the average annual temperature decreased about 0.2° F. for each 10-inches increase in average rainfall.

The average annual range increases 1.8° F. per degree of latitude northward in the East, but there is practically no change in the arid west, the range being close to 46° F. The daily range averages about the same (18° F.) throughout the East, and throughout the arid west (22° F.). The variation in daily range from winter to summer is practically zero in the East, but 12° F. in the arid west. Thus the values of Ma, Ra, can be expressed in terms of latitude φ and elevation h, while Rd and Vv are constants.

With all substitutions the general equations become:

$$T = 110 - 1.4\varphi - 0.002h + (0.9\varphi - 12)\cos t + 9\cos\theta \ldots \text{(east)}.$$

$$T = 121 - 1.4\varphi - 0.0033h + 23\cos t + 11\cos\theta + 3\cos\theta\cos t \ldots \text{(west)}.$$

These formulae give a temperature usually within 3.5° F. of the normal for the selected time, and usually within 5° F. of the actual temperature at a particular hour on a particular day.

"The equation has practical value in such cases as the determination of early morning temperatures where heating to protect crops from frost is practiced, in calculating hourly values where thermograph records have not been taken, and for engineers engaged in laying concrete in determining the normal time in the spring and fall when freezing temperatures are experienced during working hours."—C. F. B.]

Vol. 1, page 118: In the formula the divisor 2 should have been under Va instead of under Ma.

The energy of cyclones. Alexander McAdie. (By title.)

[The problem of the origin of the energy of cyclones has long attracted the attention of meteorologists. No entirely satisfactory explanation exists, but Sir Napier Shaw has recently put forth in *Nature*, December 2, 1920, an explanation on a mechanical basis. Granting initial solar and terrestrial radiation as the cause of atmospheric motion, he considers the transformation of the energy. Convection is regarded as a *prime mover up* in connection with the prevailing westerly winds in high levels. Above the level of equal density winds flow from equator to pole and below this level from pole to equator. He postulates the existence of two great counterflows. The geostrophic wind is regarded as the main flow and surface winds are geostrophic winds lessened by friction. The actual trajectories of pilot balloons are seldom vertical, hence mental pictures of vertical convection need revision. The function of the stratosphere is conservative but not constructive. Briefly the energy of a cyclone is due originally to convection in a region with variation of wind velocity with height. There is a slow loss of energy at the ground by friction but a reinforcement by additional convection. A travelling cyclone does not carry its supply of rain a long distance but probably makes it in the low levels as it journeys on. An anticyclone is regarded as a region of descended air *if the month is taken as the unit of time.*]

At the close of the session the following resolution drawn up by a resolutions committee, consisting of Messrs. Fassig and Clough, was adopted unanimously:

Chicago, Illinois,
Dec. 29, 1920.

To the University of Chicago, and the Local Committee of Arrangements of the A. A. A. S.:

The American Meteorological Society desires to express its appreciation of the admirable arrangements made for the meetings of the Society and for courtesies extended during the sessions of December 28 and 29.

Meteorological Papers at Joint Meeting with Association of American Geographers, Dec. 30, 1920.

Rainfall Maps of Latin America. Eugene Van Cleef.

[The lack of rainfall stations and the lack of homogeneity in the periods of years covered by the observations at different places makes it impossible to construct accurate rainfall maps of Latin America. Under the auspices of the Peace Inquiry of the State Department, however, an attempt was made to make rainfall maps based on all data available in the library of the American Geographical Society, the New York Public Library, the Congressional Library, the U. S. Weather Bureau Library, the Pan-American Union, South American railroad offices, descriptive works, and conferences with explorers. The data for Argentina were best. Data on measured rainfall were thought to be good, but were used with discretion. In drawing the isohyets, the topography, distribution of plant life, hydrography, and distribution of winds over the oceans were used as aids. Where the conditions were doubtful, the isohyets were broken. Large hand-colored wall-maps of the rainfall in January, in July, and for the year as a whole, were shown, but their indications not discussed.—C. F. B.]

In the discussion, C. F. Brooks quoted some remarks by J. de Sampaio Ferraz, when he had looked at copies of these maps last summer, to the effect that it was his opinion that the rainfall maps of a single year would show the *relative* distribution of rainfall in Brazil better than these maps, although for each place it would not indicate the average as well as do Mr. Van Cleef's maps. Dr. Ferraz, who is now director of the Brazilian Meteorological Service, was also said to have stated that he hoped soon to prepare a rainfall map for Brazil based on records for the 10 years, 1910–1919. Mark Jefferson in calling attention to the marked contrasts in rainfall in short distances on Chilean highlands, suggested that it would be better to put numbers on the maps rather than to attempt the practically impossible task of drawing isohyetals for this region. Mr. Van Cleef, in response to a question as to when these maps would be available, said he hoped to have them published within a year.

The trade winds and anti-trades of Porto Rico. Oliver L. Fassig.

[Since the pilot balloon station at San Juan, Porto Rico, was established last summer (cf. July-Aug., BULLETIN, pp. 87–88) there has been an unbroken series of daily "runs," made by W. C. Haines and H. P. Parker. The conditions in the morning are usually favorable for following the pilot balloon with the single theodolite as high as the balloon can go without bursting. The bursting altitude in most cases is disappointingly low, and only one balloon went to a computed altitude of 20 km. The easterly, trade winds usually extend to a height of at least 4 or 5 km. Occasionally the westerly wind aloft extends down to the surface, when a strong, LOW and HIGH pass, on the north. Above the anti-trades (westerly winds) there appears to be an "upper trade" wind at a height of 10 or 12 km. The maximum wind velocity usually is found at about 1 to 1.5 km., but at considerably greater altitudes the velocity may be equally great.—C. F. B.]

In the discussion, H. E. Gregory asked if it were not worth while to organize a great system of pilot balloon stations in the Pacific. Dr. Fassig replied that it would be, if practicable, and called attention to the scarcity of possible stations.

Progress in organization of the climatological service of the West Indies. Oliver L. Fassig.

[The West Indies belong to so many different countries that it is very difficult to get climatic information together for the region as a whole. Aside from a few of the larger islands there is no consistent climatological network. Visits to all of the islands except Jamaica and some of the smallest ones encouraged the speaker to hope for a regular assemblage of rainfall statistics at the section center, San Juan. In Santo Domingo, for example, a service was established in 1920 which will include 400 rainfall stations. The question of collecting temperature statistics has been set aside temporarily, because of the difficulties of getting good exposures for thermometers. Central America and the coast of South America will be included later. Reports of storm or no storm are sent by radio daily from the various islands to the district forecaster at San Juan and to the supervising forecaster at Washington, D. C. Seismological observations are being made at only two places.—C. F. B.]

Rise in temperature on mountain summits earlier than on valley floors. H. J. Cox.

[The basis of this discussion is the statement made from time to time by meteorologists that "The temperature at the summit of a mountain usually rises before that at the base."

The pioneer work in America along this line of Professor McLeod of McGill University is briefly reviewed. He concluded that it is possible to make temperature forecasts 24 hours in advance at Montreal by noting the changes at the summit of Mount Royal (600 feet above its base and 800 feet above sea level). He claimed a verification of 78 per cent. by this means. Similar studies were conducted by H. H. Clayton at Blue Hill Observatory, Mass., with results much like those of McLeod's. J. E. Church and S. P. Fergusson also conducted studies along this line on Mount Rose, Nev., at a much greater elevation. They did not find such a variation as those just mentioned at Montreal and Blue Hill, and concluded Mount Rose was not favorably located for the occurrence of this phenomenon.

More recently still the author made extensive research of this subject in the mountain region of North Carolina. His conclusions are, that while the temperature on a peak generally rose from 1 to 3 hours earlier (due to the sun's reaching the summit first) than on the valley floor, the observations provided no data upon which temperature forecasts 24 hours in advance could be based. The paper presents in considerable detail the work carried on in these North Carolina mountains, and discusses the relative positions in respect to storm-tracks of the stations mentioned in all the above experiments.—H. L.]

In discussing this paper C. F. Brooks suggested that the greater stability of the surface cold air with an over-running warm wind at Mount Royal and Blue Hill as compared with the North Carolina Mountain region, might be the result of less turbulence induced over the northern regions, not only because they are flatter, but also because the cold, dense air lying on the surface of the frequently prevailing snow-cover is difficult to displace.

Cold surf with off-shore winds. C. F. Brooks.

[It was shown that following a spring with water temperatures about normal an unusual frequency of off-shore winds in June, July and August, 1920, at Atlantic City, N. J., resulted in abnormally cold shore water, whereas from about the same temperature in spring a marked prevalence of on-shore winds in the summer of 1919 brought in unusually warm shore water. (Cf. Sept. BULLETIN, p. 101.)]

Mark Jefferson mentioned the marked difference in water temperatures on the shores of the Great Lakes depending on the occurrence of on-shore or off-shore winds.

Vertical gradients of evaporation and soil moisture in desert and coastal mountains. Forrest Shreve.

[In desert mountains the soil moisture is very low, 4 to 8 per cent. at low elevations, and small up to 6000 feet. Above that height there is a slight increase. The conditions on south slopes are the same as those on north slopes about 1000 feet lower. The rainfall-evaporation ratio depends on rainfall, humidity and wind, and, therefore, is a useful index to climatic conditions on a mountain. As rainfall has little direct influence on soil moisture, however, the soil moisture itself was substituted for rainfall in obtaining comparable data for mountain locations. It was found that the conditions as shown by the soil-moisture evaporation ratio were 16 times as severe at the base as at the summit of a desert mountain.

In coast mountains, the conditions are reversed. At the summits the evaporation rates are higher than at the bases, and somewhat higher even than in the dry valley (Salinas Valley) on the inland side. The amount of soil moisture decreases from base to top. On the whole, then, the conditions for plant growth are best on the summits of desert mountains and at the bases of coastal mountains. Little data on this subject seem to have been collected.—C. F. B.]

Distribution of sunlight and moonlight over the earth. Zomá Baber.

Experimental animal climatology. V. E. Shelford. (Dec. 31).

SYMPOSIUM ON PRESSURE REDUCTION PROPOSED.

During the Chicago meeting, informal discussion brought out the desirability of having the outstanding feature of the Toronto meeting of the Society next December a symposium on improvements in synoptic charts, especially on the reduction of atmospheric pressure observations. This is a peculiarly international subject so far as Canada and the United States are concerned, for the weather maps of both countries contain observations made on both sides of the international boundary. Representatives of the Mexican meteorological service will be invited to participate, in view of the possibility of arranging an international exchange of observations with Mexico for purposes of our daily synoptic charts. The subject is such an important one, and presents so many difficulties that the present time is none too early to begin making the necessary studies.

The plan of such a symposium would probably involve the presentation of 4 to 6 carefully prepared papers, with an interval for discussion after each, and, at the end, possibly the adoption of a resolution for transmittal to the Chiefs of the national weather services involved and to the chairman of the International Meteorological Committee. Those interested are invited to communicate with the Secretary on this subject.

PRESSURE REDUCTIONS IN THE UNITED STATES.

In view of the proposed symposium on pressure reduction to be held at the Toronto meeting of the American Meteorological Society in December, it may be of interest to members of the Society, who have not had their attention directed to the importance of this question, to review a few of the points involved. In the first place, we know that as one ascends into the atmosphere, the barometric pressure, or weight of air above the observer, decreases; and, since this is true, in order that barometers may be comparable, they would all have to be located at the same elevation above sea-level. Obviously, this is not possible, and the only remaining solution of the difficulty is to decide upon some fixed level, and, by means of reduction formulae which have been accurately determined, reduce the pressure to this level. The level that is universally used is that of the sea, and the daily weather maps in all parts of the world show the isobars reduced to sea-level.

But the use of sea-level as a reduction plane is not altogether satisfactory, for several reasons. In the first place, as far as meteorological conditions go, sea-level does not represent anything except over the oceans. Most of the