mined for each vapor at ordinary temperature, is: water 1.9×10^{-11}, ethyl alcohol 2.5×10^{-11}, benzene 0.8×10^{-11} per cent of the total vapor molecules present, which would correspond to about 100,000,340,000,190,000 molecules per cu. cm. These nonelectric molecules are characteristic for each vapor. Exposure of the vapor-gas mixtures to β and γ radiations, further increases the size of the nuclei, and thus the numbers of molecules per nucleus, to 8 for water and 6 for alcohol; and increases also in particular their number very much, in accordance with the radiation intensity. Lenard's theory supplements Kelvin's theory by adding a term depending on the ratio of the portion of the drop surface from which evaporation can take place, and on the surface tension which varies with the radius and the thickness of the liquid shell. It also differs from J. J. Thomson's theory in so far as with increasing expansion a supersaturation is said to be reached at which all the nuclei are condensed; the total number of nuclei in water vapor (no external field) seems to be limited to 10^5, as stated.—*H. B[orns]*.

551.573 (048)

A NEW EVAPORATION FORMULA.[1]

By R. E. HORTON.

[*Reprinted from* Science Abstracts, Sect. A, Aug. 30, 1917, § 791.]

In 1802 Dalton deduced the formula $E=C(V-v)$, where E is the rate of evaporation from a liquid surface, V the vapor pressure corresponding with the temperature of the liquid, v the vapor pressure existing in the atmosphere at the time and C is a constant. The effect of the wind was allowed for by varying the value of C. Later workers have usually introduced a factor of the form $(1+kw)$ to allow for the wind speed w. According to the formula thus modified, the rate of evaporation increases indefinitely with increase of wind, whereas in practice a maximum value is obtained when the wind velocity reaches 15 to 20 miles an hour, and above this there is no further increase. The author, therefore, prefers to allow for wind by the introduction of an exponential factor, and deduces the equation,

$$E=C[(2-e^{-kw})V-v].$$

Values of the coefficient $(2-e^{-kw})$ may be read off from a graph thus simplifying the working. The formula is also applicable to the case of condensation. It will be seen that under certain conditions of temperature and humidity condensation will take place in still air, while there will be slight evaporation under the same conditions in a wind. This result has been verified in practice. The formula as stated applies to a small liquid surface. The latter part of the paper is devoted to a consideration of the case of a larger area where the evaporation from the leeward part will be hindered by the presence of the vapor given off by the part more to windward. The author states that it will, in many cases, be more accurate to calculate the rate of evaporation from a large water surface by means of the formulæ here put forward, than to rely on attempts at direct measurement with the ordinary type of evaporimeter.—*J. S. Di[nes]*.

551.578.1 : 634

FORESTS-AND-RAINFALL EXPERIMENTS.

There appeared in Nature, for August 2, 1917 (pp. 445–446), a review by Mr. Hugh R. Mill, of the recent Indian Forest Bulletin No. 33 by M. Hill, chief commissioner of forests of the Central Provinces. Dr. Gilbert Walker of the Indian Meteorological Department contributed two appendices to that bulletin, and concerning Dr. Walker's conclusions Mr. Mill says in part:

> Dr. Walker considers that, as Blanford pointed out in 1887, "the only satisfactory evidence would be that obtained by comparing the rainfall of a district when well supplied with forests with that of the same district when the trees were very few." In our opinion the comparison should not be that of a district A at the time t with the same district at the time t'; but to compare the relation of district A to a contiguous district B at the time t with the relation of A to B at time t', where A is a district that has undergone a great change as regards forest covering, while B has remained unchanged. The reason for this indirect comparison is, of course, to eliminate the effect of the two periods falling in what Prof. H. H. Turner calls different climatic chapters. Another method would be to determine the relation of the isohyetal lines to the configuration of the land on wooded and treeless districts of similar character. As pointed out in the report on the rainfall in the Geological Survey's "Water Supply Memoirs of Hampshire," the district of the New Forest shows a considerably higher general rainfall than its elevation above sea level appears to suggest. The subject is both fascinating and important, and the time will no doubt come when increase of accurate observations will enable the vague belief in the beneficial influence of forests on climate to be supported or corrected by definite meteorological evidence.

It seems appropriate here to recall the circumstance that precisely the first method here suggested by Mr. Mill for solving the problem of the relations between rainfall and forestation was adopted by the United States Weather Bureau in 1910, cooperating with the United States Forest Service. These two services have selected two contiguous and practically indentical watersheds in the Rio Grande National Forest (lat. 37° 45′ N., long. 106° 50′ W., alt. 9,400–11,000 feet) near Wagon Wheel Gap station on the Denver & Rio Grande Railroad, at present under identical forested conditions, and have established therein a large number of thermometer, precipitation, and stream-gage stations. Careful observations will be carried on in both watersheds for a number of years [1] and at the conclusion of this first period one of the watersheds will be deforested and the same observations continued for a second period corresponding to the first one.

Already we have secured nearly a full 6-years' record there, as observations actually began October 22, 1910. While the United States seems to have been the first to take this step, it is certainly desirable that as many other countries as possible should make the same test.

Concerning the second method suggested by Mr. Mill, it is not likely that any area in the United States is sufficiently supplied with well-distributed raingages to encourage one in undertaking the computational labor involved.—C. A., jr.

EXCESSIVE PRECIPITATION IN LONDON, ENGLAND.

[*Reprinted from* Nature, London, June 21, 1917, 99:328.]

Dr. H. R. Mill records, in the London Times of June 19, 1917, that the thunderstorm between 5 and 7 p. m. (summer time) [2] on Saturday, June 16, was, if measured by rainfall, one of the most severe ever experienced in London. More than 2 inches fell over an area measuring 10 miles from Barnes to Finsbury Park and 4 miles from Hyde Park to Willesden Green. At two points within this area more than 3 inches was reported—viz,

[1] Engineering News-Record, New York, Apr. 26, 1917, 78:196-199.

[1] The experiment is described in detail in the MONTHLY WEATHER REVIEW, September, 1910, 38:1453-1455, with map.

[2] "Summer Time." This is the first reference in the MONTHLY WEATHER REVIEW to the "daylight saving" scheme that has been in such general use among European countries since 1916. "Summer time" in England is 1 hour faster than Greenwich Mean Time. A presentation of the advantages and disadvantages of "Summer Time", as developed by a year of actual experience therewith, will be found in Review of Reviews, New York, June, 1916, pp. 715-716.—C. A., jr.

3.20 inches at Campden Hill, Kensington, and 3.37 inches at Barrow Hill, north of Regent's Park. Such falls in a short period have only been exceeded in the London area, so far as Dr. Mill has been able to ascertain, by 3.42 inches at Blackheath on July 23, 1903, and by 3.90 inches at Hampstead on April 10, 1878. On June 23, 1878, Mr. Symons recorded at Camden Square a fall of 3.28 inches in about an hour and a half; on Saturday last the recording gage showed that 2.86 inches fell in 2 hours, and no heavier rain has been recorded at Camden Square in the 39 intervening years.

GREATEST 24-HOUR RAINFALL AT WASHINGTON, D. C.

It is interesting to compare with these very exceptional falls under London's conditions, the following equally exceptional falls under Washington conditions, compiled by Mr. Herbert Lyman from the records of the Washington office of the Weather Bureau.

Greatest rainfalls for any 24 hours at Washington, D. C.

Inches.	Date.	Remarks.
5.80	1878, July 29–30.	
5.66	1874, Sept. 15–16.	
5.00	1904, Sept. 14–15.	
4.96	1898, Aug. 12.	
4.22	1905, July 5–6.	3.26 inches fell in $1^h\ 13^m$.
4.16	1886, June 22.	
4.12	1876, July 30.	
3.98	1877, Oct. 4.	
3.92	1905, Aug. 25.	
3.67	1910, Oct. 19–20.	Not a thunderstorm fall.
3.50	1886, May 7–8.	
3.48	1900, June 2.	3.04 inches fell in $1^h\ 8^m$.
3.34	1886, July 26–27.	
3.27	1917, July 25.	1.90 inches fell in 1^h.

To this table must be added the remark that in 1906 2.46 inches fell within 56 minutes on August 24.—C. A., jr.

551.51 (048)

REVOLVING FLUID IN THE ATMOSPHERE.[1]

By Sir NAPIER SHAW.

[*Abstract* of an address before the Royal Society, June 21, 1917.]

It is generally assumed, as appears prticularly from a recent paper by Lord Rayleigh,[2] with reference to a former paper by Dr. J. Aitken, that the motion of air in cyclones and anticyclones may be classed as the motion of revolving fluid, symmetrical about a vertical axis. Reasons are given to show that this assumption with regard to cyclones and anticyclones of middle latitudes is erroneous; that circular isobars on the map do not indicate revolving fluid, and, vice versa, that traveling revolving fluid would not be indicated by a system of circular isobars. The next point for consideration is how a mass of revolving fluid traveling with a speed of translation of the same order as the speed of rotation, and of sufficient size, would be represented on a map. Diagrams are drawn showing the distribution of velocity in four cases for different ratios of the velocity of translation to the velocity of rotation, and assuming that systems of velocities could be fitted to pressure lines of the same shape, it is inferred that cases of traveling revolving fluid would be indicated by isobars similar to those which are classed meteorologically as belonging to small secondaries, or distortions of the isobars, generally on the southern side of the great cyclonic systems. Conditions are next considered which must exist if a column of rotating fluid is maintained and transported within a current represented by the isobars of a great cyclonic depression. The conditions arrived at are briefly: (1) That the velocity of translation must be the velocity corresponding with the separation of the isobars of the main depression unaffected by the presence of the revolving mass. (2) The column must probably extend throughout the troposphere, otherwise it could not be "capped." (3) The velocity of the current transporting the revolving fluid must be the same at all heights. This condition is shown to be satisfied if the line of lapse of temperature with height in the atmosphere corresponds with an adiabatic line, and this is known to be approximately the case in a cyclonic depression where convection has been ubiquitous and vigorous.

[1] *Reprinted from* Nature, London, July 5, 1917, 99:378.
[2] Abstract published in this REVIEW August, 1917, pp. 413–414.—C. A., jr.

MOTION OF A PARTICLE ON THE SURFACE OF A SMOOTH ROTATING GLOBE.[1]

By F. J. W. WHIPPLE.

[*Reprinted from* Science Abstracts, Sect. A, Aug. 30, 1917, § 721.]

The free motion of a particle over a smooth rotating globe has not in the past received much attention, but the author considers that a knowledge of the motion of such a particle will prove a useful preliminary to a proper understanding of the more complicated motion which actually occurs in winds, where the air particles have other forces besides that of gravity acting upon them. After briefly dealing with the case of a particle on a smooth rotating sphere, the case of a globe having a "level" surface is considered. During the motion over the surface the relative speed remains constant. If the velocity is small so that variation in latitude is negligible the track is a circle and the period of the motion relative to the surface of the globe $\frac{1}{2}$ cosec ϕ days (where ϕ = latitude.)

Where variations of latitude must be taken into account the general equations are worked out, but before a complete solution can be found it is necessary to assume that ϕ is small throughout the motion. The equations are thus approximate only and must not be used for high latitudes. The solution then falls into 3 classes according as constant C is positive, zero, or negative. The value of C is governed by the initial motion and starting point of the particle.

The results are illustrated by curves which show the motion of a particle given the velocity of 10 m./sec. over a globe having the dimensions of the earth. The first set of curves (C positive) give oscillatory paths backward and forward across the equator. In the second set ($C=0$) after a looped path the particle approaches the equator asymptotically. In the third case (C negative) motion is confined to one side of the equator. An approximately circular path is followed out, but with a gradual drift to the westward.—*J. S. Di[nes]*.

MOTION OF THE AIR IN THE LOWEST LAYERS OF THE ATMOSPHERE.[2]

By G. HELLMANN.

[*Reprinted from* Science Abstracts, Sect. A, Aug. 30, 1917, § 732.]

From measurements of the wind velocity at five different heights up to 258 meters above the ground at the

[1] Philosophical Mag., London, June, 1917, 33:457–471.
[2] Berichte, Preuss. Akad. Wiss., Berlin, 1917, 10:174–197.