TABLE 10.

Vapor of water at absolute temperature.	Years.
200	1.22×10^{38}
250	3.37×10^{23}
300	1.94×10^{16}
400	$2.40 \times 10^{9} = 2,400,000,000$
500	$4.28 \times 10^{4} = 42,800$
600	$1.06 \times 10^{2} = 106$

Dr. Bryan arrives at the following conclusions:

1. The earth's attraction is capable, according to the kinetic theory, of retaining a gas of twice the weight of hydrogen in the form of a (practically) permanent atmosphere of uniform temperature as high as any temperature commonly existing in its present atmosphere.

2. The vapor of water is similarly capable, according to the kinetic theory, of existing on Mars in the form of a (practically) permanent atmosphere of uniform temperature at any ordinary temperature.

It appears from the foregoing that according to the kinetic theory the assumption that helium, because of its frequently recurring high molecular velocities, is escaping from the earth's atmosphere is not warranted, and, therefore, the conclusion that the vapor of water can not be retained by Mars is not warranted, at least under the conditions usually assumed for their atmospheres.

This paper would, however, not be complete without a reference to Dr. Stoney's reply[7] to the papers "On the Escape of Gases from Planetary Atmospheres According to the Kinetic Theory," by the writer, and "The Kinetic Theory of Planetary Atmospheres," by Dr. Bryan.

In his reply Dr. Stoney argues that the Boltzmann-Maxwell distribution will not account for the number of molecules attaining a velocity many times greater than the velocity of the mean square. Dr. Stoney concludes[8] that out of N free paths the actual number whose speed lies between v and $v + dv$ is

29 $$N(\pi + \delta)\, dv$$

where π is the probability function, which according to the Boltzmann-Maxwell law, is a function of v only, while δ is a function of the variables, v, h, n', θ, t, etc.

Where v is the speed; n, the number of molecules; n', the number of encounters; θ, the average duration of the free path; t, the average duration of an encounter; and where etc. stands for any other variable that might influence the value of δ.

Allowing the validity of this equation it seems from the nature of the functions δ and π that δ can not be many times greater than π. But even if δ could by some means attain to the value of $100\,\pi$ or $10,000\,\pi$ the permanency of an atmosphere of helium on the earth would not be materially affected, as will be evident by referring to Tables 2, 7, and 9. The fact that δ is a function of variables that may be either positive or negative would indicate that its value can not be large compared with the value of π, if indeed its value is not zero.

The value of Dr. Stoney's researches on the permanency of atmospheres must be determined more from the fact that they have opened up new fields of inquiry, and paved the way for the development of the kinetic theory of atmospheres, than from the specific result reached by the a priori method.

More recently M. E. Rogowsky[9] has discussed planetary atmospheres, but since he based his calculations on the results furnished by Dr. Stoney's memoir his conclusions, some of which are indeed very remarkable, must be modified in accordance with his note in Nature for July 3, 1902, i. e., in accordance with the results arrived at by the kinetic theory. In summing up these researches on the escape of gases from planetary atmospheres and the kinetic theory of planetary atmospheres we conclude:

1. That helium forms a constituent though very small part of the earth's atmosphere,[10] and that according to the kinetic theory the earth will retain an atmosphere of helium at temperatures much higher than those that are known to prevail.
2. That the vapor of water will remain on the planet Mars at ordinary temperatures.
3. That according to the kinetic theory the moon, if it had a mean temperature of 0° C. would lose an atmosphere of nitrogen and oxygen.
4. That all the planets can retain atmospheres similar to the earth's atmosphere, and that the superior planets can retain atmospheres composed of gases much lighter than hydrogen.

[7] Astrophysical Journal, 11, pp. 251, 357, 1900.

[8] loc, cit. 22, pp. 363.

[9] Astrophysical Journal, November, 1901.

[10] Chemical News, 1895. Heinrich and Kayser. Nature, September 28, 1898. E. C. C. Baly. Nature, September 28, 1898. Ramsay & Travers. Nature, October 13, 1898. William Crookes. Nature, July 4, 1901. Prof. James Dewar.

CLIMATOLOGY OF COSTA RICA.

Communicated by H. PITTIER, Director, Physical Geographic Institute.

[For tables see the last page of this REVIEW preceding the charts.]

Notes on the weather.—On the Pacific slope the rain has been very scarce, the total amount for the month remaining in most cases inferior to the third part of the normal fall. As an immediate consequence, the coffee crop has been greatly diminished by premature ripening and by the havoc of several insect pests, the development of which has been favored by the prevailing drought. In San Jose the pressure has been about normal, the temperature slightly above the mean; rainfall 163 mm. against 241, normal; sky generally cloudy. On the Atlantic slope the rain has continued in excess of previous years, with the usual accompanying landslides and inundations.

Notes on earthquakes.—August 6, $0^h\ 10^m$ p. m., slight shock, E–W, intensity I, duration 2 seconds. August 11, $7^h\ 20^m$ p. m., slight shock, NE–SW, intensity II, duration 3 seconds. August 12, 8^h a. m., strong shock, E–W, intensity III, duration 6 seconds. August 13, $5^h\ 55^m$ a. m., tremors with several interruptions, total duration 8 seconds. August 16, $2^h\ 17^m$ a. m., several consecutive shocks, E–W, intensity III, duration 20 seconds. August 18, $11^h\ 31^m$ p. m., sensible shock, E–W, intensity III, duration 12 seconds.

HAWAIIAN CLIMATOLOGICAL DATA.

By CURTIS J. LYONS, Territorial Meteorologist.

GENERAL SUMMARY FOR AUGUST, 1902.

Honolulu.—Temperature mean for the month, 78.5°; normal, 77.7°; average daily maximum, 83.7°; average daily minimum, 74.2°; mean daily range, 9.5°; greatest daily range, 13°; least daily range, 5°; highest temperature, 86°; lowest, 72°.

Barometer average, 29.971; normal, 29.980; highest, 30.09, 29th; lowest, 29.86, 4th; greatest 24-hour change, that is, from any given hour on one day to the same hour on the next, .07; lows passed 4th and 24th; highs, 15th and 29th.

Relative humidity average, 70.5 per cent; normal, 68.5 per cent; mean dew-point, 67.3°; normal, 66°; mean absolute moisture, 7.32 grains per cubic foot; normal, 7.01 grains; dew on grass, 0.

Rainfall, 1.74 inches; normal, 1.97 inches; rain record days, 25; normal, 18; greatest rainfall in one day, 0.26 on the 14th; total at Luakaha, 9.08 inches; normal, 11.02 inches; total at Kapiolani Park, 0.42 inch; normal, 0.71 inch.

The artesian well level fell during the month from 33.40 to 33.10 feet above mean sea level. August 31, 1901, it stood at 33.30. The average daily mean sea level for the month was 9.78 feet, the assumed annual mean being 10.00 above datum. For August, 1901, it was 10.38. Trade wind days, 30 (3 of