No snow covered the ground permanently until November 15, and no ice was formed in the small lakes near the wintering base until December 4, when the long periods of winds ceased and a fortnight of calm, clear weather set in. The mercury did not fall below zero until January 2—a weather condition without precedent in my experience of the North. Great Whale River early in December had a minimum temperature of −30° and recorded a constant average for the period well below zero [F].

On January 2 [1916] winter commenced in earnest. The month was characterized by constant drifting winds of a maximum force of 70 miles; calm days were unknown; and the average temperature was −16°. In February the winds abated; there were many days of sunshine, a few of them almost calm. The average temperature for the month was −19° [F]. Throughout March strong winds again prevailed; by the end of the month the snowfall for the winter had reached its maximum, 4 feet; the average temperature for the month rose to −9°. In April and May there was the usual prevalence of wind, and several blizzards occurred, each covering a period of from one to two days. In the latter part of May the weather broke and became warm and summery; in fact, there were heavy thunderstorms at this time. On May 28 sledging over the ice fields was at an end, and by June 10 the field ice surrounding the islands had blown off to southward. Then commenced the most trying time of the year; for hardly two days together did fair weather obtain. From mid-June onward to the time of our departure on September 13 exceedingly heavy gales of wind of from one to three days' duration occurred in every week. The prevailing direction of the winds was south-southwest for not only that period but for the entire year. Days of sunshine were rare; the sky was generally overcast; and rains, accompanied usually by heavy southeast winds, were frequent. According to the natives the weather we experienced during that year was not at all typical; usually, they said, the winds were fewer and less violent, and the temperature during the winter was lower. The remarkable lateness of the freeze-up (December 23) was, they said, without precedent. The minimum temperature for the winter was −48° as compared with the lowest mean reported temperature on the mainland of −55°. The maximum thickness of fresh-water ice was 5½ feet, and of sea ice, 5 feet. The maximum temperature for the summer, occurring on July 25 at noon, was 70°.

## CLIMATE OF THE GALAPAGOS ISLANDS.

By G. M. McBRIDE.

[Excerpts from article on "The Galapagos Islands" in *Geogr. Rev.*, September, 1918, vol. 6, pp. 229-239 (pp. 236, 237, 239).]

The Galapagos Islands lie at the meeting place of two ocean currents. * * * The Humboldt Current, during nine months of the year when the trades are blowing constantly, divides into two branches off the coast of Ecuador, and larger one veering westward toward the Galapagos. Its velocity is very great, sometimes as much as 75 miles a day. * * * From the northeast a warm current that has come down along the coast of Central America enters this same region. The meeting of the different streams produces what has been called "current doldrums," the current turning east or west, north or south, according to the direction of the wind. The fact that the current from the southeast is cold and that it flows along a desert coast where few streams enter the sea, while the northern current has a higher temperature and bathes a shore whose numerous torrents in the rainy season come laden with sediment, probably accounts for the greater resemblance of fauna and flora to those of Central America.

The climate of the Galapagos is far from equatorial. The presence of cold water from the Humboldt Current reduces still farther the mild temperature to be expected in an oceanic climate. Darwin reported a temperature of 60° F. 1 foot below the surface on the southeast side of Albermarle, and Wolf records surface temperatures of 70° F. and 73° F. at several points between the islands. So marked is the effect of the cold current that, while the geographical equator passes directly through the group of islands the thermal equator lies some distance north, throughout many months departing over 20° of latitude from the geographical line.

This favors the development of strong southeast trades at the islands during most of the year. A further contributing influence to the cool temperature of the ocean in this region is probably found in the upwelling of cold water from the ocean depths.[1] These factors combine to make the Galapagos cooler than any other equatorial land at so near sea level. Even on the lowlands the heat is modified, but the effect of air currents from off a cool water surface is most striking as one ascends the slopes toward the interior.

The zones of vegetation find their explanation in the varying meteorological conditions that exist at different levels. Both in temperature and moisture is this difference notable. Though continuous records are lacking, the observations made by scientists at different seasons of the year give a fairly accurate idea of the climate. While near sea level the temperature often rises to 90° F. (even higher in places sheltered from the wind), Wolf found a fall of one or two degrees for every hundred meters of ascent. Upon the middle slopes some 400 to 600 feet above the sea the average temperature was less than 70° F. On the summit of the hill of San Joaquin in Chatham Island at an elevation given as 2,330 feet, he recorded a mid-day temperature of 57.2° F. during heavy mist and a strong southeast wind. There is little variation from day to day and no marked seasonal difference A passing cloud, or the presence of a fog, produces greater change of temperature than do the seasons, while the greatest range occurs from day to night. After sundown it becomes actually cold on the higher hills, and travelers who pass the nights there in the open air huddle about their camp fires even during the milder months of the year.

The northern islands lie more within the influence of the warmer ocean waters from the Gulf of Panama, those toward the south receiving the full effect of the cold Humboldt Current. The low temperature of the ocean waters had made possible the occurrence of some forms of life rarely found outside the higher latitudes. Several kinds of seals are common, among them *Otaria australis*, found also on the coast of Peru and Chile and about the islands of Tierra del Fuego. Penguins, whose range is generally restricted to the coast of subpolar regions, are here found directly upon the equator; and the great albatross so common about Cape Horn has followed the cold current toward the north, nesting by hundreds upon the island of Hood.

[1] Cf. R. E. Coker: Ocean Temperature off the coast of Peru, *Geogr. Review*, vol. 5, 1918, pp. 127-135.

### RAINFALL AND MOISTURE.

In amount of moisture the zones of elevation are still more marked. The lower levels are almost rainless. During the first four months of the year some showers may fall, but completely rainless years are not unknown. The nature of the soil is such that any water which may fall immediately disappears beneath the rock-strewn surface. Some who have visited the islands in unusual seasons have been surprised to find the lower lands green with vegetation; but in normal years there is a very serious lack of moisture.

In contrast with the desert conditions characteristic of the slopes near the sea, the uplands are bountifully supplied with moisture. Besides a well-marked period of frequent convectional showers extending from February to May when the southeast trades are interrupted and equatorial calms prevail, there is a so-called summer, approximately from June to January, when, though the tropical downpours have ceased, the hills are drenched in dense mists (*garúas*) sufficient to keep the roads filled with mud, make books and papers mold in a short time, and quickly rust unpainted iron. Light rains may fall here at any season. On the southeast side of the islands, as on corresponding slopes of the hills, the moist zone extends several hundred feet lower, while the northern exposures, sheltered from the rain-bearing winds, present a striking contrast in their relatively arid character. The effect of abundant moisture on the uplands is evident not only in the ranker growth of vegetation but even upon the lava flows that stretch from near the summits to the sea. The upper sections of these flows are often badly weathered and covered with plants that have found lodgment upon their surfaces, while the lower reaches, that cross the arid zone beneath, show little effect of atmospheric action but lie in solid blocks of black obsidian. But for the constant humidity on the highlands the soil itself would still resemble that of the desert lower grounds.

* * * No storms visit the group during any period of the year.

### THE CLIMATE OF SÃO PAULO AND CEARA, BRAZIL.

[Reprinted from Geographical Review, New York, December, 1919, vol.-8, pp. 356-357.]

Mr. R. C. Mossman, who was for some years connected with the Argentine Meteorological Service, is at present devoting attention to the climatology of various portions of South America. Hitherto by far the greater part of all available published data for South America have covered varying periods of time and have not been reduced to a homogeneous system. Hence, these observations have not been directly comparable and have lacked the accuracy which is an absolute essential in all good climatological work. In two recent communications (Quart. Journ. Royal Meteorol. Soc., January, 1919), Mr. Mossman gives the results of compilations which he has completed for the State of São Paulo and for the city of Fortaleza, in the State of Ceara, Brazil. The chief interest of São Paulo centers in its coffee industry, but the region is also becoming more and more a cattle country. Mr. Mossman has now reduced the temperatures and rainfalls of São Paulo, as published, to a homogeneous system. The data were extracted from the Dados Climatologicos of the Servico Meteorologico de São Paulo, issued since 1887, the last volume published dealing with the year ending November, 1912. These bulletins give an abundance of climatic information with a detail "such as is available for no other portion of South America." Mr. Mossman's summary includes all the essential facts:

The special interest of the State of Ceara lies in the fact that this region is periodically visited by severe droughts, and the object of the present study is to summarize the results regarding rainfall obtained from 1849 to 1915, the ultimate end in view being an investigation which it is hoped may lead to a clew concerning the "precise mechanism associated with these droughts." The rainfall data are given in great detail, in convenient and easily accessible form, and will prove of distinct value to all those who are interested in the economic climatology of Brazil.—*R. DeC. Ward.*

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### RECENT ADDITIONS TO THE WEATHER BUREAU LIBRARY.

C. FITZHUGH TALMAN, Professor in Charge of Library.

The following have been selected from among the titles of books recently received as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies:

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