the corresponding points on the photographs taken with cameras about 30 km. apart can generally be recognized. *An interesting novelty is the successful use of the kinematograph for auroral photography.* As to the results set out in the memoir, the most important appears to be a confirmation of the discovery that the lower limit of the draperies tends to fall at one or other of two somewhat closely defined levels, 100 and 107 km. above sea level, a discovery which must, in the opinion of the authors, almost inevitably lead to the conclusion that a predominant part of the cosmic rays coming from the sun and producing the aurora borealis is made up of two groups of rays, each of which has its own quite definite penetrating power.

The development of auroral photography in the Shetlands, the most promising region of the British Isles for the purpose, will be awaited with great interest.

OCCURRENCE OF OZONE IN THE ATMOSPHERE.

[The Victoria University of Manchester, July 14, 1920.]

[Reprinted from Nature, London, July 22, 1920, p. 645.]

With reference to the lecture of Lord Rayleigh published in *Nature* of July 8 on "The Blue Sky and the Optical Properties of Air," the conflicting results obtained by chemical methods in the estimation of atmospheric ozone are recalled. I beg to direct attention to my paper on "The Occurrence of Ozone in the Upper Atmosphere" (Proc. Roy. Soc., 1914, A, vol. xc, p. 204), in which it is shown that a reagent of potassium iodine solution can be made to provide a basis for the distinction of ozone and oxides of nitrogen at high dilutions and enable the approximate estimation of the former. By this method it is shown that, in accordance with the conclusions of Lord Rayleigh, ozone is present in the upper atmosphere, the amount present at an altitude of 10,000 feet being *of the order of* 5×10^{-6} parts per unit volume. Measurements made with sounding balloons up to altitudes of 20 km. also showed the presence of definite amounts of ozone, but no detectable increase between 4 km. and 20 km. The view was put forward that this amount of ozone must be taken into account in considering the optical properties of the sky.

An extension of these measurements was made with greater precision at the Mosso Laboratory on Monte Rosa at an altitude of 15,000 feet, where an average proportion of about 1×10^{-6} parts per volume of ozone was found.—*J. N. Pring.*

THE RELATIONSHIP BETWEEN CLOUD AND SUNSHINE.[1]

By J. R. SUTTON.

[Abstract reprinted from Nature, London, July 22, 1920, p. 667.]

A brief discussion of the observations of sunshine and cloud made during the 20 years, 1900–1919, at Kimberley. In a general way much sunshine postulates little cloud; but the relation is not intimate, and a sunshine recorder can not be regarded as an automatic device for determining the cloudiness of the sky. August gets the most sunshine and February the most cloud.

ATMOSPHERIC AND TERRESTRIAL RADIATION.

By W. H. DINES.

[Abstracted from Quar. Jour. Roy. Meteorological Soc., 46, 163-173, April, 1920.]

The atmosphere is divided into 10 layers of equal mass, each thus contributing 100 mb. to the pressure near sea level. The radiation emitted by each layer on each side is assumed to be $\eta\sigma T^4$, where T is the absolute *temperature*, σ *Stefan's constant, and* η *a constant* depending upon the humidity, mass, cloudiness, etc., of the layer. The proportion of incident radiation absorbed by a layer is η, $1-\eta$, being transmitted. Then the net radiation absorbed or omitted by any layer as a consequence of the absorption and emission by the earth and the rest of the atmosphere may be calculated. For thirteen widely different assumptions as the values of η and their distribution, corresponding to different vertical distributions of cloudiness, etc., the same general results were obtained: The known mean values of T over England show that all strata up to the 400 mb. level are emitting more radiation than they are abosrbing, those from 400 mb. to 200 mb. are absorbing more than they emit, and those above 200 mb. are again suffering a net loss. Since the mean temperatures are not undergoing a systematic change, the losses and gains must be compensated for. In the lower layers the loss is made up by heating due to latent heat of condensation and to *solar* radiation, mainly through contact with the ground and convection; in the highest layers, probably by direct absorption of solar radiation. The gain in the intermediate layers is balanced by the loss due to forced mixing of different layers by winds, resulting in a tendency to estsblish an adiabatic lapse rate where normally the lapse rate is considerably less than adiabatic.

Equatorial temperature distributions, on the other hand, show that all the strata above 400 mb. are gaining by absorption, probably because of the small amount of emission at the low temperatures existing there. This indicates that these low temperatures are due to dynamic, not to radiational, causes.

This method of computation, devised by L. F. Richardson as a substitute for the complex methods used by Gold in his studies on the stratosphere, gives a value for the total loss of heat by the earth in good agreement with that of Abbot and Fowle.—*E. W. W.*

LONG-RANGE FORECASTING IN JAVA.

By C. BRAAK.

[Reprinted from Nature, London, August 5, 1920, pp. 729–730.]

Publication No. 5, 1919, of the Royal Observatory of Batavia, entitled "Atmospheric variations of short and long duration in the Malay Archipelago and neighboring regions, and the possibility to forecast them," by Dr. C. Braak, embodies the results of a long investigation into the sequence of rainfall in the equatorial regions east of the Indian Ocean. Three kinds of variation are studied: (1) With periods of one or more years up to and including the sun-spot period; (2) secular variations; and (3) with periods less than a month, comparable with Abbot's short-period solar fluctuations. The variations, the period of which is intermediate between (1) and (3) above, are treated as disturbances of (1). Dr. Braak lays much stress on a three-year period, of the persistence of which he gives plausible, though not quite convincing, examples. He classifies three groups of years, of high barometer, low barometer, and transition (from high to low), but naturally finds a proportion of years not strictly true to any of these types. It is scarcely surprising that he finds in general a correlation between barometric pressure and rainfall. For the east monsoon he finds strong positive correlation between high pressure and drought, and weaker between low pressure and excess of rain. For the west monsoon he finds, with

[1] Royal Society of South Africa, Cape Town, May 19.

local exceptions, excess of rain with high barometer, and deficit with low barometer. His problem is thus reduced to the intensity of the correlation and the chances of a correct forecast of the barometer variation. His next step takes into account temperature changes which may be expected to modify pressure conditions, but his result is disappointing. He obtains rules, but their application is so far a failure that they appear to break down most thoroughly in years of drought—that is, when, if correct, they would be most valuable.

Turning to secular variations, he finds no evidence of progressive change in Batavian rainfall; in fact, the only progressive change on which he lays stress is in Batavian air temperature. Comparison with stations in India, Australia and other places in the same quarter of the globe provides other types of change, but none agreeing with Batavia, and the question is left unsolved.

There remain the short-period pressure waves. The equatorial manifestations of these he attributes to a kind of surge, caused by the great disturbances in higher latitudes, exercising a sucking influence or its converse, with slight variations of the rainfall, less than 10 per cent of the normal, the effect of which is to compensate the pressure difference by cooling or heating air probably above the 3,000-meter level.

Other variations of rainfall, humidity, and cloudiness he considers to be local, and, on the whole, rejects the possibility of forecasting any short-period variations in the rainfall. Inasmuch as we are bound to regard the Tropics as the first stage in the translation of solar variation into weather, it seems a pity that the result obtained in what is probably the best-known region of the Tropics in regard to meteorological statistics should appear so meager and wanting in definiteness.[1] Similar work in temperate regions may well be discouraged. but there is still an enormous mass of data.—*W. W. B.*

PROBABLE AMOUNT OF MONSOON RAINFALL IN 1920.

By GILBERT T. WALKER.

[Reprinted from Nature, London, August 5, 1920, pp. 724-725.]

A memorandum regarding the probable amount of monsoon rainfall in 1920, by Gilbert T. Walker, has recently been issued. Data of importance are given, showing how the monsoon rainfall in India is affected by previous weather conditions over various parts of the earth. In summing up the effects of the various factors it is mentioned that the prejudicial effect of snowfall from Persia to the Himalayas is exerted when at the beginning of June the accumulations extend over a larger area than usual. The great excess of snow reported this year is confirmed by the low temperatures in the Punjab. Heavy rainfall in South Ceylon, Zanzibar, East Africa, and Seychelles is prejudicial, but data for this year show a moderate deficit or normal conditions. A close relationship exists between heavy rain in Java from October to March and low barometric pressure in Bombay in the succeeding six months; in Java the rainfall was nearly normal and its effect is negligible. High barometric pressure in Argentina and Chile is a favorable condition, but this year pressure is in slight defect. It is stated that the conditions indicate in northwest India the monsoon is likely to be weak, at any rate in the earlier part of the season, and for the rainfall of the peninsula, northeast India, and Burma the indications are not sufficiently definite to justify a forecast.

[1] Cf. "Forecasting the weather on short-period solar variations," Monthly Weather Review, Mar., 1920, 48: 149-150, in which C. F. Marvin throws grave doubts on the reality of appreciable short-period solar variations. Therefore, this result does not seem anomalous.—EDITOR.

EFFECT OF THE RELATIVE LENGTH OF DAY AND NIGHT AND OTHER FACTORS OF THE ENVIRONMENT ON GROWTH AND REPRODUCTION IN PLANTS.[1]

By W. W. GARNER and H. A. ALLARD.

[Abstract reprinted from Experiment Station Record, Dept. Agr., Washington, v. 42, no. 9, p. 818.]

The results are given of investigations carried on by the authors in the Bureau of Plant Industry, U. S. Department of Agriculture, in which a dark chamber was used for growing plants, by which the number of hours of exposure to sunlight could be controlled. As a part of the investigation, a series of plantings of soy beans was made in the field at intervals of three days throughout the season, in order that the effects produced by different dates of planting could be compared with those produced by artificial shortening of the daily exposure to light.

Tobacco, soy beans, and a large number of other plants were experimented with, and it was found that the relative length of the day was an important factor in the growth and development of the plants, particularly with respect to sexual reproduction. In some species it was found that the normal plant could attain flowering and fruiting stages only when the length of the day falls within certain limits. Consequently, these stages of development are ordinarily reached only in certain seasons of the year. In the absence of favorable length of day for bringing into expression the reproductive processes in certain species, vegetative development was said to continue more or less indefinitely, thus leading to the phenomenon of gigantism. On the other hand, under the influence of a suitable length of day, precocious flowering and fruiting may be induced. In this way certain varieties or species may act as early or late maturing, depending on the length of day to which they happen to be exposed. The species exposed to a length of day favorable to the growth and sexual reproduction have shown a tendency to assume an ever-blooming or ever-bearing type of development.

The relationship between annuals, biennials, and perennials was studied, and under artificial conditions it was found possible to change the nature of the plants materially. In all species studied the rate of growth was found directly proportional to the length of the daily exposure to light, but within the limits of the experiment light intensity was not found a factor of importance. With soy beans, limiting water, inducing temporarily wilting daily, was without effect on the date of flowering, although the drought hastened the final maturing of the seed. Interrelationships between length of day and prevailing temperatures of the winter season are said to control successful reproduction largely in many species and their ability to survive in certain regions. The authors point out that the relation between the length of the day and the time of flowering is of great importance in crop yields, and indicates the necessity for seeding at the proper time.

[1] Journ. Agr. Research, U. S. Dept. Agr., Washington, 18 (1920), No. 11, pp. 553-606, pls. 16, figs. 3.