from the original diagram published in the Annals of the Astronomical Observatory of Harvard College, Vol. XXX, Part iv, 1896.

## BRIGHT METEORS.

Many observers and correspondents of the Weather Bureau have been in the habit of sending us observations of bright meteors, but the observations have not been utilized as completely as is desirable.

The special interest meteors have for the meteorologist consists in the fact that their visibility, due to the heat generated as they pass thru the atmosphere, demonstrates the existence of gases at great heights about which we otherwise have no information whatever; and it has always been hoped that the visible paths of meteors and the behavior of the trains that are often left behind them may tell us much about the upper atmosphere.

We are happy to state that, by permission of Prof. Henry A. Peck, the astronomer at the University of Syracuse, all good observations of meteors received by us will hereafter be forwarded to him, who will make the necessary computations and tell us whatever may be learned relative to their orbits.

Every observer who reports a meteor is requested not to fill up his account with unnecessary verbiage, but state in a simple, straight way, first, *at what exact point in the sky the meteor was* LAST *seen*. This point may be defined either with reference to the stars or the moon or sun; or by horizontal angular bearings and vertical altitudes, such as are measured with engineering instruments; or by reference to certain trees, buildings, or other marks, whose linear distances and altitudes are known, so that angular bearings and altitudes may be calculated. One of the most convenient methods of estimating angular altitudes to the nearest whole degree consists in holding a graduated yardstick vertically at arm's length. Record the distance from the eye and the vertical distance on the yardstick above the line drawn from the eye to the horizon, from which the astronomer can easily get some idea of the angular altitude. Having fixt the point of disappearance, then record as nearly as possible the point of appearance, and in fact several points along the path, such as the point where it crost the north-south line and the east-west line, and especially the point where it approached nearest to the zenith. By marking the shadow of a pole or of the corner of a building one may secure a good record of the path of a very bright meteor. Continuous photographic records of meteors are peculiarly desirable.—*C. A.*

## INTERNATIONAL AND LOCAL ORGANIZATIONS FOR THE PROMOTION OF SEISMOLOGY.

The German Ambassador at Washington, and the United States Ambassador at Berlin, have officially announced to the Department of State, under date of March 7, that Prof. Luigi Palazzo has accepted and entered upon his duties as vice-president of the permanent committee of the International Seismological Association. The financial agent of this association is the "Aktiengesellschaft für Boden-und Kommunalkredit", at Strassburg, to whom all subscriptions should be paid. The United States is a member of this association, and a small appropriation has been made by Congress for fees and the expense of the delegate. Prof. Harry Fielding Reid, of Johns Hopkins University, is the member of the permanent committee representing the United States.

Two notable steps have been taken during the past year tending to a more definite and permanent organization of seismological interests in the United States. First, as a direct result of the California earthquake, the Seismological Society of America was organized, with headquarters at the University of California, Berkeley. The objects of the society are stated to be:

"For the acquisition and diffusion of knowledge concerning earthquakes and allied phenomena, and to enlist the support of the people and the Government in the attainment of these ends".

Prof. Geo. D. Louderback, of the University of California, is the present secretary. The other officers are:

*Board of Directors–1907.*

George Davidson, *President*; Andrew C. Lawson, *1st Vice-President*; T. J. J. See, *2d Vice-President*; Alex. G. McAdie, *3d Vice-President*; J. N. LeConte, *Treasurer*; Chas. Burkhalter, W. W. Campbell, C. Derleth, jr., G. K. Gilbert, A. O. Leuschner, J. S. Ricard.

*Scientific Committee.*

Andrew C. Lawson, *Chairman*; John C. Branner, G. K. Gilbert, C. Derleth, jr., J. N. LeConte, A. G. McAdie, H. F. Reid.