

ON THE AVERAGE MONTHLY AND ANNUAL RAINFALL OF PORTO RICO

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The existing system of rainfall stations in Porto Rico was established in 1898 as an extension of the U. S. Weather Bureau service to the tropics. A daily record of rainfall has been maintained without interruption to the present time. During the intervening period of thirty years, rainfall has been recorded daily in the eighty-five localities shown in Table I for periods varying from four or five years to thirty years, the average length of record being eighteen years. At twenty-five stations well distributed over the Island the records are continuous for the entire period of thirty years.

TOPOGRAPHY

The Island of Porto Rico is the smallest and most eastern of the Greater Antilles, which form the northern barrier of the Caribbean Sea. Lying between the parallels of 18° and 19° north latitude, the position of the Island, with reference to the equator, is approximately that of Jamaica, St. Thomas and the Hawaiian Islands. In form Porto Rico is nearly rectangular, with an average east-west length of about one hundred miles and a width of forty miles; hence the area is less than 4,000 square miles, about twenty-five per cent less than that of the State of Connecticut.

While the physical features of the Island have never been accurately charted, the more conspicuous outlines of topography and hydrography are fairly well known. Seen from a distance, the Island gives the impression of a confused mass of short mountain ranges, having in the main an east-west trend. Closer examination reveals a well defined ridge, the Cordillera, extending across the full length of the Island, parallel to, and from ten to twelve miles from the south coast, its eastern end following for a short distance the northeast trend of the coast line. In the northeast portion of the Island there is a smaller group of mountains, the Luquillo Range, also with an eastwest trend, and with peaks slightly lower than those of the main range. These two mountain ranges form the principal watershed separating the short streams which flow southward into the Caribbean

Sea from the longer and more numerous streams flowing in a general direction northward into the Atlantic Ocean. The longest of the streams, Río de la Plata, does not exceed forty-five miles. Numerous spurs diverge from the main ranges, mostly from the north side, forming a complex system of narrow ridges, and of deep valleys through which hundreds of small streams carry the waters of an abundant rainfall rapidly to the sea. The south slope of the main divide is decidedly more precipitous than the north side: From Guayama Pass southward to the coastal plain the descent is about one hundred feet per kilometer; northward the rate is about fifty feet per kilometer. The main divide has an average elevation of about 2,500 feet, with peaks rising to a maximum of from 3,500 to 4,000 feet, while the elevations of the main spurs will vary from 1,500 to 2,000 feet. The lowlands are found only in a narrow belt bordering the coast, the broadest stretches not exceeding four or five miles in width.

The average elevation of the Island as a whole, above sea-level, is perhaps eight hundred feet. Of the climatological stations established by the United States Weather Bureau, thirty-five are on the coastal plain with an average elevation above the sea of less than one hundred feet; the inland stations, numbering about fifty, have an average elevation of nine hundred feet, with a maximum of 2,800 feet.

The well watered mountain slopes are covered with a dense perennial tropical growth. In the more inaccessible regions of the Luquillo Range, within the National Forest Reserve, may still be found in considerable quantity primitive growth of valuable hard-wood timber, such as ausubo, laurel, tabonuco and guaragua. The mountains with their rich tropical growth of palms, tree ferns, mosses and air plants, the many peaks and deep ravines, the innumerable clear streams and waterfalls, offer a rich field for the naturalist and for the tourist who is inclined to wander from the beaten paths of conventional travel.

The Island has always been, and will probably continue to be, devoted primarily to the pursuit of agriculture. The coastal plain and the foothills are planted to sugar cane, citrus fruits and pineapples; the mountain sides are planted extensively to coffee and tobacco; while good pasture lands are found in all portions of the Island. The relative importance of the industries is readily seen in the statistics representing the value of exports during the year 1926. With a total value of all exports placed at ninety-eight mil-

lions of dollars, forty-eight millions are represented by sugar and molasses, and approximately seven millions each for tobacco, coffee and fruits, leaving about thirty millions for all other exports.

In spite of the great variability of rainfall from month to month, and to the great differences in nearby localities, a carefully kept record of rainfall of twenty years in the tropics offers a reasonably reliable normal value. Apparently few records for extended periods prior to 1898 are known; that of Spanish Government in San Juan covers the period from 1868 to 1898; the only other considerable record available is that of the Canóvanas Sugar Co., begun in 1883 and maintained without interruption to the present time—this constitutes the longest continuous record available in Porto Rico.

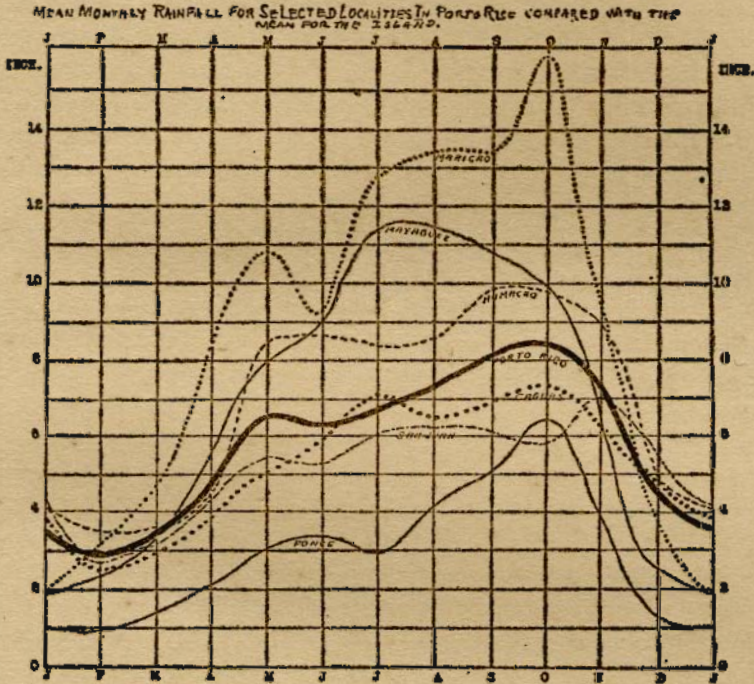
Only the broader features of the distribution of rainfall in Porto Rico will be considered at the present time. Figure I shows the trend of the annual rainfall through the year for the Island as a whole and for stations selected to show the great variations in the monthly amounts in the different regions of the Island.

Examining the heavy curve in Figure I we find a steady increase in rainfall from a minimum of 3.26 inches in February to a maximum of 8.69 inches in October, followed by a rapid decrease to January. A slight but well marked drop occurs in the annual curve in June. While the annual rainfalls for individual localities in the Island vary greatly from the normal for the Island, in amount the same general trend is apparent in all divisions. The salient features of the rainfall distribution through the year are: (a) the light rainfall along the south coast (Ponce) and the comparatively heavy rainfall of the east coast (Humacao) the west coast (Mayagüez) and of the interior highlands (Maricao). Amounts below the normal for the entire Island are shown by the curve for San Juan (north coast) and by that of Cayey (interior valley).

The great variations in rainfall in as small a unit area as Porto Rico are due primarily to topography. On the windward slopes of the Luquillo and Central ranges the annual precipitation exceeds one hundred inches, falling to less than one-half the amount to leeward. The small isolated islands of Culebra and Mona, uninfluenced by marked differences in topography have an annual rainfall of about forty inches while localities like La Fe and Luquillo at only moderate elevations on an east slope have averages of 127.68 inches and 135.55 inches, respectively. Rains occurring in connection with hurricanes, while excessive in amount, do not greatly affect the normal annual amounts owing to their infrequency.

The seasonal geographical distribution of rainfall is shown in Charts I to IV and the annual distribution in Chart V. Excepting a small area along the south coast and the northwest coast, where

FIGURE I



AVERAGE MONTHLY RAINFALL FOR PORTO RICO.

- Heavy line..... Entire Island.
- Light lines..... Selected Stations in Porto Rico.
- San Juan..... North coast (Sugar cane and fruits.)
- Ponce..... South coast (Sugar cane.)
- Humacao..... East coast (Sugar cane.)
- Mayagüez..... West coast (Sugar cane.)
- Maricao..... Mountain districts (Coffee.)
- Cayey..... Central Valleys (Tobacco.)

irrigation projects are in operation, the entire Island has an abundant rainfall; even in the dry areas with twenty-five to forty inches the annual rainfall is adequate when effectively distributed through

the seasons. However, erratic distribution seems to be associated with light rainfall. Over the greater portion of the Island drainage is of more importance than irrigation.

The salient features of the annual geographical distribution (Chart V) are: (a) the areas of heavy rainfall (over 80") in the western portion of the central mountain range, primarily a region of coffee plantations, and in the Luquillo region; (b) the areas of comparatively light precipitation (less than 40") on the coastal plain on the south side from Aguirre to Guánica (sugar cane fields). The regions of moderately heavy rainfall, from 60" to 80", along the north, east and west coasts are devoted mostly to sugar-cane and to citrus fruits. The interior valleys, with moderate rainfall but frequent rains, are given largely to tobacco growing. Charts I to IV show an essentially similar distribution of rainfall with seasonal modifications.

TABLE I
MEAN MONTHLY RAINFALL

	Years	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Adjuntas.....	10	3.85	1.21	4.03	5.53	8.79	7.48	7.94	12.16	11.03	12.78	8.73	4.91	88.44
Aguirre.....	30	1.38	1.57	1.52	1.88	3.76	4.74	4.48	4.65	6.22	6.46	4.13	1.86	42.65
Albionto.....	23	4.05	3.36	3.63	4.17	5.41	3.85	5.33	5.54	6.43	7.82	6.98	4.57	61.14
Alto Bandera.....	12	2.93	3.31	3.94	6.07	8.69	6.77	7.38	12.36	11.93	14.71	8.60	5.12	91.81
Añasco.....	21	1.52	2.90	2.82	5.63	8.71	10.15	11.63	12.21	11.05	10.47	6.26	2.84	86.19
Arecibo.....	26	5.44	4.07	4.05	4.50	5.50	3.32	5.01	4.52	4.83	4.73	8.52	6.07	60.56
Bacupey (Jobos).....	16	4.61	4.08	4.15	7.07	8.56	5.70	5.20	7.62	9.36	8.22	8.93	5.90	79.48
Barceloneta.....	14	5.77	4.64	3.52	3.75	5.50	3.17	5.88	4.31	5.47	5.03	8.40	5.36	60.80
Barros.....	11	5.63	3.15	5.89	4.93	9.37	4.13	7.35	4.58	8.34	8.93	8.98	7.68	78.96
Bayamón.....	30	4.89	3.21	3.82	5.00	7.33	7.44	8.38	8.40	7.76	6.57	7.54	6.24	76.58
Cabo Rojo.....	22	2.15	2.98	3.84	5.36	5.55	4.57	7.64	7.94	9.04	8.75	5.73	2.80	66.35
Caguas.....	30	3.86	2.44	2.97	3.84	5.03	5.92	7.10	6.43	6.90	7.32	6.37	4.79	62.97
Camuy.....	16	4.03	2.92	3.25	3.32	3.74	2.49	3.53	3.78	4.56	4.67	6.85	4.36	47.50
Cangrejo.....	8	4.67	3.78	2.39	3.98	5.83	5.59	6.47	4.54	6.34	7.28	7.86	4.99	63.72
Canóvanas.....	40	5.69	3.34	3.95	5.03	6.84	6.82	9.55	8.18	7.08	7.07	9.02	7.32	79.89
Carite Camp.....	18	4.79	4.94	4.73	4.70	6.57	7.55	9.63	7.61	9.12	10.38	8.17	4.71	82.90
Cayey.....	30	3.21	2.83	2.90	3.47	4.44	5.64	6.22	6.53	6.60	6.37	6.26	4.13	58.65
Cepero.....	17	5.26	3.94	3.94	5.57	7.21	6.02	8.57	6.94	7.73	7.06	8.41	5.80	76.45
Cidra.....	23	6.67	4.14	4.32	5.14	7.49	7.20	8.33	10.16	7.35	5.90	6.86	6.89	80.45
Coamo.....	8	3.43	1.48	1.77	3.80	4.26	5.60	3.60	5.97	5.26	6.81	6.43	4.04	52.45
Coamo Springs.....	9	0.70	2.29	1.86	2.73	3.88	2.61	3.58	6.22	5.98	5.65	5.18	0.90	41.58
Coloso.....	30	2.13	2.09	2.97	4.90	9.92	12.20	9.37	9.99	10.80	8.32	6.79	2.60	81.58
Comerio Falls.....	22	6.63	4.53	4.85	5.78	5.70	4.52	7.91	8.29	7.69	6.70	8.57	7.11	78.28
Corozal.....	28	5.37	4.40	4.61	6.58	7.50	5.35	7.69	7.96	7.78	7.48	8.98	7.41	81.11
Culebra Island.....	7	2.88	2.15	2.10	1.77	4.54	2.72	2.73	4.70	5.15	4.28	5.53	2.62	41.17
Destino.....	16	1.14	1.34	1.16	1.81	3.19	2.73	2.45	3.47	5.77	4.84	3.95	1.29	33.14
Dorado.....	21	5.45	4.19	3.94	4.67	5.69	4.65	6.68	5.95	6.15	5.38	8.92	6.21	66.88
Ensenada.....	27	0.72	1.17	1.22	1.98	2.78	2.17	1.75	2.70	3.75	4.02	3.34	1.11	26.71
Fajardo.....	30	3.50	3.01	3.11	3.71	5.40	4.96	5.88	5.54	7.30	8.34	8.64	4.86	64.25
Guajataba.....	8	4.00	4.47	4.32	7.86	7.97	8.58	6.80	8.07	11.42	8.87	6.59	5.17	84.12
Guayama.....	18	2.11	2.37	2.04	2.17	4.34	5.11	5.19	4.52	6.91	7.23	5.52	2.46	49.97
Humacao.....	30	4.08	3.48	3.56	4.54	8.54	8.62	8.36	8.54	9.92	9.90	9.03	4.92	83.49
Inabón Falls.....	8	5.46	6.68	6.64	9.11	14.61	10.52	11.00	10.45	14.16	14.20	11.52	5.27	119.62
Isabela.....	30	3.43	2.69	2.58	3.53	5.27	3.89	3.49	4.82	5.05	4.94	7.41	4.62	51.72
Isidora.....	12	0.89	1.41	0.88	1.20	2.00	1.90	2.12	2.08	4.82	4.68	3.76	0.74	26.48
Isolina.....	20	5.58	3.79	6.62	7.48	11.95	6.07	6.18	8.18	11.15	9.27	10.55	7.11	93.93
Jájome Alto.....	16	4.36	4.65	4.74	4.61	6.14	7.54	9.09	7.39	10.20	8.25	7.25	4.74	79.05
Jayuya.....	20	2.25	2.20	5.53	7.26	6.38	3.95	6.02	5.89	10.37	8.10	7.02	2.45	67.42
Josefa.....	28	1.74	1.95	1.86	2.04	4.16	5.18	5.13	4.52	6.95	7.62	5.36	2.12	48.63
Juana Díaz.....	30	1.07	1.71	2.10	3.50	4.63	4.51	3.87	6.08	7.24	8.65	5.08	1.80	50.24
Juncos.....	19	3.24	2.78	2.88	3.61	5.59	5.70	7.55	7.49	8.02	8.20	7.35	3.02	65.43
La Carmelita (A).....	9	2.92	2.88	5.33	6.65	10.83	7.25	7.61	11.45	13.06	15.20	11.07	6.75	101.00
La Carmelita (B).....	9	4.26	3.91	6.41	6.93	11.84	7.28	7.77	13.09	14.23	15.86	12.09	7.58	111.25
La Fe.....	4	4.46	4.42	6.84	5.84	9.95	9.50	14.36	11.02	13.48	22.49	19.86	5.46	127.68
Lajas.....	7	2.18	0.79	2.53	2.10	4.13	5.52	5.41	5.75	44.83	5.67	6.58	2.12	47.61

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MEAN MONTHLY RAINFALL—Continued

	Years	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Lares.....	24	3.26	3.60	4.39	9.16	11.74	9.99	8.46	9.26	12.23	12.32	8.79	5.03	98.23
Las Marias.....	17	2.75	2.61	4.72	6.49	12.37	10.66	9.34	12.14	13.24	12.37	8.97	3.72	99.38
Luquillo (La Perla).....	9	8.21	3.37	6.54	11.27	14.94	13.75	14.56	11.14	12.24	13.94	16.23	9.36	135.55
Manati.....	30	5.14	4.22	4.66	5.26	5.89	4.16	6.03	5.00	6.45	5.68	8.27	6.75	67.51
Maricao.....	18	1.92	3.14	4.65	8.36	10.77	9.18	12.75	13.40	13.26	15.80	9.37	3.68	106.28
Maunabo.....	30	3.70	3.27	3.45	3.24	5.86	8.22	7.15	7.10	9.50	9.81	8.55	5.00	74.85
Mayagüez.....	30	1.89	2.20	3.31	5.52	7.94	9.00	11.23	11.26	10.78	9.99	6.42	2.62	82.16
Mona Island.....	11	1.05	2.32	2.44	2.09	3.15	2.75	3.26	2.97	4.38	4.22	4.06	2.14	34.03
Morovis.....	9	5.25	3.38	6.38	5.74	8.35	5.63	6.46	11.06	8.61	10.01	8.62	7.70	87.19
Naguabo.....	15	4.46	3.84	3.60	5.16	8.39	6.74	7.41	7.47	9.55	9.62	9.94	5.65	81.83
Oriente.....	3	3.61	3.58	4.66	5.17	8.78	4.82	2.77	4.47	5.09	7.86	8.33	6.32	64.26
Paraiso.....	4	6.77	4.85	5.44	6.78	10.10	10.56	5.28	12.17	13.84	10.47	4.13	96.86	
Petillas Reservoir.....	18	3.41	3.27	2.73	2.46	4.92	6.08	7.11	6.23	7.07	8.27	6.75	3.70	62.00
Petucas.....	21	1.58	2.69	2.04	4.19	4.90	4.15	4.82	6.10	6.99	8.56	5.85	2.07	35.94
Ponce.....	28	1.01	0.99	1.44	2.08	3.06	3.46	2.97	4.16	4.97	6.45	4.05	1.22	35.88
Potala.....	21	0.86	1.27	1.04	2.21	2.65	2.10	2.42	3.79	4.61	4.88	3.42	0.99	30.24
Río Blanco Florida.....	18	5.57	5.01	5.13	5.81	9.35	10.19	9.33	9.61	12.20	11.02	11.41	7.61	102.24
Río Blanco (A) P. R. R. & L.....	5	10.31	10.12	9.55	9.91	11.77	12.25	13.09	12.61	12.95	12.76	13.34	11.99	149.56
Río Blanco (B) P. R. R. & L.....	5	11.58	11.17	9.81	9.94	12.07	13.25	13.45	13.31	13.36	10.48	13.60	12.97	144.99
Río Blanco (C) P. R. R. & L.....	5	5.50	6.66	4.33	5.85	7.94	8.85	9.47	10.46	10.28	10.80	10.92	8.60	99.66
Río Grande.....	14	6.43	5.84	5.13	5.26	7.23	7.68	12.12	8.06	9.09	7.92	10.32	9.68	94.79
Río Piedras.....	28	4.69	3.47	3.78	4.96	6.65	6.16	7.85	7.54	8.05	6.54	7.30	6.47	75.46
Sabana Grande.....	18	1.60	2.19	3.17	5.10	5.03	3.19	5.95	7.00	6.87	9.12	7.92	2.85	69.03
San Cristóbal.....	4	4.04	3.83	3.74	5.67	7.75	6.10	10.96	8.31	12.24	12.59	10.21	4.77	90.24
San Germán.....	30	1.96	2.55	3.52	6.49	5.59	4.31	5.79	7.45	7.39	9.05	6.86	3.19	64.25
San Juan (U. S. W. B.).....	30	4.14	2.76	3.10	4.24	5.37	5.21	6.02	6.12	6.17	5.74	6.99	5.47	61.33
San Juan (Spanish).....	32	3.02	2.34	2.38	3.59	4.73	4.89	5.76	5.92	5.09	6.01	6.43	4.23	54.39
San Lorenzo.....	16	3.13	2.53	3.84	4.35	6.63	10.17	8.81	8.24	9.09	8.79	7.71	4.47	77.75
San Lorenzo (Farm).....	4	2.47	2.84	2.74	3.18	5.20	4.13	6.34	6.59	9.12	7.55	7.43	2.78	69.47
San Salvador.....	20	3.40	2.78	4.19	6.74	8.77	5.80	6.94	7.74	9.77	10.61	8.63	4.91	80.28
San Sebastián.....	17	3.64	2.45	4.94	8.24	13.29	12.47	9.53	11.01	12.59	11.91	9.01	3.95	103.09
Santa Isabel.....	28	1.04	1.01	1.11	1.62	3.45	2.62	2.85	3.52	4.46	5.93	4.10	1.97	33.68
Santa Rita.....	21	0.91	1.71	1.06	2.22	2.49	1.84	2.38	3.33	4.10	4.83	3.73	1.02	29.62
Toro Negro.....	18	3.88	4.39	4.57	8.43	9.02	6.64	7.43	7.54	13.01	14.50	10.90	4.84	95.00
Utua.....	15	3.72	1.86	3.64	6.94	8.19	7.66	6.47	7.68	12.75	10.24	7.66	3.89	80.89
Vieques Island.....	30	2.95	2.53	2.21	2.68	3.53	3.96	4.24	4.55	6.12	6.26	5.77	3.35	48.15
Vieques Sugar Co.....	11	2.40	2.45	1.93	1.47	3.50	3.66	4.30	4.32	5.99	5.61	6.94	2.96	45.53
Yabucoa.....	24	3.98	4.04	3.04	3.73	7.10	7.08	7.75	7.55	10.24	9.82	9.20	4.92	78.45
Yauco.....	12	2.05	0.92	2.51	3.36	4.48	5.28	3.87	5.84	5.70	6.82	5.33	1.76	47.92
Means.....	18.5	3.70	3.26	3.72	4.89	6.89	6.16	6.97	7.31	8.48	8.69	7.91	4.64	72.62

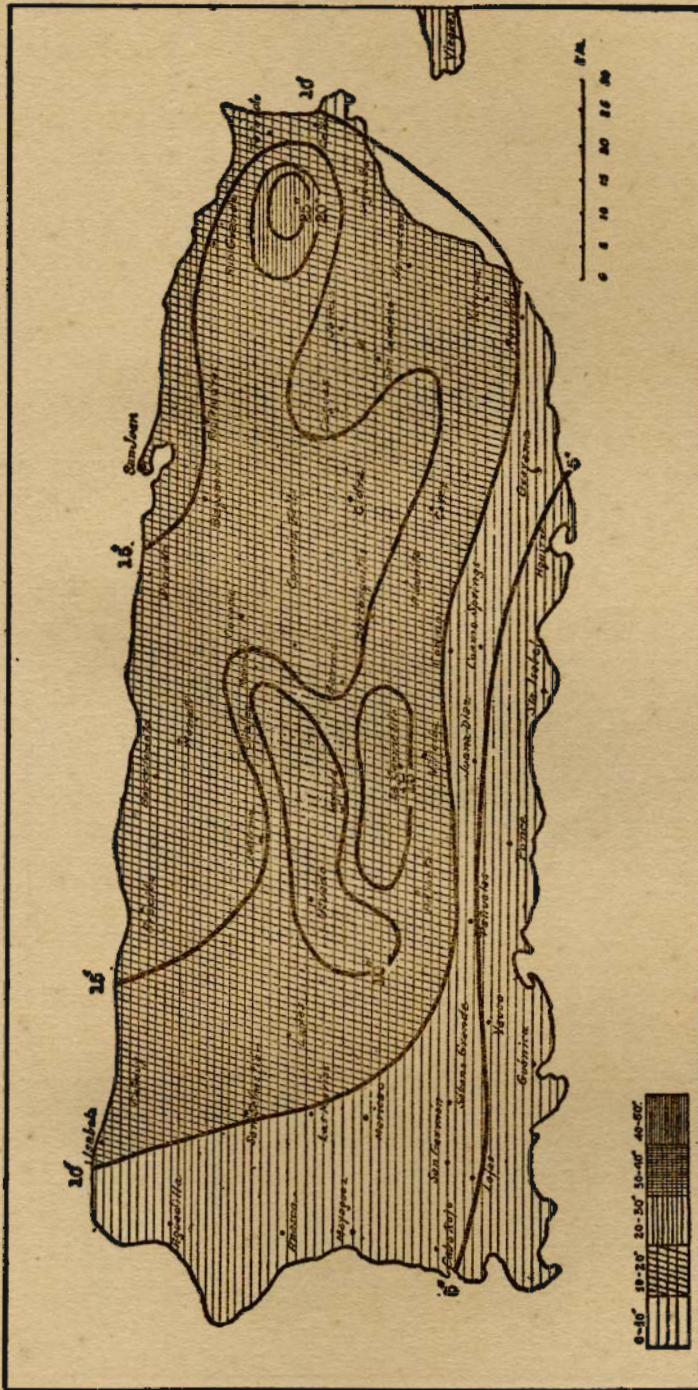


CHART I.—AVERAGE WINTER RAINFALL. (DEC., JAN., FEB., 1899-1928.)



CHART II.—AVERAGE SPRING RAINFALL. (MARCH, APRIL, MAY, 1899-1928)

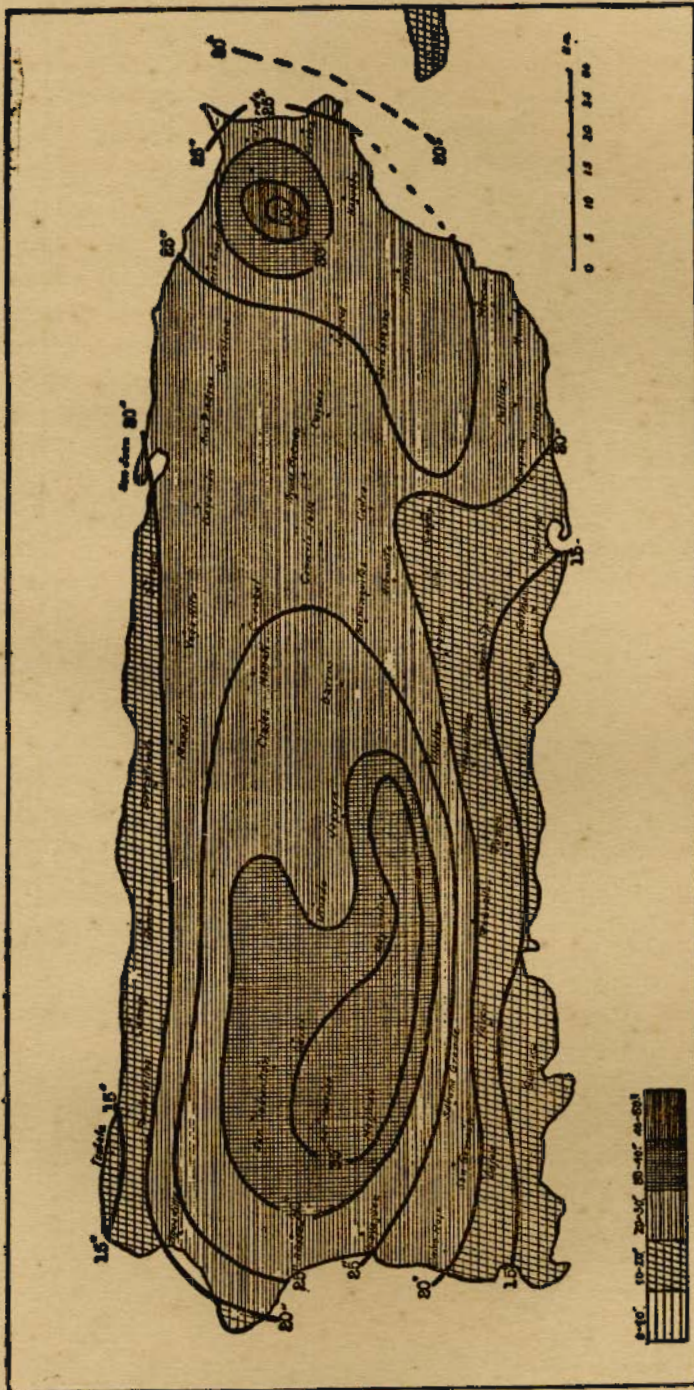


CHART III.—AVERAGE SUMMER RAINFALL. (JUNE, JULY, AUGUST, 1899-1928)



CHART IV.—AVERAGE AUTUMN RAINFALL. (SEPT., OCT., NOV., 1899-1928)



CHART V.—AVERAGE ANNUAL RAINFALL. (BASED UPON ALL AVAILABLE RECORDS FROM 1899 TO 1928.)