STUDIES ON THE FAUNA OF CURAÇAO, ARUBA, BONAIRE AND THE VENEZUELAN ISLANDS: No. 1.

GENERAL INFORMATION

The region which forms the field of these studies lies between Trinidad and the Goajira-peninsula, off the northcoast of South America, comprising of seventeen islands or island-groups with a total area of about 2000 square kilometers. It is a part of the Venezuelan Republic, excepting Curaçao, Aruba and Bonaire, which is Netherlands territory. The total number of inhabitants can be estimated at 164000, chiefly confined to Margarita (70000), Curaçao (61000), Aruba (24000), Bonaire (5500) and Coche (3000).

This region was visited in 1936 and 1937 with the main object of studying the land and freshwaterfauna, excluding birds and the greater part of the insects. For comparison some parts of the adjacent continent were also visited.

Already in 1868, a clergyman, G. J. Simons, gave an enumeration of 265 kinds of animals, occurring on the island of Curaçao; the value of this list however is very doubtful.

Scientific surveyance of the Leeward Group began in 1885, by an expedition of Prof. K. Martin, geologist, and Prof. W. F. R. Suringar, botanist, both of the Leyden University,

with an entomologist, J. R. H. Neervoort van de Poll, and two students.

In 1899 J. Boeke was send to the Dutch West Indies to study the fisheries; in 1921—1922 the geologist G. J. H. Molengraaff examined Curaçao, and in 1922 C. J. van der Horst, conservator of the Zoological Museum at Amsterdam, stayed for some time on the same island to make a study of the sea-fauna. All three brought back a small collection of land animals.

The U. S. A. has given more proof of their permanent interest in the zoology of the Leeward Group. Several official institutions, principally the Field Museum of Natural History and the University of Michigan Museum of Zoology, have sent their staff-members and collectors to this region and have encouraged private research. In this connection only the names of Henry R. Raven (abt 1870), J. E. Benedict and W. Nye (1884), Wirt Robinson (1895), Austin H. Clark (1901), Ned Dearborn (1908), John F. Ferry (1909), Horace Burrington Baker (1922), Paul Bartsch (1929) and Horace G. Richards (1939) may be mentioned. The works of Ernst Hartert (1892) and Percy R. Lowe (1904, 1906), and the researches of Adolf Ernst (1871, 1873, 1874), J. S. Gibbons (1877), Ernst Peters (1890), Alfons Gabriel (1922-25) and Alf Wollebæk (1925) show however, that also other nationalities were fascinated by this desert-island animal world.

The author's interest in the Caribbean Islands off the Venezuelan coast was roused by the news, that Prof. L. M. R. Rutten, with his wife and five students of the Utrecht University, had planned a geological excursion to Curaçao, Aruba and Bonaire. After acceptance as a member of this party, we had a glorious time, camping in western Curaçao (14.IV.—4.V.), Bonaire (10.V.—10.VI.) and Aruba (16.VI.—9.VII. 1930). After a wonderful excursion through the mountains of Táchira and Falcón, as guests of the Caribbean Petroleum Company, we returned to Curaçao where the „Utrechtsche Antillen Excursie 1930" came to an end.

During this trip birds were collected by M. G. Rutten and L. W. J. Vermunt, while H. J. MacGillavry spent his spare time collecting insects. After the departure of my fellow-travellers, I again visited Bonaire, from August 20th until December 7th.

Most of my time was devoted to the study of marine fauna, although much attention was given to inland-waters. The results of this trip, appearing under the title of "Zoologische Ergebnisse einer Reise nach Bonaire, Curaçao und Aruba, im Jahre 1930" were published in the "Zoologische Jahrbücher, Abteilung für Systematik, Ökologie und Geographie der Tiere", vol. 64, 1933 (Nr. 1—12) and vol. 67, 1936 (Nr. 14—22), the "Capita Zoologica", vol. 8, 1936 (Nr. 23), 1937 (Nr. 24), 1939 (Nr. 25—27), and "Mémoires du Musée Royal d'Histoire Naturelle de Belgique" ser. 2, part 2, 1935 (Nr. 13). In this series publications of W. Michaelsen (Nr. 2, Oligochaeta), H. Augener (Nr. 3, Polychaeta), Walter Rammner (Nr. 4, Phyllopoda), Walter Klie (Nr. 5, Ostracoda), P. A. Chappuis (Nr. 6, Harpacticoida), Friedrich Kiefer (Nr. 7, Cyclopoida), K. Stephensen (Nr. 8, Amphipoda), C. Willmann (Nr. 10, 20, Oribatidae), Max Beier (Nr. 21, Chernetes) and M. Sanders (Nr. 22, Pisces) dealt with the land and freshwaterfauna.

In 1936 and 1937 I again visited the same islands, the main object being to investigate the land and freshwaterfauna. The field was however extended to the Venezuelan islands and a short visit was made to some parts of the adjacent continent for comparison.

Margarita was traversed by car, with Porlamar as head-quarters (10.V.—8.VI., 20—24.VI., 29.VI.—18.VII., 4.VIII.—13.VIII. '36). The islands South and East of Margarita, and the coast of the state of Sucre were visited by a 4 ton sailing boat (21.V., 9.VI.—19.VI., 25.VI.—28.VI.); the islands to the West, as far as the Aves de Barlovento, were reached by a 10 tonner (19.VII.—4.VIII.). On Curaçao (21.VIII.—12.XI., 16.XI.—2.XII. '36, 3—12.III., 2—4.IV. '37), Aruba (4.XII. '36—13.I. '37, 29.I.—

13.II., 25.II.—2.III. '37) and Bonaire (13—15.XI. '36, 22.III.—1.IV. '37) I stayed at Piscadera Baai, Oranjestad and Kralendijk. A coaster brought me to Las Piedras, whence I visited the interior of the peninsula of Paraguaná (14.II.—24.II. '37), and to Puerto López, from where I crossed the peninsula of La Goajira to Rio Hacha and the Cabo de la Vela (14.I.—28.I. '37).

My grateful thanks are due to the Netherlands and Venezuelan authorities whose kind assistance made travelling with heavy luggage smooth and pleasant, and to everybody else who facilitated my work. My weakness for the West Indies has been really intensified by the friendly and helpful attitude of the natives, which I encountered even in the most remote spots of the Caribbean.

With special gratitude I must refer to the kind gesture of Dr. E. Heldring, through whom the useful and helpful services of Mr. Chr. L. Bakker, inspector of the Royal Dutch Steamship Company at Caracas, were placed at my disposal. Mr. Bakker officially prepared my visit to Margarita and Paraguaná and brought me in touch with the family Abouhamad at Porlamar, who were very kind to me during my stay in Margarita and whose help proved indispensable. The kind assistance of Clemente Sibú and his family, whilst staying at "Hotel Central" in Porlamar, must also be mentioned. On Paraguaná I was the guest of the Mene Grande Oil Company's Terminal Las Piedras.

My thanks too must be offered for the car placed at my disposal by Mr. L. Wagemaker and Mr. J. M. St. van Eps, the "gezaghebbers" of Aruba and Bonaire, but the greatest piece of luck was when the "N.V. Curaçaosche Petroleum Industrie Maatschappij", represented by Mr. W. van Eijk, spontaneously loaned me a car for three months, and in that way made possible an extensive exploration of the island of Curaçao.

Lastly I should like to emphasize that, without the unending generosity and interest shown by my parents, my neotropical investigations would be altogether out of the question.

CLIMATE.

The islands are strongly exposed to the tradewinds, which blow with great steadiness nearly the whole year, directions not differing much from ENE and E, with a mean velocity of about 5 m sec. (3,4 Beaufort) [Table 1 and 2]. The seawind blows with only slightly diminished force also during the night, rendering the heat less oppressive than the high daily means of temperature would suggest. Only one temperature maximum occurs in the course of the year, August and September being considered the hottest months, January and February the coolest; the difference between highest and lowest monthly means however, rarely exceeds 4° C [Table 3].

The islands are just S of the most southernly hurricane-tracks, only occasionally cyclones exert their influence at a fairly safe distance.

According to its marine situation, the mean relative humidity is always rather high, the year-mean for Curaçao being about 75 %. The degree of cloudiness is rather low. Even in the rainy season drizzling weather is rare and the rain falls in short-lived showers, followed by a rapid clearing. Cloudiness is highest in the morning, lowest at noon and again increasing before sunset. On Margarita the highest part of the mountains are frequently wrapped in clouds during twilight, night and dawn.

The mean evaporation of a free watersurface on Curaçao, calculated from monthly means by M o l e n g r a a f f, may be estimated at 4.5 (Dec.)—7.5 (Aug.) mm a day.

The Leeward Group wholly falls within the area of low rainfall which extends along the N-coast of South America, between the mouths of the Río Orinoco and that of the Magdalena. The climate of this isolated dry region belongs to the "steppe-climates" of K ö p p e n, which are defined by a rainfall of 340—680 mm a year, if the annual temperature is 27° C. Several scattered smaller areas are certainly still dryer and may therefore fall within the "desert-climates" of K ö p p e n. The higher mountains of Margarita and, in less degree, also the highest tops of Tamarindo and Curaçao, may receive considerably more rain and form wet islands in a dry surrounding.

TABLE 1.

Wind at Willemstad (from Braak, 1935)

	Jan.	Febr.	March	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Fort Amsterdam, 1910—Juni 1921 (surrounding buildings made the site of observation unfavourable)													
Mean windforce (Beaufort)	2.6	2.7	3.0	3.1	3.2	3.5	3.3	2.9	2.7	2.1	1.8	2.2	2.8
Mean windvelocity (m. p. s.)	3.5	3.7	4.4	4.5	4.8	5.3	4.8	4.1	3.6	2.7	2.2	2.8	3.9
Direction wind-vector (N...E)	85°	85°	84°	86°	87°	87°	87°	88°	89°	89°	87°	86°	87°
Stability (%)	97	97	98	98	98	99	98	97	98	94	95	98	97
Cas Chiquito, July 1921—1926 (a little farther from the sea but in a more favourable position)													
Mean windforce (Beaufort)	3.1	3.1	3.5	3.9	4.1	4.0	3.8	3.6	3.2	2.6	2.4	2.6	3.3
Mean windvelocity (m. p. s.)	4.5	4.5	5.3	6.1	6.5	6.3	5.9	5.5	4.7	3.5	3.1	3.5	4.9
Direction wind-vector (N...E)	94°	94°	90°	94°	96°	94°	97°	97°	98°	99°	91°	91°	95°
Stability (%)	93	94	93	96	95	96	94	92	90	84	88	91	92

TABLE 2.

Frequencies of windforce and winddirection, numbers for 10000 observations, at Willemstad (Fort Amsterdam), 1910—Juni 1921.

(from Braak, 1935; surrounding buildings made the site of observation unfavourable)

Beaufort	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	Total
0	—	—	—	—	—	—	—	—	—	—	—	—	—	474
1	4	2	63	164	596	51	35	4	14	1	6	—	2	942
2	3	1	88	389	1460	60	54	3	5	2	2	—	—	2067
3	2	1	81	544	3223	66	29	2	2	2	3	—	3	3958
4	—	—	24	247	1771	20	7	—	—	—	1	1	—	2071
5	—	—	6	59	383	4	—	—	—	—	—	—	—	452
6	—	—	—	6	27	1	1	—	—	—	—	—	—	35
7	—	—	—	—	1	—	—	—	—	—	—	—	—	1
Total	9	4	262	1409	7461	202	126	9	21	5	12	1	5	10000

TABLE 3.

Temperature

Willemstad from Braak, 1935; Maracaibo from Jahn, 1934.
Las Piedras from the original records of the Mene Grande Oil Co. C.a.

	Las Piedras (1927-29, 1931-36)			*Willemstad* (1910-1933)					*Maracaibo* (1915-1931)		
	Mean	Mean min.	Mean max.	Mean	Mean min.	Mean max.	Abs. min.	Abs. max.	Mean	Mean min.	Mean max.
Jan.	26,5	21,8	31,2	25,8	23,1	28,6	20,1	30,5	27,1	23,7	31,0
Febr.	27,0	22,2	31,8	25,8	23,1	28,7	19,0	32,6	27,2	23,9	31,3
March	27,9	23,0	32,8	26,2	23,5	29,2	17,0	32,2	27,6	24,5	32,0
April	28,7	24,0	33,4	26,8	24,3	29,7	20,1	32,5	28,2	25,2	32,4
May	29,5	24,8	34,2	27,5	25,0	30,4	21,0	35,5	28,1	25,7	33,0
June	29,7	25,0	34,4	27,6	25,1	30,5	21,5	34,3	28,8	25,9	33,1
July	30,0	25,2	34,8	27,7	25,0	30,5	22,0	34,5	29,1	25,8	33,4
Aug.	30,4	25,4	35,4	28,1	25,4	31,1	21,5	35,0	29,0	25,8	33,4
Sept.	30,6	26,0	35,2	28,5	25,8	31,5	21,5	35,6	28,6	25,5	32,4
Oct.	30,7	25,6	35,8	28,2	25,5	31,0	21,0	34,5	28,1	25,0	31,5
Nov.	28,6	24,6	32,6	27,5	24,6	30,2	20,0	33,5	27,6	25,0	30,9
Dec.	26,8	22,6	31,0	26,7	23,9	29,2	20,4	32,3	27,5	24,4	30,9
Year	28,9	24,2	33,6	27,2	24,5	30,0	17,0	35,6	28,1	25,0	32,1

In Curaçao, Aruba, Bonaire and, probably, the neighbouring islands as far as Orchila, the rainfall is scarce from February till September. On Curaçao the precipitation in the dry-season is about 200 mm, against 350 mm in the wet-season, October till January. A similar relation exists in Paraguaná and La Goajira. On the eastern Venezuelan Islands however, the heaviest rain falls later in the season, while the midsummer-rains are also important, being the main water supply of the opposite mainland [Table 4]. The distribution of the rainfall is rather irregular, owing to the frequent occurrence of local showers.

On Curaçao the number of rain-seasons, in which the precipitation is less than the mean rainfall, is larger than the number in which it is more. If, during the rain-season there is less than the mean, we might add these four months to those of the dry-season, getting in this way the notion of dry-period, which lasts at least 8 + 4 + 8 months. By a succession of poor rain-seasons

TABLE 4.

Mean Rainfall

Carúpano, La Asunción in part, Cumaná, Coro and Maracaibo from Pittier, 1936; Kralendijk, Willemstad and Oranjestad from Braak, 1935; La Asunción in part and Las Piedras from the original records.

	Carúpano (1920-33)	La Asunción (1920-29, 1931-35)	Cumaná (1919-31)	La Guaira (1920-33)	Kralendijk (1905-33)	Willemstad (1894-1933)	Oranjestad (1901-1933)	Coro (1920-33)	Las Piedras (1927-29, 1931-36)	Maracaibo (1915-31)
Jan.	45	93	5	27	55	55	50	19	12	3
Febr.	30	41	4	20	27	26	14	5	9	1
March	27	25	4	28	15	22	14	17	4	4
April	19	6	3	20	16	21	14	11	5	15
May	55	10	10	33	12	12	11	30	16	59
June	162	42	25	56	16	22	13	12	8	61
July	132	44	43	38	26	30	23	35	8	54
Aug.	109	36	56	33	24	34	23	21	16	53
Sept.	71	32	51	65	39	32	35	44	41	75
Oct.	58	31	29	42	70	90	67	59	87	121
Nov.	77	48	47	74	122	126	109	75	99	79
Dec.	92	99	44	62	90	89	74	42	49	13
Year	877	507	321	498	511	559	447	370	354	538
Minim.	439 (1920)	96 (1924)	56 (1919)	201 (1930)		137 (1930)		107 (1920)	138 (1929)	256 (1930)
Maxim.	1431 (1933)	1271 (1927)	851 (1931)	1403 (1927)		1075 (1906)		763 (1932)	663 (1933)	1179 (1931)

such a dry-period may extend for several years. M o l e n g r a a f f determined, largely on rainfall-observations of the last 200 years, the following dry-periods for Curaçao: 3 periods of 68 months, 3 of 56, 3 of 44, 3 of 32 and 10 of 20 months. Probably such unfavourable conditions also occur in other parts of this dry region.

SURFACE-WATER.

The drainage area being mostly hilly and little wooded, the weathered surface layers thin and the showers heavy, much rainwater runs straight to sea. Therefore many valleys are dammed for agricultural purposes, changing the surfacewater into groundwater. The accumulated water usually gets a bad composition and dries up; often wells are dug behind the dams for drinking and irrigation purposes.

In the limestone region most of the rainwater quickly reaches the watertable and often runs along the surface of the underlying and more impervious rock. Where this horizon is exposed springs are to be expected. These hillside springs are often permanent, although clearly influenced by the rainfall (e.g. Hato and San Pedro on Curaçao, Fontein in Bonaire and Aruba).

In the lower limestone regions, every hole and fissure which reaches the watertable, may be connected with large cavities filled with fresh or brackish water. The cavern-water has pushed aside the seawater and is often clearly in balance with it. In the limestone-plateau of southern Bonaire the watersurface in such holes after rains quickly reaches again its normal level, scarcely lowering in the dryest periods. In several of these holes, as far as and more than 1 km from the shore (Pos Calbas), oscillations of the watertable may be observed, which must be associated with the tide.

In the non-calcareous regions permanent springs are less frequent. On Curaçao four or five occur in the neighbourhood of the Seroe Christoffel and on Bonaire one exists on the northern slope of the Brandaris. On Aruba there are more, even forming rivulets, which however are of little importance owing to their high salinity.

On Margarita, several small streams find their way down from

the Cerros de Copey, swelling no doubt during rains to torrents, but in the dry season they become rather insignificant brooklets, drying up long before reaching the sea, and are scarcely sufficient to supply the more populated centres with drinkwater.

VEGETATION.

Resulting from the unfavourable rainfall-conditions, the "tropical dry-forest" vegetation has a pronounced xerophytic character, dominated by deciduous and thorny shrubs of Euphorbiaceae, Mimosaceae, Papilionaceae, Rubiaceae and cactuses. Frequently it has been developed as an open vegetation with scattered shrubs and occasional small trees. In Venezuela this type is called "espinares" or "cardonales", characterized resp. by a predomination of thorny shrubs and columniferous cactuses; on the Dutch Islands it may be generally called "Croton-vegetation", determined by *Croton flavens* and *Acacia*. The ground is very exposed, in a few places only a more coherent plantcovering has been more or less artificially obtained. Where desert conditions prevail or the soil is fully exposed to the tradewind, a very scanty plantlife may be observed. The sabana's of La Goajira and northern Falcón are very poor, having a richer grassy covering in wintertime only.

A poor "tropical semi-deciduous forest" vegetation may be found in a few protected places with more favourable rainfall-conditions. In the Cerros de Copey on Margarita a more abundant vegetation occurs, occasionally even being comparable with "tropical rain-forest".

Along the sea-shore, also bordering the inland bays, a beach-vegetation may be found, often connected with a considerable growth of mangroves. Beach-vegetation appeared to be the only covering of several small islands, and the isolated rocks of Centinela and La Sola even were devoid of all plant life.

SOIL.

Nearly 30 % of the Leeward Group area consists of quaternary coralrock or coral-detritus; a very small area only is formed of older calcareous rock. On Curaçao, Aruba and Bonaire the higher

situated beds must have belonged to a limestone-cap, extending over the greater part of the islands, which is rarely more than 30 m thick. These beds are bordered by lower and younger limestone terraces near the sea. The limestone generally shows a "lapiés" or "Karren" habit, while the rock has been weathered into a reddish-brown substance which has been washed into caverns or removed by the wind. Many caves exist, often still filled with the groundwater, which are made accessible by collapse of the roof or exposure through an escarpment. In the higher parts, water and wind have created a cuesta-landscape, broad valleys with steep escarpments or narrow gorges, while near the coast the sea has modelled chasms and large coves. Tortuga, Las Aves, Klein Bonaire, Klein Curaçao and the Roques Islands, with exception of El Gran Roque, consist of corallogeneous material only. No limestone exists on the Testigos Islands, Los Frailes, Los Hermanos and Centinela.

The non-calcareous soil consists of igneous and sedimentary rock of various composition. In the dry season a rather constant aerial drift of finely weathered material may be observed, depriving the hills of their most valuable soilmaterial, which enriches the detritus-deposits towards the W and SW, but for the greater part is lost in the sea.

HISTORY.

Margarita was discovered by Cristóbal Colón in 1498; Curaçao by Alonso de Ojeda in 1499.

The interest of the visitors was keenly focussed on gold, pearls and slaves. At first the northcoast of South America was only occasionally ransacked, but soon this was more systematically done by the Spaniards from the settlements of Cumaná (1522), Coro (1527) and Santa Marta (1525), ably assisted by the Welser-firm from Augsburg until 1546. At this time the chief trade of the Spaniards had already been transferred to more inland centres, such as Caracas, Valencia, Mérida and Bogotá.

The pearlfisheries near Margarita were primarily organized from Cumaná; at first they were very profitable and even the

desert-island of Cubagua founded a settlement, but soon the great profits were cut down and Cubagua was abandoned. Nowadays, the pearlfisheries South of Margarita, strictly controlled by the Venezuelan Government, are still of importance, whilst those on the western coast of the peninsula of La Goajira have more obviously decreased.

The original inhabitants of Curaçao, Aruba, Bonaire and the opposite mainland, were the Caquetios, belonging to the Arowaks, while the inhabitants of Margarita and the adjacent continent were the Guaiqueris, belonging to the Caribs. The small part which survived the first contact with European civilisation was soon assimilated, only the indians from the Goajira-peninsula remained.

Curaçao was seized by the Dutch in 1634, as a base against the Spaniards. They searched for salt and logwood. Salt was chiefly taken from the pans of Punta de Araya and of Tortuga; later their want was provided by the salt industry of Bonaire, Curaçao and St. Martin. Logwood (*Haematoxylon Brasiletto*) was especially collected on Bonaire, Tortuga, Curaçao and Paraguaná.

Owing to its favourable situation and excellent anchorage, Curaçao soon became a centre of illicit trading and an important slave-market. Besides all this, much attention was given to planting. After the emancipation set-back in 1862 many experiments were carried out to improve agriculture and cattle-breeding, but without lasting success, leaving the shipping of Willemstad the only important feature of the colony. Some phosphate- and goldmining in Aruba, already stopped in 1916, and a more endurable exploitation of the phosphate-layers of Curaçao brought new profits, whilst the opening of the Panamá-canal greatly improved Curaçao's position in world-trade. The most drastic alterations however were connected with the development of the petroleum industry in the Maracaibo-basin, which gave rise to the establishment of large refineries on Curaçao and Aruba.

Margarita has seen fewer changes. Agriculture largely filled the local wants but has never been very important, and the mining of magnesite near Paraguachí was short-lived. The salt industry, a government monopoly, is extensively carried out along

the coasts of Sucre, Falcón and Zulia, on the island of Coche and on the western shore of La Goajira.

It is rather difficult to get an idea of the island-region vegetation in former days. The interest of the visitors was obviously concentrated on useful plants and the statements of the inhabitants were invariably biased. Although the first travellers already do not give a very cheerful account of the vegetation, yet it is without doubt that human agency has badly influenced the plantlife of this region. Especially in the beginning much has been carelessly cut down for private use, commerce or arable land. Charcoal-burning was always an important business. Goats were kept on a large scale and permitted to run wild even on the smallest island.

Along the Venezuelan mainland-coast the "espinares" and "cardonales" are distinctly spreading at the cost of the dry-forest, whilst the enormous extension of xerophytic associations in the basin of the Río Tocuyo is also due to wood-destruction. Very probably the greater part of the island-area is covered with second-growth, which might be rather poor in comparison with the original vegetation. It is not certain that this vegetation will even re-establish itself; in the mean time the weathered soil has been largely removed by wind and water and because of this much ground is hopelessly spoilt.

It is not impossible that, by altering the vegetation, human agency has noticeably changed the macro-climate, although there are no data which point to such a change in historical time. The occurrence of an isolated dry region along the northern coast of South America is generally explained by the presence of cold water, welling up from deeper layers, because the equatorial-current has been forced to move away from the continent beyond Trinidad; therefore it is not very probable that the climatological conditions have changed much since pleistocene time. On the other hand, the common occurrence of extensive weathered dripstone formations and the lack of important active dripstone deposits, show that the climate of Curaçao, Aruba and Bonaire must have been considerably less arid for some time, after the emergence of the lower limestone terraces.

It is clear that the arrival of man with his wood-destruction, land-cultivation and introduction of plants, cattle, fowl and domestic animals, has seriously impaired the local fauna. Animal life was constantly threatened. Turtles nowadays are very rare near the Dutch Islands, but in 1737 their slaughtering in Willemstad was prohibited because of the nasty smell. An order was issued the same year, protecting the booby's which occured in great numbers on Klein Curaçao, but which have at the present time entirely disappeared from this and the neighbouring islands. In 1926 several useful animals were protected in the territory of Curaçao; in 1931 this too was extended to some which were becoming extinct.

THE TERRITORY.

LOS TESTIGOS.

Eleven islands or island-groups, seven being of considerable size. Greatest distance between two islands estimated at 10 km; total area est. 4 km². Highest point abt. 200 m. Only the Morro de la Iguana and Tamarindo inhabited.

Morro de la Iguana.

Situated 11°21'30" N. Lat., 63°5'30" W. Long. Gr.; 1½ km S of Tamarindo, 70 km from the continent; separated from the latter by water of 60 m deep. Greatest length est. 1½ km, width ⅔ km; area est. ⅔ km². Highest point est. 100 m. Inhabitants (1936) 44.

Consisting of granitic rocks. Higher parts with a considerable growth of shrubs and small trees. A minor centre of fisheries.

Chiwo.

Situated 11°21'30" N. Lat., 63°5'30" W. Long.; 200 m N of the Morro de la Iguana. Greatest length est. 300 m, width 100 m; area est. 1/50 km². Highest point est. 20 m.

Consisting of granitic rocks. With some growth of shrubs and small trees.

Angoletta.

Situated 11°22' N. Lat., 63°5'30" W. Long.; 200 m S of Tamarindo, 1 km N of Chiwo. Greatest length est. 80 m, width 25 m; area est. 1/1000 km². Highest point est. 10 m.

Consisting of porphyrites. With a considerable growth of herbs and shrubs.

Tamarindo (Testigo Grande).

Situated 11°22'—11°24' N. Lat., 63°5'—63°7' W. Long.; 72 km from the continent, 155 km WSW of Grenada; separated from the former by water of 60 m deep, from the latter by water of abt. 1000 m. Greatest length est. 4 km, width 1 km; area est. 2½ km². Highest point abt. 200 m. Inhabitants (1936) 3.

Consisting of granitic rocks. Lee-side covered by a considerable growth of shrubs, the higher parts even rather densely wooded with small trees.

Isla de Conejo.

Situated 11°24' N. Lat., 63°5' W. Long.; 2½ km NNE of Tamarindo. Greatest length est. 1¼ km, width ½ km; area est. ½ km². Highest point est. 80 m.

Consisting of porphyrites. Lee-side with a rather considerable growth of shrubs and small trees.

LA SOLA.

Situated 11°20' N. Lat., 63°34' W. Long. Gr.; 24 km NE of Puerto Real, 50 km W of Tamarindo; separated from both by water of 40—50 m deep. Greatest length estimated at 30 m, width 15 m; area est. 1/3000 km². Highest point est. 7 m.

Consisting of an unknown kind of rook. Devoid of plant-life. (not visited)

LOS FRAILES.

Seven islands of considerable size and several rocks. Greatest distance between two islands estimated at 9 km; total area est. 1½ km². Highest point est. 100 m. Uninhabited.

Puerto Real.

Situated 11°11′—11°12′ N. Lat., 63°43′40″—63°44′50″ W. Long. Gr.; 13½ km NE of Margarita; separated by water of 30 m deep. Greatest length est. 2½ km, width ½ km; area est. ¾ km². Highest point est. 100 m.

Consisting of diabases and diorite. The vegetation is rather scanty, the lee-side only has often a considerable growth of low shrubs, cactuses predominating.

La Pecha.

Situated 11°12′—11°12′30″ N. Lat., 63°45′—63°45′30″ W. Long.; ¾ km NE of Puerto Real. Greatest length est. 1¼ km, width ²/₅ km; area est. ¼ km². Highest point est. 60 m.

Consisting of porphyrites. Lee-side with a considerable growth of low shrubs.

COCHE.

One large island and a couple of rocks.

Situated 10°44′—10°47′50″ N. Lat., 63°53′40″—63°59′50″ W. Long. Gr.; 9 km S of Margarita, 9 km from the continent; separated from the former by water of 50 m deep, from the latter by water of 10 m. Greatest length 11⁴/₅ km, corresponding width 5²/₅ km; area 50 km². Highest point abt. 60 m. Inhabitants (1926) 2865; San Pedro. Exports: salt.

The island is flattened and consists chiefly of thick deposits of non-calcareous debris lying on weathered schists.

The vegetation is very scanty, mainly composed of scattered shrubs and cactuses.

Centre of salt-manufacture and pearl-fisheries.

CUBAGUA.

One large island and a couple of rocks.

Situated 10°47′50″—10°50′20″ N. Lat., 64°8′40″—64°13′50″ W. Long. Gr.; 9 km S of Margarita, 15 km from the continent; separated from the former by water of 30 m deep, from the latter by water of 60 m. Greatest length 9²/₅ km, corresponding width 4²/₅ km; area 26½ km². Highest point abt. 60 m. Inhabitants (1936) abt. 30.

The island is flattened and consists chiefly of limestones.

The vegetation is very scanty, scattered cactuses predominating.

Recently inhabited by fishermen. The spanish settlement of Nueva Cádiz was abandoned in the 16th century.

MARGARITA.

One large island, one small islet and a couple of rocks.

Situated 10°51′40″—11°10′35″ N. Lat., 63°47′—64°24′40″ W. Long. Gr.; 22 km N of the continent; separated by water of 50 m deep. Greatest length

70 km, corresponding width 33 km; area, without inland-waters, abt. 850 km². Highest point 990 m (El Copey). Inhabitants (1926) 69392; Porlamar 10547, Punta Piedras 9060, La Asunción 7744, Juan Griego 4169, Santa Ana 3992, San Juan Bautista 3505, El Valle 3201, Pampatar 2722. Exports: dividivi, pearls, dried fish, straw hats, goatskins.

The island is composed of two parts, connected by a long, narrow wall of sand and coral-debris, between which is the large Laguna de Arestinga.

The central part of eastern Margarita consists of several metamorphic rocks, e.g. gneisses, mica-schists, serpentine-schists and marbles; in some localities other rocks occur which are very probably of granitic origin. In the SE there are considerable areas of calcareous shales and sandstones. The western part of the island, Macanao, also has a crystalline basement. In the S and the W thick layers of sand and non-calcareous debris have been deposited. Coral-limestone terraces occur in SW-Macanao and, in a lesser degree, at a few places near the S- and N-coast.

The vegetation of the coastal plains is usually very scanty; the lee-side of the hills however, is often covered by a considerable growth of shrubs, while the upper parts of the Cerros de Copey are densely wooded, with large trees in favourable localities. In some higher valleys the vegetation may even be rather hygrophytic.

The greater part of the inhabitants of San Juan Bautista, El Valle, La Asunción and Santa Ana are agriculturalists; principle products being corn, sugar cane, beans, bananas, coconuts, cotton, yuca, batates, dates, pineapple, mango, guayaba and citrus fruit.

Isla Blanca.

Situated 10°57'50" N. Lat., 63°47'50" W. Long.; 2 km E of Margarita; separated by water of 16 m deep. Greatest length 100 m, width 50 m, area estimated $^1/_{800}$ km². Highest point abt. 30 m. Uninhabited.

Consisting of phosphatized clastic rock, with guano-deposits. Only a few plants of *Philoxerus vermicularis* occurring.

LOS HERMANOS.

Five islands of considerable size and one small island, some accompanied by a couple of rocks. Greatest distance between two islands estimated at 15 km; total area est. 4 km². Highest point abt. 200 m. Uninhabited.

Morro Fondeadero.

Situated 11°44' N. Lat., 64°25' W. Long. Gr.; 22 km E of Blanquilla, 75 km N of Margarita; separated from the latter by water of probably more than 200 m deep. Greatest length est. 1 km, width ¾ km; area est. ½ km². Highest point est. 80 m.

Consisting of amphibolites, diorites and gabbros. With a rather considerable growth of shrubs and cactuses on the flattened top.

Morro Pando (Orquilla).

Situated 11°48' N. Lat., 64°26' W. Long.; 16 km E of Blanquilla, 7 km N of Morro Fondeadero; separated from the former by water of probably 100 m deep.

Greatest length est. 2 km, width 1¾ km; area est. 2 km². Highest point abt. 210 m.

Consisting of diorites. Lower lee-side covered by a considerable growth of shrubs, cactuses predominating; other parts with a more scanty plantcovering.

BLANQUILLA (Isla Blanca).

Situated 11°49′—11°55′ N. Lat., 64°35′—64°39′ W. Long. Gr.; 155 km E of Orchila, 115 km NE of Tortuga; separated from both by water of probably more than 1000 m deep. Greatest length 11½ km, corresponding width 6½ km; area abt. 45 km². Highest point abt. 60 m. Inhabitants (1936) 8.

The greater part of the island consists of a flat diorite landscape with gently sloping hills. Nearly 25 % of the area is occupied by coral-limestone, broadly capping the older rocks along the E-coast, and occurring as a very narrow, frequently interrupted border along the S- and SE-shore.

The landscape often has a sabana-like appearance, with grassy diorite hills and scattered bushes. The bays on the S-coast are lined with mangroves.

There is some cattle-breeding and several small coconut-groves occur in the S.

TORTUGA.

One large island with four small islets N and NW, a couple of rocks and a fragmentary reef along the S-coast.

Situated 10°54′30″—11°0′ N. Lat., 65°12′—65°24′30″ W. Long. Gr.; 77 km E of Centinela, 83 km from the continent; separated by water of abt. 200 m deep. Greatest length 23 km, corresponding width 10 km; area abt. 140 km². Highest point abt. 30 m. Usually uninhabited.

The island consists of coral-limestone in which three terraces of varying height may be distinguished.

It generally has a rather considerable growth of shrubs and small trees with cactuses. The S-shore is often lined with mangroves.

The SE-coast is frequently visited by fishermen and has abandoned salt-pans.

CENTINELA.

One small island with a rock-flat of abt. 2 m high, estimated at 300 m NNW.

Situated 10°48′ N. Lat., 66°6′ W. Long. Gr.; 110 km S of Orchila, 25½ km from the continent; separated from the former by water not exceeding 1000 m, from the latter by water of abt. 90 m deep. Greatest length est. 100 m, width 50 m; area est. 1/300 km². Highest point est. 20 m. Uninhabited.

Probably consisting of hornstone. Devoid of plant-life.

ORCHILA.

One large island, four islands of considerable size and several small islands and reef-fragments. Greatest distance between two islands 14 km; total area estimated at 32 km². Highest point abt. 120 m. Uninhabited.

The smaller islands are formed by a low terrace of coral-rock or are sandy keys with walls of coral-debris and low dunes. The most northern island was exploited for guano about 50 years ago.

Huespen.

Situated 11°47′—11°49′ N. Lat., 66°6′—66°13′30″ W. Long. Gr.; 52 km E of El Gran Roque, 128 km from the continent; separated from the former by

water of abt. 1400 m deep, from the latter by water probably not exceeding 1000 m. Greatest length 13½ km, corresponding width abt. 3 km; area abt. 25 km². Highest point abt. 120 m.

The island consists of several outcrops of granitic rocks and gneisses, connected by a very low limestone terrace, occupying abt. 70—80 % of the area, which is partly covered by sand and other detritus.

It has a scanty vegetation with some scattered cactuses and a few low shrubs.

LOS ROQUES.

One large island (according to the map), several islands of considerable size and a hundred or more small islands and reef-fragments. Greatest distance between two islands abt. 35 km; total area of the smaller islands estimated at 5 km², together with the large island — generally indicated on the map as "Cayo Grande" but not found by the author — possibly abt. 60 km². Highest point 123 m. Only El Gran Roque inhabited.

El Gran Roque.

Situated 11°57′—11°58′ N. Lat., 66°40′—66°42′ W. Long. Gr.; 77 km E of Ave de Barlovento, 145 km from the continent; separated from the former by water of probably more than 1000 m deep, from the latter by water of abt. 1200 m. Greatest length 3⅕ km, corresponding width 1 km; area, without inland waters, 1⅓ km². Highest point 123 m. Inhabitants (1936) 320.

The rocky part, consisting of granitic rocks, amphibolites and phosphorites, is very steep and has only on its SE-side considerable deposits of debris, which gradually pass into a sandy beach enclosing some shallow lagoons.

The rocky soil has a very scanty vegetation, without ordinary shrubs or trees. The detritus has only beach-vegetation with remnants of a considerable growth of *Rhizophora*.

A rather important centre of fisheries. The W-part has phosphorite-veins which are of little commercial value.

Isla Larga.

Situated abt. 11°54′ N. Lat.., 66°48′ W. Long.; abt. 6 km SW of El Gran Roque. Greatest length est. 5 km, width 1/10 km; area est. 1/5 km². Highest point est. 5 m.

Consisting of a wall of coral-debris, running E—W, with low dunes, occasionally broadened to a sandy area. It has beach-vegetation with some growth of *Rhizophora*.

Cayo de Agua.

Situated abt. 11°53′ N. Lat., 66°55′ W. Long.; abt. 25 km WSW of El Gran Roque. Greatest length est. 2 km, width 1/3 km; area est. 1/3 km². Highest point est. 10 m.

A sandy key, running E-W, with dunes; the W-part being connected to the main-part by a narrow sandspit of 200 m long, submerged at high tide. It has beach-vegetation, excepting seven miserable date-palms growing in the centre, and seven poor coconuts which occur in the W-part of the island.

LAS AVES.

Two or three islands of considerable size and a hundred or more small islands and reef-fragments, distinguished as Aves de Barlovento and Aves de Sotavento. Greatest distance between two islands abt. 30 km; total area estimated at 1½ km². Highest point est. 5 m. Probably uninhabited.

Ave de Barlovento.

Situated 11°27′ N. Lat., 67°25′ W. Long. Gr.; 85 km E of Bonaire, 24 km E of Ave de Sotavento, 152 km from the continent; separated from the former by water of probably more than 1000 m deep, from the latter by water of abt. 1800 m. Greatest length est. 3 km, width 1/7 km; area est. 1/10 km². Highest point est. 4 m.

Consisting of a wall of coral-debris, running E-W, which in the S. is broadened to a sandy area with very low dunes. It has beach-vegetation with a considerable growth of *Rhizophora*.

BONAIRE.

One large island and one much smaller island.

Situated 12°2′—12°19′ N. Lat., 68°12′—68°25′ W. Long. Gr.; 40 km E of Curaçao, 87 km from the continent; separated from the former by water of 1500 m deep, from the latter by water of 1700 m. Greatest length 35 km, corresponding width 11 km; area, without inland-waters, abt. 265 km². Highest point 243 m (Brandaris). Inhabitants (1937) 5565; Kralendijk, Rincón. Exports (1937): charcoal (59000 fl.), aloe-resin (58000 fl.), goats and sheep (15000 fl.), dividivi (12000 fl.), salt (5500 fl.), manure (4500 fl.).

The island mainly consists of: 1. The "Washikemba" formation, diabase and porphyrite, lavas and tuffs, with intercalations of cherts and limestones; forming the greater part of the hills, including the highest top. 2. A series of limestones and conglomerates, called "Rincón" formation and "Soebi Blanco" conglomerate, occurring only in small areas in the central part. 3. A deposit of upper-eocene marl SE of Fontein. 4. A quaternary limestone formation which occupies 65—70 % of the island area, encircling the older formations, forming table-mountains (up to 143 m) and a large plateau in the NE and in the S. In the NW hand-shaped bays occur; they are separated from the sea by a wall of coral-shingle and may be of considerable depth or entirely dry.

The greater part of the southern limestone plateau has beach-vegetation; this gradually passes into a *Croton*-vegetation which, in the higher parts, changes into a more forestlike type. Cereoidea are still more predominant than on the other islands, often entirely covering the hills. Bordering the Lac, probably the largest beach-forest of the Leeward Group occurs, its 1½ km² of *Rhizophora* being comparable only to the mangrove growth in the Laguna de las Maritas on Margarita.

A considerable part of the inhabitants are agriculturalists. Fruitgrowing is confined to small irrigated areas, called "hofjes", at Fontein and Bronswinkel.

Klein Bonaire.

Situated 12°9′—12°10′ N. Lat., 68°17′30″—68°19′30″ W. Long.; ¾ km W of Bonaire, separated by water of 42 m deep. Greatest length 4 km, corresponding width 2½ km; area abt. 7 km². Highest point 6 m. Uninhabited.

Consisting of a limestone-plateau. It has *Croton*-vegetation with some scattered trees.

KLEIN CURAÇAO.

Situated 11°59′—12°0′ N. Lat., 68°38′30″—68°39′ W. Long. Gr.; 11 km ESE of Curaçao, 61 km from the continent; separated from the former by water of 600 m deep, from the latter by water of 1400 m. Greatest length $2^2/_5$ km, corresponding width ¾ km; area abt. $1^1/_5$ km². Highest point nearly 3 m. Inhabited by 3 coast-guards.

Consisting of a coral-limestone plateau. It has a very poor beach-vegetation. In former days extensive guano-deposits have been levelled off.

CURAÇAO.

Situated 12°2′—12°23′30″ N. Lat., 68°44′30″—69°10′ W. Long. Gr.; 76 km E of Aruba, 64 km from the peninsula of Paraguaná, separated from the former by water of 1300 m deep, from the latter by water of 1400 m. Greatest length 59 km, corresponding width 11 km; area, without inland-waters, abt. 425 km². Highest point 372 m (Seroe Christoffel). Inhabitants (1937) 60.883; Willemstad 29000, Emmastad 24000. Exports (1937): oilproducts (117.382.000 fl.), phosphate (Tafelberg St. Barbara, 873.500 fl.), straw hats (291.000 fl.), dividivi (23000 fl.), orange-peel (2500 fl.), salt (1500 fl.).

The island mainly consists of: 1. A formation of diabases, exposed in two large areas, E and W, which are usually deeply weathered and much denuded. 2. The "Knip" beds, chiefly cherts and tuffaceous beds, cropping out in the most eastern part and forming the higher tops. 3. A few small areas of upper-cretacic "Seroe Teintje" limestone in the northern part of the island. 4. A somewhat larger deposit of upper-eocene "Seroe di Cueba" limestone in the N and probably also an eocene marl in the S, forming the Seroe Mainsjie. 5. The "Midden Curaçao" beds, composed of conglomerates, sandstones, shales and marls, chiefly occurring in the middle of the island. 4. A limestone formation which occupies 25—30 % of the island-area, partly encircling the older formations and forming conspicuous table-mountains (up to 230 m). Several hand-shaped bays occur, they may be of considerable depth or entirely dry.

The vegetation of Curaçao is nearly the same as that of Bonaire. On the diabase-hills in the E only a very scanty plant-life may be observed; the W however, is often rather densely wooded. The higher parts of the Seroe Christoffel have a rather different vegetation, more comparable with that of the lower parts of the Cerros de Copey.

Owing to shipping and industries, agriculture has been greatly neglected. Fruitgrowing in several "hofjes", and a little horticulture near Willemstad, is of local importance.

ARUBA.

Situated 12°24′30″—12°37′30″ N. Lat., 69°52′3″—70°4′ W. Long. Gr.; 27 km N of the peninsula of Paraguaná, 200 km E of the peninsula of La Goajira, separated from both by water of 180 m deep. Greatest length 30 km, corresponding width 8 km; area abt. 175 km². Highest point 188 m (Jamanota). Inhabitants (1937) 23.719; Oranjestad, St. Nicolaas. Exports (1937): oilproducts (149.303.000 fl.), aloe-resin, manure.

The island mainly consists of: 1. A diabase-schist-tuff formation, the principal rocks being diabases, cropping out in a hilly landscape which includes the highest top. 2. A quartzdiorite batholith with its differentiates, occupying the

greater part of the island. In distinction from the diabase landscape the diorite area is generally flat; one of the differentiates, "hooibergite", occurs as more or less steep hills (Hooiberg, 164 m), 3. A limestone formation which occupies abt. 35 % of the island area, partly encircling the older formations and forming rather conspicuous table-mountains (up to 135 m). A few handshaped bays occur, they are either entirely or almost dry. Dunes occur locally along the N- and E-shore. Along the S-coast lies a frequently interrupted shore-reef with a wall of coral-shingle and sand, up to 3 m above sea-level.

The vegetation of Aruba is largely comparable to that of Bonaire and Curaçao. The island is very scantily wooded; especially in the non-calcareous region in the N and the E a very scattered vegetation may be found. The reef has beach-vegetation with some growth of mangrove.

The agriculture was less affected by the industries than in Curaçao; the cultivation of *Andropogon Sorghum* is still of importance. Fruitgrowing is practically confined to the "hofje" of Fontein. The mining of gold and phosphate (Seroe Colorado) was of great importance until 1916.

LOS MONGES.

Three or four small islands and several rocks; distinguished as Monges del Sur, two islets to abt. 70 m high, Monge del Este, abt. 45 m high and Monges del Norte, seven rocks to abt. 45 m high. Greatest distance between two islands 14½ km; total area est. at ¼ km². Uninhabited. Monge del Sur consists of hornblende-rock and has little plant-life. (not visited)

CONTINENTAL COAST OF SUCRE.

Peninsula de Puerto Santo.

10°44′ N. Lat., 63°10′ W. Long.; connected with the mainland by a 1½ km long, sandy wall; length 1 km, width ½ km, area ¼ km²; highest point estimated 100 m. Uninhabited. Crystalline schists and marble. Considerable growth of herbs and shrubs with scattered small trees.

Morro de Puerto Santo.

10°44′ N. Lat., 63°10′30″ W. Long.; 200 m from the mainland, separated by water est. 5 m; length est. 1 km, width ⅔ km, area est. ⅓ km²; highest point est. 100 m. Uninhabited. Crystalline schists. Grassy plantcovering with scattered shrubs.

Morro de Esmerarda.

10°39′ N. Lat., 63°30′30″ W. Long.; 200 m from the mainland, separated by water est. 10 m; length ¾ km, width ½ km, area abt. ¼ km²; highest point est. 70 m. Uninhabited. Crystalline schists. Rather dense growth, cactuses rather predominating.

Morro de Chacopata.

10°41′—10°43′ N. Lat., 63°48′—63°49′30″ W. Long.; connected with the mainland by a 4 km long, sandy wall; length 3¼ km, width 2¼ km, area abt. 3 km²; highest point abt. 45 m. Inhabitants: est. 300. Thick deposits of non-calcareous debris with a few outcrops of schists. Very scanty vegetation.

Isla de Caribes.

10°42′ N. Lat., 63°51′30″ W. Long.; 2½ km from the continent, separated by water of 3½ m; length 1¼ km, width ²/₅ km, area abt. ¹/₃ km²; highest point abt. 30 m. Inhabitants: est. 50. Chiefly schists. Scanty plantcovering with scattered bushes.

Lobos.

10°42′ N. Lat., 63°53′ W. Long.; 2¼ km E of Isla de Caribes, 6 km from the continent, separated by water of 18 m; combined length of the two islets ½ km, width ¼ km, area abt. ¹/₂₀ km²; highest point abt. 30 m. Usually uninhabited. Mainly schists. Considerable growth of herbs with scattered shrubs.

PENINSULA DE PARAGUANA.

11°36′—12°12′ N. Lat., 69°48′—70°18′30″ W. Long.; connected with the mainland by a broad, 25 km long wall of sand and coral-rock; length 68½ km, width 60 km, area abt. 2570 km²; highest point abt. 800 m. Inhabitants: estimated at 25.000. Limestones, marls and detritus-deposits, broadly encircling several outcrops of gabbroid rocks. Vegetation generally very scanty, cactuses often predominating. Exports: dividivi, goats. A crude oil transhipment-station at the bay of Las Piedras.

PENINSULA DE LA GOAJIRA.

Abt. 11°35′—12°28′ N. Lat., 71°6′30″—abt. 72°15′ W. Long.; connected with the mainland by a low plain of 40 km breadth; length abt. 120 km, width 75 km, area abt. 7000 km²; highest point abt. 800 m. Inhabitants: est. at 10.000. Several mountain-complexes of igneous and metamorphic rocks, often with considerable layers of sandstone and limestone, encircled by detritus-plains with occasional quaternary limestone-terraces. Vegetation generally very scanty, cactuses often predominating, only the protected central part with a richer plantcovering. Exports: some cattle, dividivi.

THE LOCALITIES.

A few localities in which collecting has been done in 1930 (cf. *Zool. Jahrb. Syst. 64*, pp. 289—326, 1933), are included without special numbering. A capital-letter after the station-number indicates a different habitat or a comparable habitat in another locality; an ordinary-letter indicates that the same habitat has already been studied before. — The water-temperature is given only if a constant value could be expected. Netherlands Governmental maps were used for the altitudes in Curaçao, Aruba and Bonaire; other values were estimated and therefore must be considered as inexact.

Proper names are not translated, therefore it may be useful to explain a few common terms which often have a special local significance:

spanish — papiamento or netherlandish — english
aljibe — pos, put — deep well
cerro — seroe, berg, heuvel — mountain, hill

cueva — cueba, spelonk, grot — cave
laguna — tanki; lagoen, lagune — large pond, lake; lagoon
manantial — bron — spring
morro — morro, klip, rots — rock, rocky island
poza — tanki, plas, vijver — pond
pozo — pos, put — well
quebrada, arroyo — rooi, dal, rivierbed — gully
salifia — salinja, zoutmeer, zoutvlakte — saltlake, salty mud-flat

At the same time attention may be drawn to the significance of the following terms which are often quite differently used:

West Indies — Antilles, Bahamas, Florida Keys, Bermuda, Cayman I.ds, Swan I.d, Old Providence, St. Andrews
Antilles — chain of islands from Cuba to Trinidad and Aruba
Greater Antilles — islands from Cuba to Puerto-Rico
Lesser Antilles — islands from Virgin I.ds to Trinidad and Aruba
Leeward Islands — from Virgin I.ds to Dominica
Windward Islands — from Martinique to Grenada
Caribbees — from the Anegada Passage and Sombrero to Grenada
Windward Group — from Virgin I.ds to Grenada (Bovenwindsche Eilanden, Islas de Barlovento, Inseln oben dem Winde)
Leeward Group — from Los Testigos to Aruba and Los Monges (Benedenwindsche Eilanden, Islas de Sotavento, Inseln unter dem Winde).

KEY TO THE FRESH AND BRACKISH WATER HABITATS.

I *Underground water*
A Connected with limestone: 56, 73; 40, 47, 48, 53, 54, 55, 57, 58, 61, 71, 72, 74, 76, 79, 80, 92, 94, 95, Pepe, Jatoe Largoe, Guajaká L., Gabriel, Blauwduif, Guajaká K.B.

II *Springs*
A Connected with limestone: 48, 71, 72, 74, 76, 77, 79, 80; 75, 93
B Unconnected with limestone: 44A, 86, 87, 102, 104; 15, 16, 17, 19, 21, 26, 88, 103

III *Running water*
A Rapidly or rather quickly streaming, or more quiet pools
A Connected with limestone
a at spring
bb rivulet 48, 71, 72, 76
b near spring
bb rivulet 71A, 72A, 74, 76A, 79
c at some distance of spring
cc brooklet 2
B Unconnected with limestone
a at spring
aa watertrack 104
b near spring
bb rivulet 17, 19, 88, 104A
c at some distance of spring
bb rivulet 15, 22, 27
cc brooklet 21, 26, 103

B Slowly or very slowly streaming

A Connected with limestone
a at spring
bb rivulet 77, 80
b near spring
aa watertrack 76B, 77A, 80A
B Unconnected with limestone
a at spring
aa watertrack 44A
bb rivulet 86, 102
b near spring
aa watertrack 87
bb rivulet 102A, 104B
c at some distance of spring
bb rivulet 16, 23
dd river 1, 115

IV *Stagnant water*

A With more or less regular underground water-supply
A Connected with limestone or coralsand
a in dark caves
aa never dry 56, 73
b connected with dark caves
aa never dry ..... 40, 47, 53, 54, 55, 57, 58, 61, 92, 93, 94, 95, Shiki, Pepe, Jatoe L., Guajaká L., Gabriel, Blauwduif, Guajaká K.B.
c with restricted underground circulation
aa probably never dry 9, 36, 39, 49, 52, 60, 64, 75, 112
bb probably rarely dry ..... 59, 64A, Oranjepan
B Unconnected with limestone or coralsand
a′ deeply or rather deeply dug
aa probably never dry 11, 14, 20, 29, 37, 41, 42, 45, 65, 84
b′ free or superficially dug
aa probably never dry ..... 35, 44, 66, Hoeba, Chikitoe

B Without more or less regular underground water-supply
A Connected with limestone or coralsand
aa probably never dry 63, 81, 105, 107, 108, 109
bb probably rarely dry 70, 96, 106
dd usually dry for several months a year ... 43, 62, 68, 69, 90, 91
B Unconnected with limestone or coralsand
aa probably never dry 13, 18, 38, 50, 78, 82, 83, 100, 110, 114
bb probably rarely dry 28, 30, 31, 32, 46, 67, 89, 101, 111, 113
cc usually dry for a few months a year 3, 4, 5, 6, 8, 10, 12, 24, 25, 51, 65A, 85
dd usually dry for several months a year 7, 33, 34, 97, 98, 99

KEY TO THE LAND HABITATS.

I *Strongly influenced by seawater*
  1 Small island
    aa rocky 156, 200, 200A
    bb sandy 177, 178, 179, 179A, 278
  2 Part of larger island or continent
    aa rocky 247A, 253A
    bb sandy 180, 247, 285, 287, 291
II *Not strongly influenced by seawater*
  1 Island, more than 5 km from continent
    A Usually swamped or moistened by groundwater
      a' seriously affected by cultivation
        a with limestone 192, 193
        b without limestone 194
      b' not seriously affected by cultivation
        b without limestone 150, 161, 236
    B Not usually swamped or moistened by groundwater
      A Average rainfall more than 800 mm a year
        a well protected from trade-wind
          b' not seriously affected by cultivation
            b without limestone 143, 144, 149
        b rather protected from trade-wind
          b' not seriously affected by cultivation
            b without limestone 163, 163A, 163B, 234
        d fully exposed to trade-wind
          b' not seriously affected by cultivation
            b without limestone 145, 146
      B Average rainfall less than 800 mm a year
        A' In cave-depth
          a with limestone 141, 142, 183, 183A, 188, 189, 209, 218, 219, 219A, 250, 251, 251A
        B' Not in cave-depth
          a well protected from trade-wind
            a' seriously affected by cultivation
              a with limestone 216
              b without limestone 155, 245
            b' not seriously affected by cultivation
              a with limestone 139, 140, 208, 238, 263
              b without limestone 165, 197, 198, 233, 235
          b rather protected from trade-wind
            a' seriously affected by cultivation
              a with limestone 257, 274, 220
              b without limestone 147
            b' not seriously affected by cultivation
              a with limestone 173, 190, 207, 211, 213, 220, 231, 240, 244, 260A
              b without limestone 136, 157, 162, 167, 168, 204, 205, 243A, 246

c rather exposed to trade-wind
a′ seriously affected by cultivation
a with limestone 186, 259, 264
b without limestone 148, 172, 172A, 230
b′ not seriously affected by cultivation
a with limestone 138, 173A, 175, 184, 184A, 185, 185A, 187, 190A, 191, 199, 199A, 201, 202A, 206, 210, 212, 215, 217, 221, 223, 224, 227, 228. 229, 232, 240A, 241, 242, 242A, 242B, 243, 248A, 249, 255, 256, 260, 260B, 265, 272, 272A, 275, 276
b without limestone... 131, 132, 133, 135, 151, 158, 160, 166, 169, 201A, 204A, 222, 229A, 245A, 268, 268B, 269, 277
d fully exposed to trade-wind
a′ seriously affected by cultivation
a with limestone 258A, 262A, 265A, 271
b′ not seriously affected by cultivation
a with limestone 130, 152, 153, 171, 172B, 181, 182, 195, 196, 202, 203, 213A, 214, 225, 226, 237, 239, 248, 253, 254, 258, 261, 262, 266, 267
b without limestone 129, 134, 137, 154, 159, 164, 168A, 170, 174, 176, 252, 252A, 268A, 270, 270A, 273

2 Continent, or island less than 5 km from continent
B Not usually swamped or moistened by groundwater
A Average rainfall more than 800 mm a year
a well protected from trade-wind
b′ not seriously affected by cultivation
a with limestone 123, 124
b rather protected from trade-wind
b′ not seriously affected by cultivation
a with limestone 125
d fully exposed to trade-wind
b′ not seriously affected by cultivation
b without limestone 126
B Average rainfall less than 800 mm a year
b rather protected from trade-wind
b′ not seriously affected by cultivation
a with limestone 122, 279
b without limestone 281
c rather exposed to trade-wind
b′ not seriously affected by cultivation
a with limestone 282, 292, 293
b without limestone 121, 283, 288, 289, 294
d fully exposed to trade-wind
b′ not seriously affected by cultivation
a with limestone 280, 290A
b without limestone 127, 128, 284, 286, 290

TABLE 5.

Water Analyses

„Rijksbureau voor Drinkwatervoorziening", Utrecht,
through the kind offices of Dr. L. H. Louwe Kooymans.
(from samples of 80 cc)

Station:	Cl′ mg/l	HCO_3′ mg/l	Total hardness German degr.	Station:	Cl′ mg/l	HCO_3′ mg/l	Total hardness German degr.
1	40	170	7	63	120	100	5
2	290	420	27	63a	850	330	17
4	490	140	23	64	530	430	19
5	200	170	8	64A	5050	—	200
6	380	160	15	65	200	470	24
8	930	230	31	65A	210	540	26
9	1550	560	46	66	1980	450	95
10	550	590	47	67	790	550	50
11	55	430	18	68	40	190	8
12	120	260	9	69	60	310	12
13	70	150	3	70	690	400	27
14	1850	540	130	71	310	400	20
15	80	460	23	72	210	280	16
16	4400	—	280	73	160	250	12
17	270	760	42	73a	160	230	12
18	150	160	5	74	320	200	17
19	80	95	4	75	450	230	13
20	110	690	29	75a	380	225	12
21	50	100	5	76	230	290	17
22	120	200	10	76Aa	240	300	18
23	390	590	32	77	150	320	16
24	85	160	4	78	310	260	19
26	60	150	5	79	360	400	21
28	55	120	5	80A	460	440	24
29	790	390	23	81	260	170	11
30	460	550	10	82	470	700	36
31	95	270	10	83	710	680	41
32	30	190	8	84	270	600	31
33	30	160	8	85	430	880	44
34	15	220	9	86	600	500	49
35	1450	500	47	87	2100	340	90
36	1650	660	22	88	3500	800	200
37	840	560	24	89	3200	780	160
38	970	690	31	90	44	190	10
39	1340	870	49	91	80	300	45
40	190	350	17	92	400	290	18
41	2100	730	63	93	400	300	19
42	3650	910	100	94	960	390	26
43	1350	680	46	95	720	430	26
44	530	420	14	96	1570	120	22
45	450	520	20	97	60	140	4
46	40	160	6	98	80	170	5
47	350	320	15	99	170	350	6
48	350	350	22	100	35	130	4
48a	360	370	20	101	3500	950	48
49	2400	640	60	102	3250	550	55
50	60	200	4	102A	3300	950	60
51	230	340	14	103	3150	900	50
52	160	190	10	104	1300	600	36
52a	1400	290	33	105	140	200	8
53	230	100	8	106	170	250	9
53a	860	330	30	107	190	250	7
55	880	450	32	108	50	200	6
56	1500	500	45	109	120	250	5
57	2600	350	65	110	110	180	7
57a	2500	380	65	111	890	1000	60
58	540	360	22	112	65	300	12
59	1500	400	45	113	85	250	11
60	370	320	16	114	820	450	19
61a	410	270	17	115	85	350	10

FRESH AN BRACKISH WATER HABITATS.

[Table 5]

N. E. Venezuelan Continent.

1 Río Chuspa, 30.7.1936.
2 Río Guanta, 7.4.1937.
3 Puddle in Bromeliaceae, 10.6.1936.
4 Estanque Arriba de Manglillo, 26.6.1936.
5 Estanque Abajo de Manglillo, 26.6.1936.
6 Estanque de Chacopata, 27.6.1936.
7 Poza de Chacopata, 27.6.1936.

Coche.

8 Poza de la Represa, 25.6.1936.

Cubagua.

9 Pozo de la Ranchería, 21.5.1936.

Margarita.

10 Poza de la Laguna Dulce, 20.5.1936.
11 Aljibe de la Laguna Dulce, 20.5.1936.
12 Poza Baranca, 20.5.1936.
13 Estanque Lato, 20.5.1936.
14 Aljibe de Diego Aguilera, 13.7.1936.
15 Manantial de Güiri, 13.7.1936. (26° C)
16 Manantial de Las Aguas Saladas, 11.8.1936. (29° C)
17 Toma de Agua de Encañado, 13.7.1936. (28° C)
18 Laguna Honda, 16.5.1936.
19 Toma de Agua de Tacarigua, 11.8.1936. (26° C)
20 Aljibe del Río de la Fuente, 11.5.1936.
21 Toma de Agua de La Asunción, 6.7.1936. (25° C)
22 Río Asunción, 3.7.1936.
23 Río Asunción, 11.5.1936.
24 Poza al Sur de Los Robles, 27.5.1936.
25 Puddle in Bromeliaceae, 10.7.1936.
26 Toma de Agua del Valle, 4.7.1936. (abt. 25° C)
27 Casa de Agua del Valle, 4.7.1936.
28 Peila del Cerrito, 27.5.1936.

Los Testigos.

29 Pozo del Puerto de la Iguana, 14.6.1936.
30 Poza del Morro de la Iguana, 14.6.1936.
31 Pozo del Puerto Real de Tamarindo, 15.6.1936.
32 Poza Inglés de Tamarindo, 15.6.1936.
33 Puddle on top of Tamarindo, 16.6.1936.
34 Puddle on top of Tamarindo, 16.6.1936.

Blanquilla.

35 Pozo de Valuchu, 21.7.1936.
36 Pozo de la Playa del Jaque, 22.7.1936.
37 Pozo de la Cocoteria, 22.7.1936.
38 Poza de Aguada, 22.7.1936.

Orchila.

39 Pozo Grande de Huespen, 24.7.1936.
40 Pozo Chiquito de Huespen, 24.7.1936.

Los Roques.

41 Pozo de la Vaca, Gran Roque, 25.7.1936.
42 Pozo de la Cabecera, Gran Roque, 26.7.1936.
43 Puddle, Cayo de Agua, 26.7.1936.

Bonaire.

44 Pos Bronswinkel, 27.3.1937.
44a Pos Bronswinkel, 31.5.1930.
44A Bron di Pos Bronswinkel, 27.3.1937. (27° C)
Pos Hoeba, 26.5.1930.
Pos Chikitoe, 26.5.1930.
45 Dos Pos, 27.3.1937.
46 Tanki Onima, 13.11.1936.
46a Tanki Onima, 23.5.1930.
47 Pos Letin, 13.11.1936.
47a Pos Letin (Pos Onima), 29.5.1930.
48 Bron Fontein, 13.11.1936. (abt. 28° C)
48a Bron Fontein, 30.3.1937. (28° C)
48b Bron Fontein, 21.5.1930. (28° C)
49 Pos Boven Bolivia, 24.3.1937.
49a Pos Boven Bolivia, 23.11.1930.
50 Tanki di Nene George, 25.3.1937.
51 Tanki Kerkhof, 31.3.1937.
52 Pos Ichi, 14.11.1936.
52a Pos Ichi, 31.3.1937.
52b Pos Ichi, 30.9.1930.
53 Pos Baca, 14.11.1936.
53a Pos Baca, 31.3.1937.
53b Pos Baca, 17.5.1930.
54 Pos Baca Chikitoe, 14.11.1936.
Pos Shiki, 3.12.1930.
55 Pos Calbas, 1.4.1937.
56 Grot Watapana, 1.4.1937.
Pos di Pepe, 29.8.1930.
Pos Jatoe Largoe, 29.8.1930.
Pos Guajaká, Lima, 29.8.1930.
57 Pos Caranja, 14.11.1936.
57a Pos Caranja, 31.3.1937.
57b Pos Caranja, 17.5.1930.
58 Pos Francés, 31.3.1937.
58a Pos Francés, 3.9.1930.
Pos Gabriel, 3.9.1930.
59 Pos Oranjepan, 26.3.1937.
Pos Oranjepan, 3.12.1930.
60 Pos Lansberg, 26.3.1937.
60a Pos Lansberg, 8.6.1930.

Klein Bonaire.

61 Pos di Cas, 15.11.1936.
61a Pos di Cas, 23.3.1937.
Pos Blauwduif, 17.10.1930.
62 Sheet of water, 15.11.1936.
63 Tanki Calbas, 15.11.1936.
63a Tanki Calbas, 23.3.1937.
63b Tanki Calbas, 9.6.1930.
Pos Guajaká, 17.10.1930.

Klein Curaçao.

64 Pos N. of Lighthouse, 29.8.1936.
64A Pos N. of Lighthouse, 29.8.1936.

Curaçao.

65 Pos di Hofje Fuik, 9.9.1936.
65A Bak di Hofje Fuik, 9.9.1936.
66 Tanki di Cas Klein St. Joris, 6.9.1936.
67 Bak di Groot St. Joris, 20.10.1936.
68 Puddle, Piscadera, 10.10.1936.
69 Puddle, Piscadera, 10.10.1936.
70 Tanki Koenoekoe Hatoen, 15.10.1936.
71 Boca Spelonk di Bak Ariba, 13.10.1936. (30° C)
71A Bak Ariba, Hato, 13.10.1936.
72 Boca di Leeuw, Hato, 13.10.1936. (30° C)
72A Bak di Boca di Leeuw, 13.10.1936.
73 Grot van Hato, 16.9.1936. (abt. 27° C)
73a Grot van Hato, 5.10.1936. (abt. 27° C)
74 Bron Cajoeda, 1.10.1936. (29° C)
75 Tanki Mamaja, 6.10.1936.
75a Tanki Mamaja, 11.10.1936.
76 Bron Wandongo, 6.10.1936. (28° C)
76A Bron Wandongo, 6.10.1936. (28° C)
76Aa Bron Wandongo, 11.10.1936. (28° C)
76B Bron Wandongo, 11.10.1936.
77 Bak Rincón, Hato, 11.10.1936. (29° C)
77A Bak Rincón, 11.10.1936.
78 Tanki Monpos, 11.10.1936.
79 Bron San Pedro, 22.10.1936. (30° C)
80 Bron San Pedro, 22.10.1936. (abt. 30° C)
80A Bron San Pedro, 22.10.1936.
81 Pos di Wanga, 9.11.1936.
82 Pos Europa, Dokterstuin, 27.10.1936.
83 Pos Ariba, Dokterstuin, 27.10.1936.
83a Pos Ariba, 29.10.1936.
84 Pos di Hofje St. Kruis, 24.10.1936.
85 Tanki St. Kruis, 24.10.1936.
86 Pos Sorsaka, 10.11.1936. (abt. 28° C)
87 Bron di Rooi Sánchez, 11.11.1936. (abt. 28° C)

88 Bron di Rooi Beroe, 10.11.1936. (abt. 28° C)
89 Tanki di Hofje Savonet, 29.10.1936.
90 Puddle, Westpunt, 27.10.1936.

Aruba.

91 Puddle, Quadirikiri, 9.2.1937.
92 Pos Fontein, 23.12.1936. (abt. 29° C)
93 Bron di Fontein, 23.12.1936. (29° C)
93a Bron di Fontein, 2.7.1930. (29° C)
94 Pos Grandi, 12.2.1937.
95 Pos W. of Rooi Lamoenchi, 11.12.1937.
96 Tanki Chikitoe, 12.2.1937.
97 Tanki Mon Plaisir, 15.12.1936.
98 Tanki di Hofje Westpunt, 9.12.1936.
99 Tanki di Goudmijn Tibusji, 9.12.1936.
100 Tanki Leendert, 16.12.1936.
101 Tanki Rooi Canashito, 7.12.1936.
102 Bron di Pos di Noord, 30.12.1936. (abt. 29° C)
102A Pos di Noord, 30.12.1936.
102Aa Pos di Noord, 28.6.1930.
103 Bron di Rooi Bringamosa, 6.1.1937.
104 Bron di Rooi Prins, 9.1.1937. (abt. 29° C)
104A Bron di Rooi Prins, 9.1.1937. (abt. 29° C)
104B Bron di Rooi Prins, 9.1.1937.
104Ba Bron di Rooi Prins, 4.7.1930.

Paraguaná.

105 Poza de la Compañía, 15.2.1937.
106 Poza de San Antonio, 16.2.1937.
107 Poza Supideo, 16.2.1937.
108 Estanque de Moruy, 18.2.1937.
109 Estanque de Santa Fé, 18.2.1937.
110 Estanque de Santa Ana, 16.2.1937.

La Goajira.

111 Pozo de Macaralpao, 14.1.1937.
112 Pozo del Cabo de la Vela, 22.1.1937.
113 Pozo del Arroyo de Appará, 27.1.1937.
114 Laguna del Pájaro, 21.1.1937.
115 Río Calancala, 17.1.1937.

LAND HABITATS

N. E. Venezuelan Continent

121 Cabo Blanco, 19.8.1936. (20 m)
122 Río Guanta, 15.8.1936. (2—4 m)
123 Peninsula de Esmerarda, 10.6.1936. (2—5 m)
124 Morro de Esmerarda, 10.6.1936. (1—5 m)
125 Peninsula de Puerto Santo, 12.6.1936. (20 m)
125A Peninsula de Puerto Santo, 12.6.1936. (80 m)
126 Morro de Puerto Santo, 12.6.1936. (60 m)
127 Morro de Chacopata, 27.6.1936. (45 m)
128 Isla de Caribes, 26.6.1936. (25 m)

Coche

129 El Guamache, 25.6.1936. (20 m)

Cubagua

130 N. W. Cubagua, 21.5.1936. (15 m)

Margarita

131 Morro de Robledar, 20.5.1936. (30 m)
132 Punta Ausente, 14.5.1936. (20 m)
133 Near Alta Gracia, 14.5.1936. (120 m)
134 Mina de Magnesite, 13.5.1936. (120 m)
135 Paraguachí, 13.5.1936. (60 m)
136 Near the Cerro Guayamuri, 11.5.1936. (180 m)
137 Near Matasiete, 27.5.1936. (150 m)
138 Near El Cerrito, 27.5.1936 (120 m)
139 Cerro de Marmoleta, 13.5.1936. (150 m)
140 El Piache, 10.7.1936. (100 m)
141 Cueva Honda del Piache, 10.7.1936. (300 m)
141A Near Cueva Honda, 10.7.1936. (300 m)
142 Cueva Honda, 10.7.1936 (300 m)
143 Below Toma del Valle, 4.7.1936. (250 m)
144 Toma de Agua del Valle, 4.7.1936. (250 m)
145 S.W. of La Asunción, 3.7.1936. (300 m)
146 W. of La Asunción, 3.7.1936. (250 m)
147 W. of La Asunción, 3.7.1936 (200 m)
148 Near Toma de La Asunción, 12.7.1936. (250 m)
149 Above Toma de La Asunción, 12.7.1936. (350 m)
150 Toma de Encañado, 13.7.1936. (150 m)
151 W. of San Antonio, 16.5.1936. (20 m)
152 Punta Mosquito, 4.6.1936. (20 m)
153 Galquire, 8.7.1936. (5—15 m)
154 S. of Los Robles, 18.5.1936. (5 m)
155 Patio, 25.5.1936. (2 m)
156 Isla Blanca, 9.6.1936. (25 m)

Los Testigos

157 Morro de la Iguana, 14.6.1936. (40 m)
158 Morro de la Iguana, 14.6.1936. (100 m)
159 Chiwo, 15.6.1936. (5—20 m)
160 Angoletta, 15.6.1936. (5—10 m)
161 Inglés, Tamarindo, 16.6.1936 (20 m)
162 Morro Grande, Tamarindo, 16.6.1936 (150 m)
163 Morro Grande, Tamarindo, 16.6.1936. (200 m)
163A-B Morro Grande, Tamarindo, 16.6.1936. (200 m)
164 Isla de Conejo, 17.6.1936. (80 m)
165 Cave on Isla de Conejo, 17.6.1936. (30 m)

Los Frailes

166 Puerto Real, 18.6.1936. (60 m)
167 Puerto Real, 18.6.1936. (40 m)
168 La Pecha, 19.6.1936. (40 m)
168A La Pecha, 19.6.1936. (60 m)

Los Hermanos

169 Morro Fondeadero, 20.7.1936. (80 m)
170 Morro Pando, 20.7.1936. (200 m)

Blanquilla

171 N. of Valuchu, 21.7.1936. (20 m)
172 Grove of El Jaque, 22.7.1936. (2 m)
172A Grove of El Jaque, 22.7.1936. (1 m)
172B Puerto El Jaque, 22.7.1936. (6 m)

Tortuga

173 S.W. Tortuga, 1.8.1936. (20 m)
173A S.W. Tortuga, 1.8.1936. (1 m)

Orchila

174 S.W. Huespen, 23.7.1936. (40 m)
175 S.W. Huespen, 23.7.1936. (1 m)

Los Roques

176 El Gran Roque, 25.7.1936. (15 m)
177 Isla Larga, 26.7.1936. (½—1 m)
178 Cayo de Agua, 26.7.1936. (2 m)

Las Aves

179 Ave de Barlovento, 27.7.1936. (2 m)
179A Ave de Barlovento, 27.7.1936. (2 m)

Bonaire

180 Cay, 29..3.1937. (½ m)
181 Zuidpunt, 26.3.1937. (1 m)
182 N.W. of Lansberg, 26.3.1937. (¼ m)
183 Grot Watapana, 1.4.1937. (½—1 m) (28½° C., moist. 85 %)
183A Grot Watapana, 1.4.1937. (½ m) (29½° C., moist. 95 %)
184 Lima, 14.11.1936.
184A Lima, 31.3.1937. (2 m)
185 Lima, 14.11.1936. (½ m)
185A Baca, 27.9.1930. (1½ m)
186 Deenterra, 25.3.1937. (3 m)
187 Near Spelonk, 24.3.1937. (6 m)
188 Cave of Spelonk, 24.3.1937. (7 m) (27½° C, moist. 80 %)
189 Cave of Spelonk, 24.3.1937. (7 m) (28½° C, moist. 90 %)
190 Fontein, 25.3.1937. (50 m)
190A S. of Fontein, 20.5.1930. (80 m)
191 Ruïns of Fontein, 30.3.1937. (40 m)
192 Tunnel of Fontein, 13.11.1936. (25 m)
193 Hofje Fontein, 30.3.1937. (22 m)
194 Tanki Onima, 13.11.1936. (3 m)
195 E. Boca Onima, 13.11.1936. (6 m)
196 W. Boca Onima, 13.11.1936. (8 m)
197 W. of Seroe Brandaris, 27.3.1937. (30 m)
198 Bronswinkel, 27.3.1937. (35 m)

Klein Bonaire

199 S.E. Klein Bonaire, 15.11.1936. (3 m)
199a S.E. Klein Bonaire, 23.3.1937; 199b id. 14.5.1930.
199A Tanki Calbas, 15.11.1936. (1 m)

Klein Curaçao

200 Klein Curaçao, 29.8.1936. (1 m)
200A Klein Curaçao 29.8.1936. (2 m)

Curaçao

201 Ronde Klip, 20.10.1936. (125 m)
201A S. of Ronde Klip, 20.10.1936. (40 m)
202 Seroe di Boca, 7.9.1936. (40 m)
202A Seroe di Boca, 7.9.1936. (5—10 m)
203 Seroe Mainsjie, 7.9.1936. (40 m)
204 Oost Seinpost, 9.9.1936. (25—40 m)
204A Fuik, 9.9.1936. (25 m)
205 Rooi Manzalienja, 4.9.1936. (2—3 m)
206 Tafelberg, 4.9.1936. (140—160 m)
207 Near Grot van Newport, 2.9.1936 (7—9 m)
208 Grot van Newport, 2.9.1936. (6 m)
209 Grot van Newport, 2.9.1936. (5—6 m)
210 Kabrietenberg, 16.10.1936. (25 m)
211 Fort Beekenburg, 16.10.1936. (10—15 m)
212 Schaarloo, 26.10.1936. (30—35 m)
213 Seroe Pretoe, 9.10.1936. (30 m)
213A Seroe Domi, 12.4.1930. (75 m)
214 Jack Evertszberg, 10.10.1936.
215 Seroe Spreit, 23.10.1936. (10—40 m)
216 Hofje Hato, 13.10.1936. (10 m)
217 Near Grot van Hato, 17.9.1936. (30 m)
218 Grot van Hato, 21.9.1936. (50 m)
219 Grot van Hato, 16.9.1936. (50 m)
219A Grot van Hato, 16.9.1936. (50 m)
220 Bron Wandongo, 6.10.1936. (10 m)
221 Groote Berg, 22.10.1936. (75 m)
222 Koenoekoe Abau, 9.11.1936. (70 m)
223 Hermanos, 9.11.1936. (40—50 m)
224 Seroe Kabritoe, 9.11.1936. (40—50 m)
225 Seroe Cabajé, 9.11.1936. (30—50 m)
225a Seroe Cabajé, 14.4.1930.
226 San Pedro, 22.10.1936. (10—15 m)
227 Seroe di Cueba, 29.10.1936. (40—45 m)
227a Seroe di Cueba, 30.4.1930.
228 Calbas Boshi, 29.10.1936. (10 m)
229 Seroe Bartool, 29.10.1936. (45—50 m)
229A W. of Seroe Bartool, 29.10.1936. (45 m)
230 St. Silvester, 22.11.1936. (15 m)
231 Seroe Teintje, 27.10.1936. (30 m)
232 Tafelberg, 10.11.1936. (60—70 m)

233 Rooi Sorsaka, 8.11.1936. (25—35 m)
234 Seroe Christoffel, 7.3.1937. (340 m)
235 Seroe Christoffel, 10.11.1936. (200 m)
236 Rooi Sánchez, 11.11.1936. (190 m)
237 Boca Tabla, 27.10.1936. (7 m)
238 Boshi di Westpunt, 27.10.1936. (2 m)
239 Westpunt, 27.10.1936. (7 m)
240 N. of Plaja Abau, 6.11.1936. (10—15 m)
240A N. Plaja Abau, 6.11.1936. (7 m)
241 S. Plaja Abau, 6.11.1936. (7 m)
242 Seroe Djerimi, 6.11. 1936. (35—45 m)
242A Seroe Djerimi, 6.11.1936. (25—30 m)
242B Near Seroe Djerimi, 6.11.1936. (9 m)
243 N. St. Kruis Baai, 24.10.1936. (8—12 m)
243A Seroe Commandant, 24.4.1930. (120 m)
244 Plaja Chikitoe, 24.10.1936. (5—8 m)
245 Hofje St. Kruis, 24.10.1936. (2 m)
245A St. Kruis, 24.10.1936. (5—15 m)

Aruba

246 Rooi Prins, 9.1.1937. (20 m)
247 Dunes of Boca Prins, 9.1.1937. (20 m)
247A W. Boca Prins, 9.1.1937. (6 m)
248 E. Boca Prins, 9.1.1937. (12 m)
248A S. of Fontein, 5.7.1930. (35 m)
249 Quadirikiri, 9.2.1937. (15 m)
250 Grot van Quadirikiri, 9.2.1937. (25 m) (25—30° C, moist. 78 %)
251 Grot van Quadirikiri, 9.2.1937. (25 m) (29° C, moist. 93 %)
251A Grot van Quadirikiri, 9.2.1937. (25 m)
252 Vader Piet, 9.2.1937. (25 m)
252A S.E. of Fontein, 9.2.1937. (25 m)
253 Boca Grandi, 5.1.1937. (25 m)
253A Boca Grandi, 5.1.1937. (10 m)
254 Culebra, 5.1.1937. (30 m)
255 Rooi Spoki, 6.2.1937. (45—55 m)
256 Savaneta, 5.1.1937. (5 m)
257 Grove in Rooi Lamoenchi, 29.12.1936. (3 m)
258 Near Pos Grandi, 29.12.1936. (2 m)
258A W. of Rooi Lamoenchi, 29.12.1936. (25 m)
259 Isla, 29.12.1936. (25 m)
260 Baranca Alto, 29.12.1936. (40—50 m)
260A Rooi near Baranca Alto, 29.12.1936. (25 m)
261 E. Spaansch Lagoen, 5.1.1937. (6 m)
262 W. Spaansch Lagoen, 5.1.1937. (5 m)
262A Balashi, 29.12.1936. (25 m)
263 Rooi Francés, 6.1.1937. (20—25 m)
264 Rooi Barcadera, 5.1.1937. (8 m)
265 Rooi Perkietenbosch, 5.1.1937. (5 m)
265A N.W. of Rooi Perkietenbosch, 5.1.1937. (5 m)

266 Seroe Canashito, 7.12.1936. (55 m)
267 Seroe Canashito, 7.12.1936. (45—65 m)
268 Hooiberg, 21.12.1936. (120—130 m)
268A Hooiberg, 21.12.1936. (160 m)
268B Hooiberg, 5.12.1936. (60 m)
269 Santa Cruz, 21.12.1936. (40 m)
270 Jamanota, 3.1.1937. (185 m)
270A Seroe Cristal, 10.2.1937. (60—70 m)
271 Seroe Plat, 10.2.1937. (85—90 m)
272 Hudishibana, 9.12.1936. (10—20 m)
272A Annaboei, 9.12.1936. (15—25 m)
273 Tibushi, 9.12.1936. (3 m)
274 Hofje Westpunt, 9.12.1936. (1 m)
275 Solito, 16.12.1936. (20—25 m)
276 Heintje Croes, 14.12.1936. (4 m)
277 Mon Plaisir, 15.12.1936. (3 m)
278 Reef of Boekoeti, 8.2.1937. (½—2 m)

N.W. Venezuelan Continent (Paraguaná)

279 Quebrada de la Compañía, 15.2.1937.
280 Cerro Transverso, 16.2.1937. (40 m)
281 W. of Santa Ana, 16.2.1937. (50 m)
282 E. of Santa Fé, 18.2.1937. (50 m)
283 N.E. of Moruy, 18.2.1937. (50 m)
284 Cerro de Machuruca, 16.2.1937. (300 m)

N.E. Colombian Continent (La Goajira)

285 Punta Tucacas, 14.1.1937. (2 m)
286 Laguna de Tucacas, 15.1.1937. (2 m)
287 Castilletes, 14.1.1937. (3 m)
288 Uribia, 17.1.1937. (10 m)
289 Ranchería del Cabo, 22.1.1937. (6 m)
290 Cabo de la Vela, 22.1.1937. (20 m)
290A Cabo de la Vela, 22.1.1937. (30 m)
291 N. of El Cardón, 22.1.1937. (2 m)
292 N.E. of Rio Hacha, 20.1.1937. (2 m)
293 S. of Rio Hacha, 18.1.1937. (5 m)
294 S. of Rio Hacha, 18.1.1937. (25 m)

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MAPS.

(nautical)

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(topographical)

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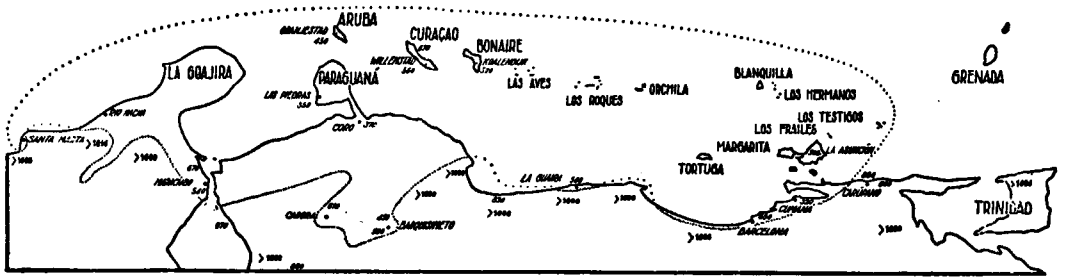

Fig. 1. Mean annual rainfall along the northcoast of South America. The climate of the indicated dry region belongs to the "steppe-climates" of K ö p p e n, which are defined by a rainfall of 340—680 mm a year, if the annual mean-temperature is about 27°C. Several districts are still dryer and may therefore fall within the "desert-climates".

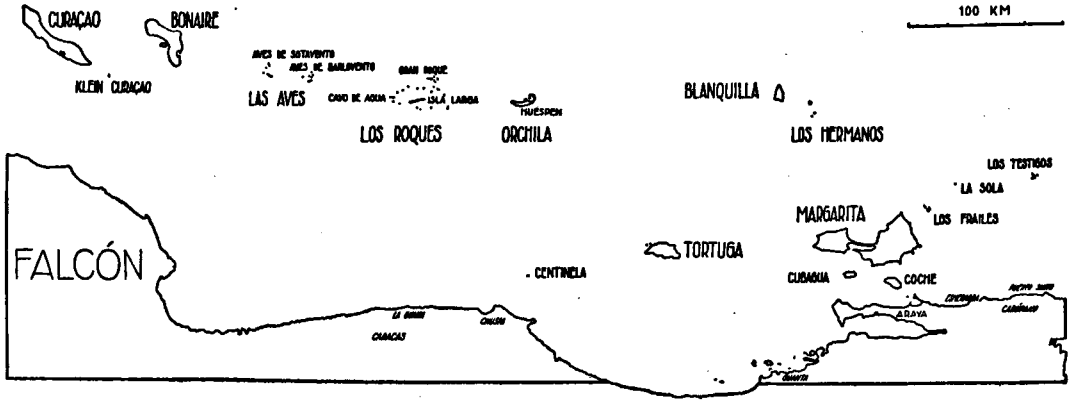

Fig. 2. Venezuelan Islands, Bonaire and Curaçao. (from U. S. Hydr. Off. chart)

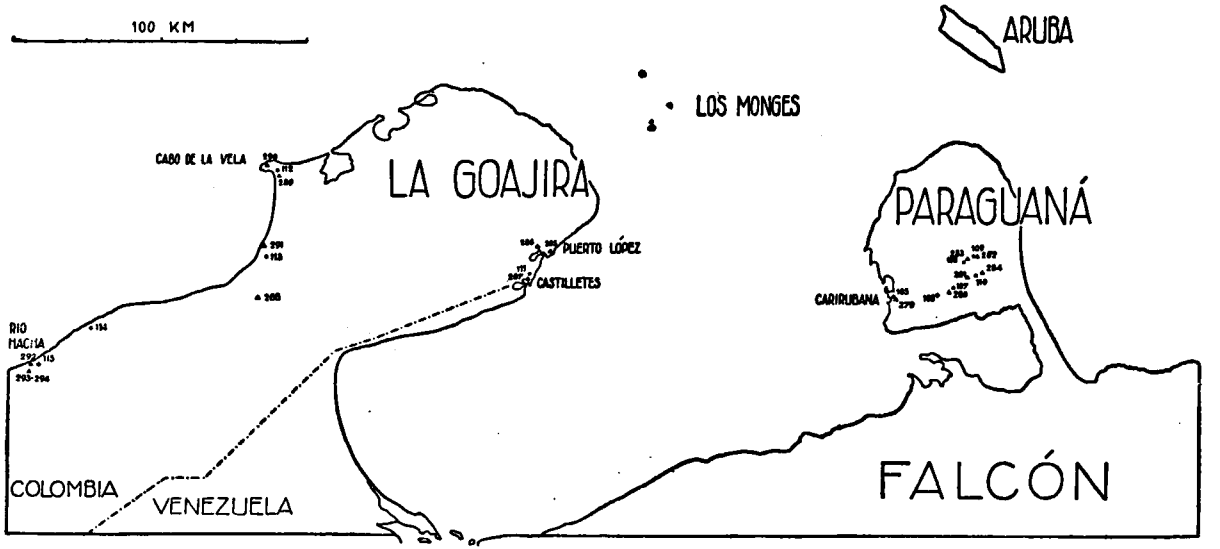

Fig. 3. Peninsulas of Paraguaná and La Goajira with Aruba and Los Monges; with mainland-stations. (from U. S. Hydr. Off. and Netherl. Govern. charts)

Fig. 4. Chief part of Testigos-islands, roughly surveyed.

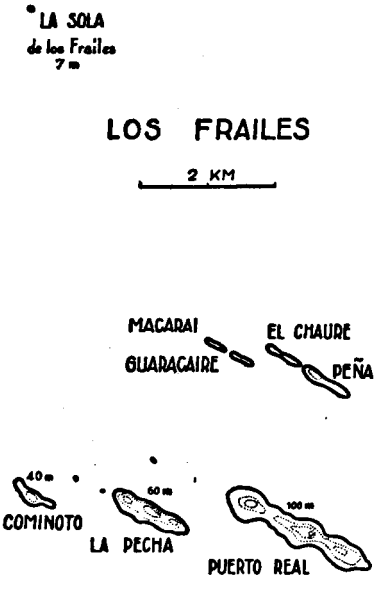

Fig. 5. Frailes-islands, roughly surveyed.

Fig. 6. Hermanos-islands, roughly surveyed.

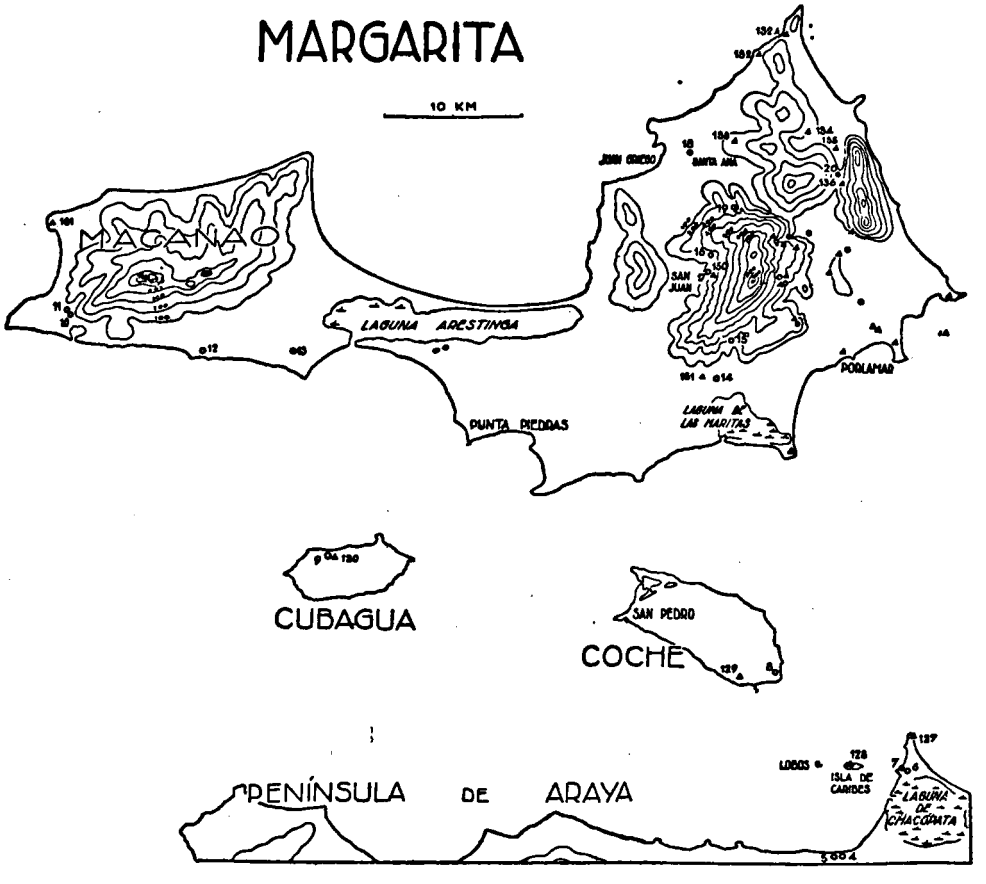

Fig. 7. Margarita, Cubagua, Coche and a part of the Araya-peninsula; with stations. (from U. S. Hydr. Off. chart, contour intervals from estimations as given on Aguerrevere's map)

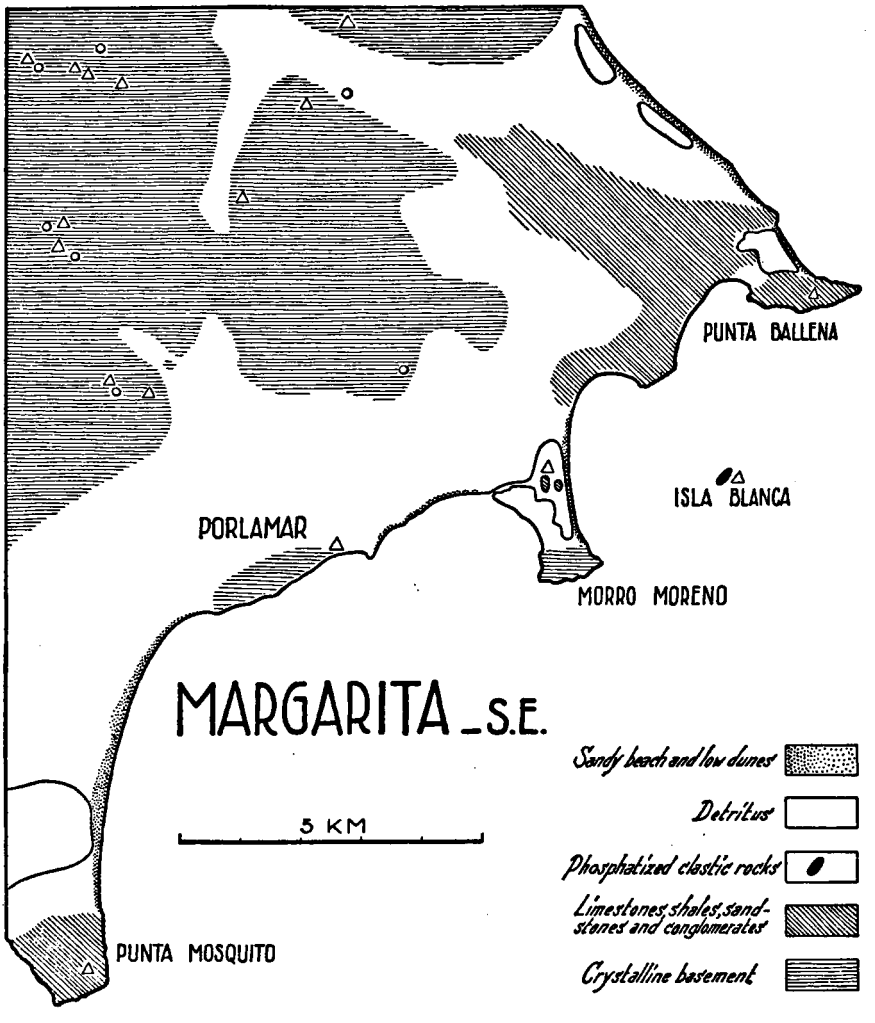

Fig. 8. Southeastern Margarita.

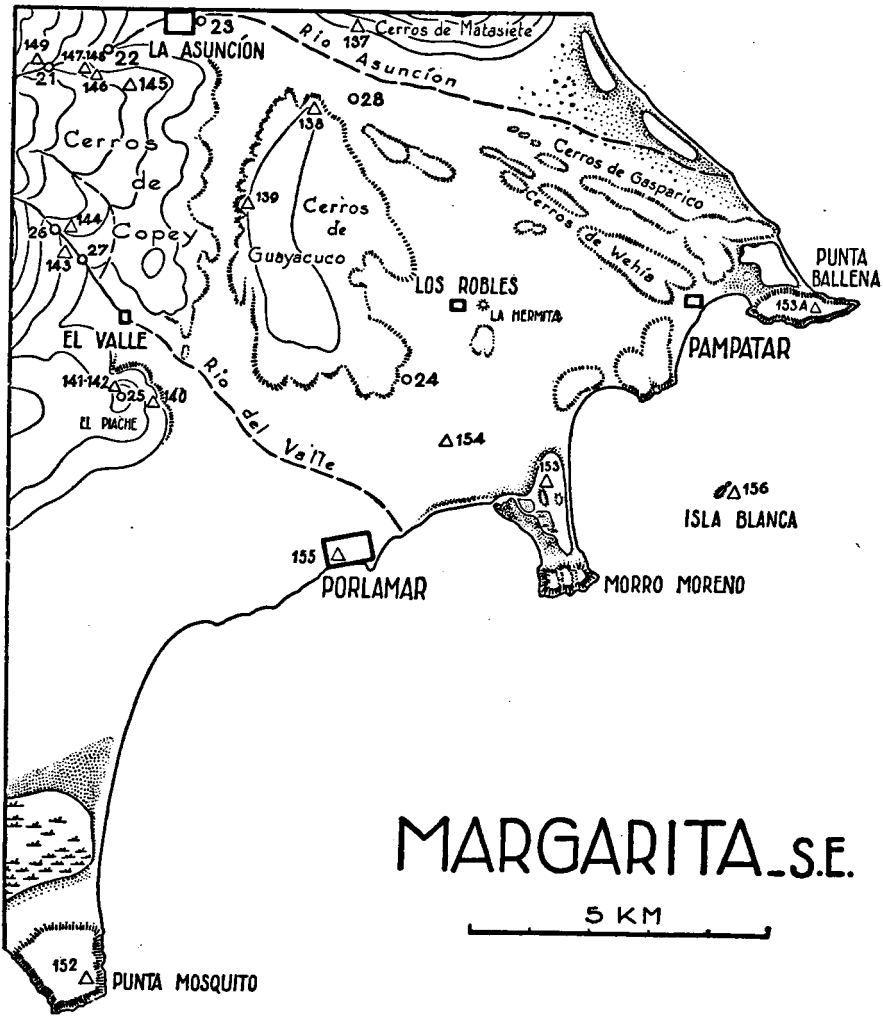

Fig. 9. Southeastern Margarita; with stations.

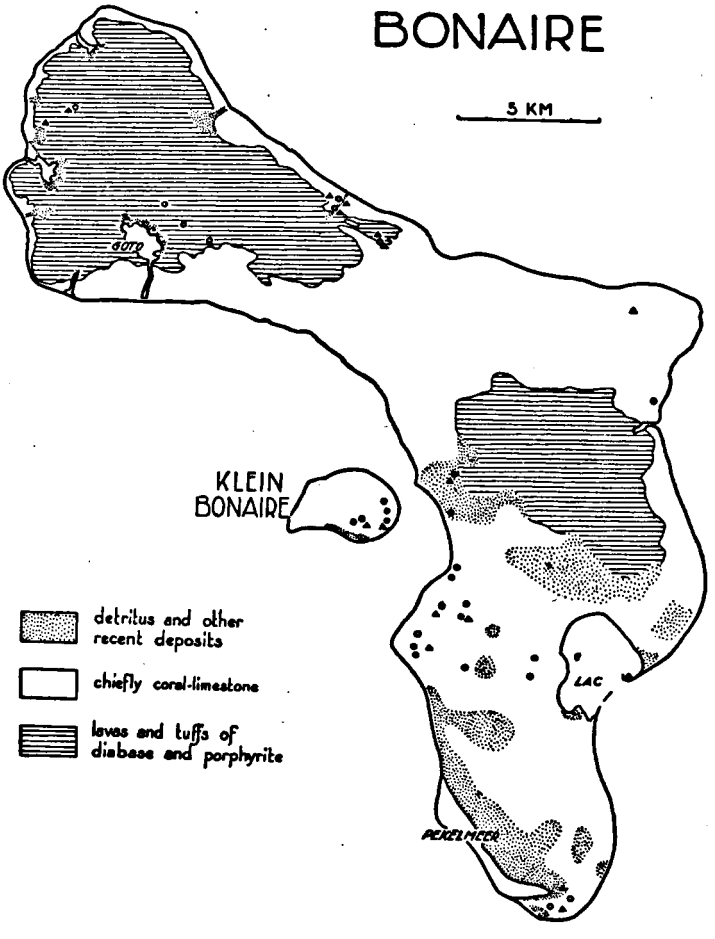

Fig. 10. Bonaire. (from Pijpers' geol. map)

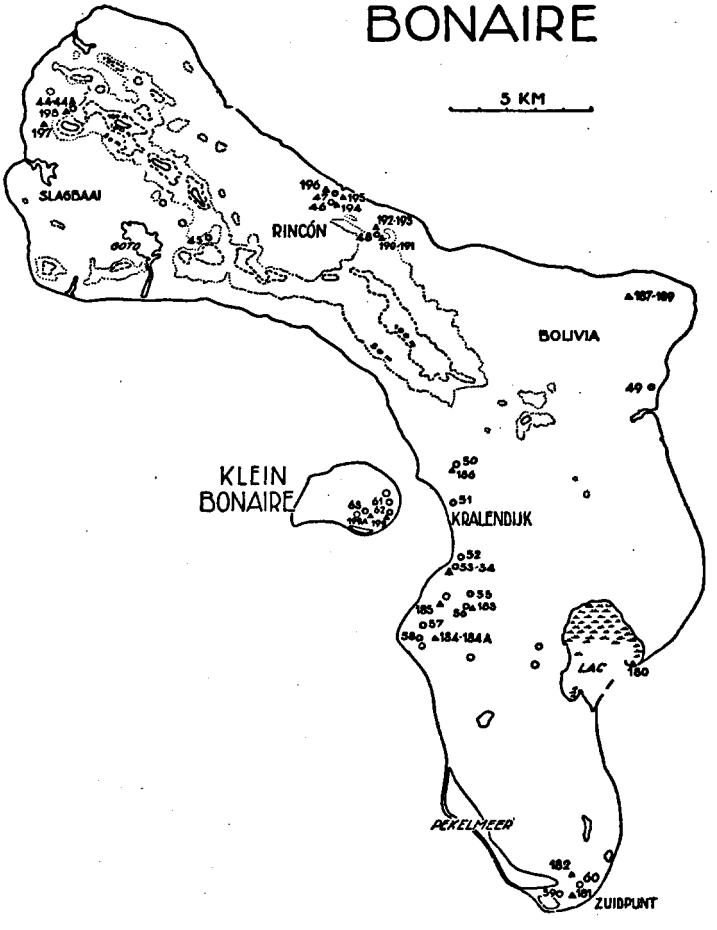

Fig. 11. Bonaire; with stations, contour intervals of 50, 100 and 150 m. (from Netherl. Govern. maps)

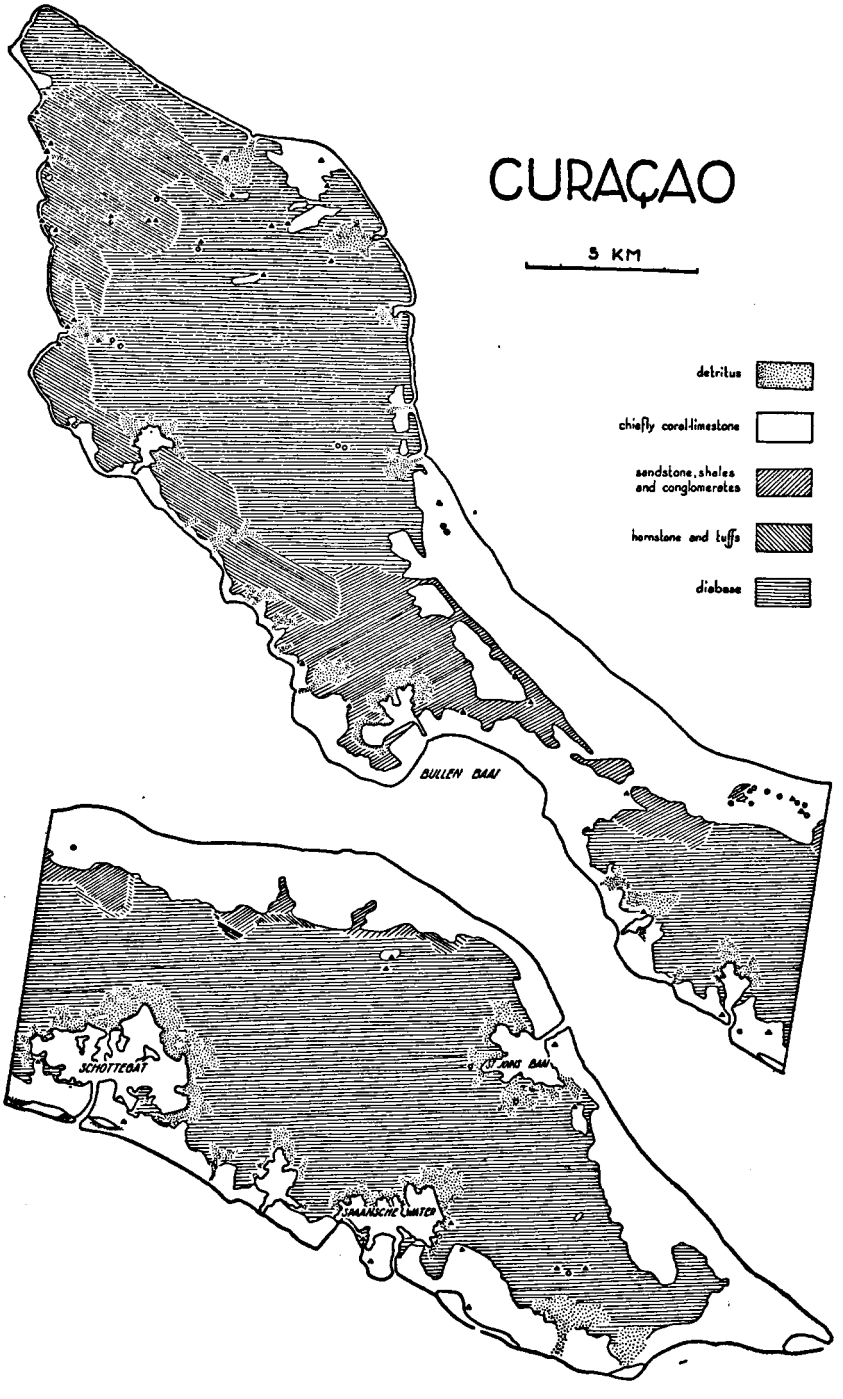

Fig. 12. Curaçao. (from Molengraaff's geol. map)

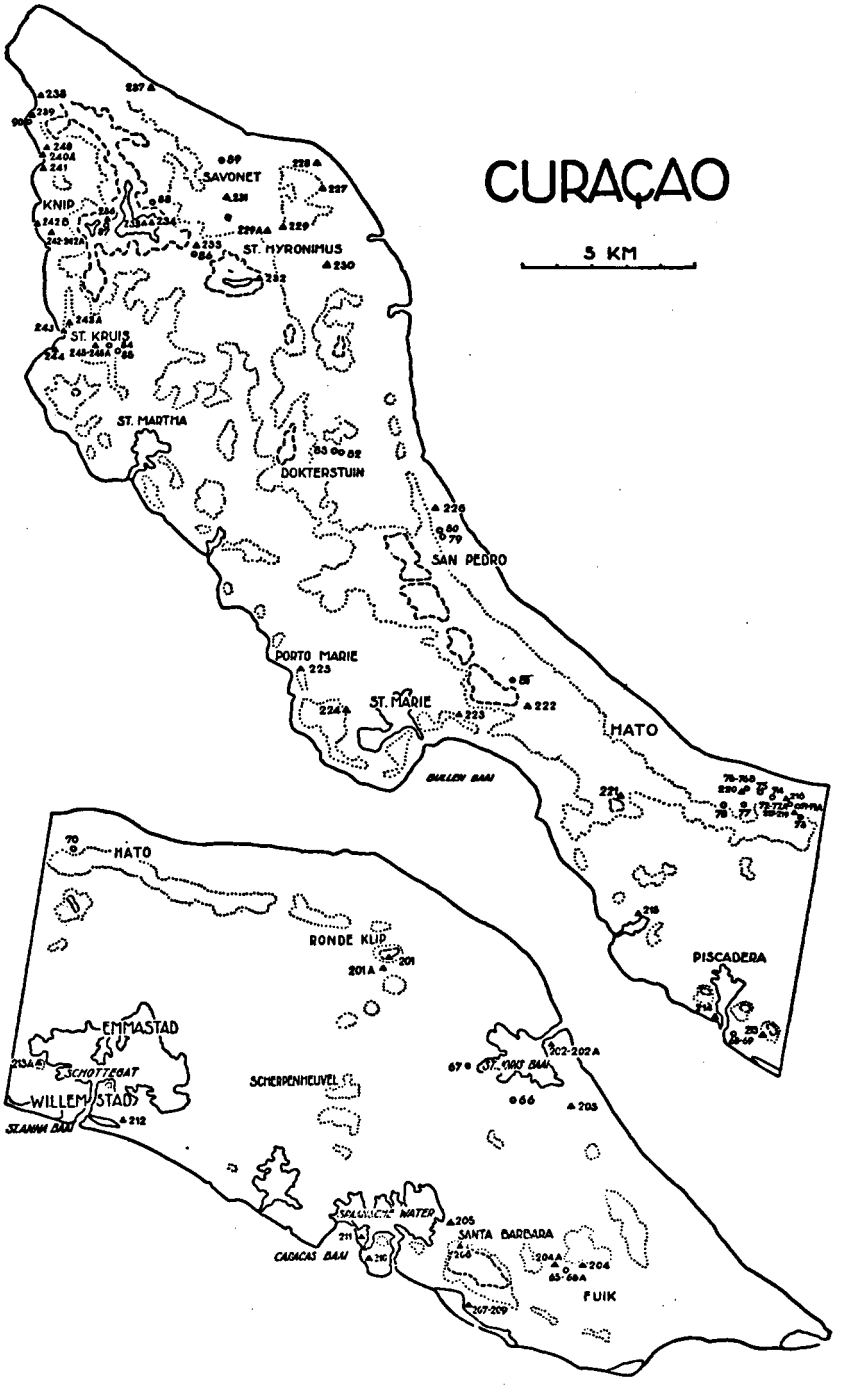

Fig. 13. Curaçao; with stations, contour intervals of 50, 100 and 200 m. (from Netherl. Govern. maps)

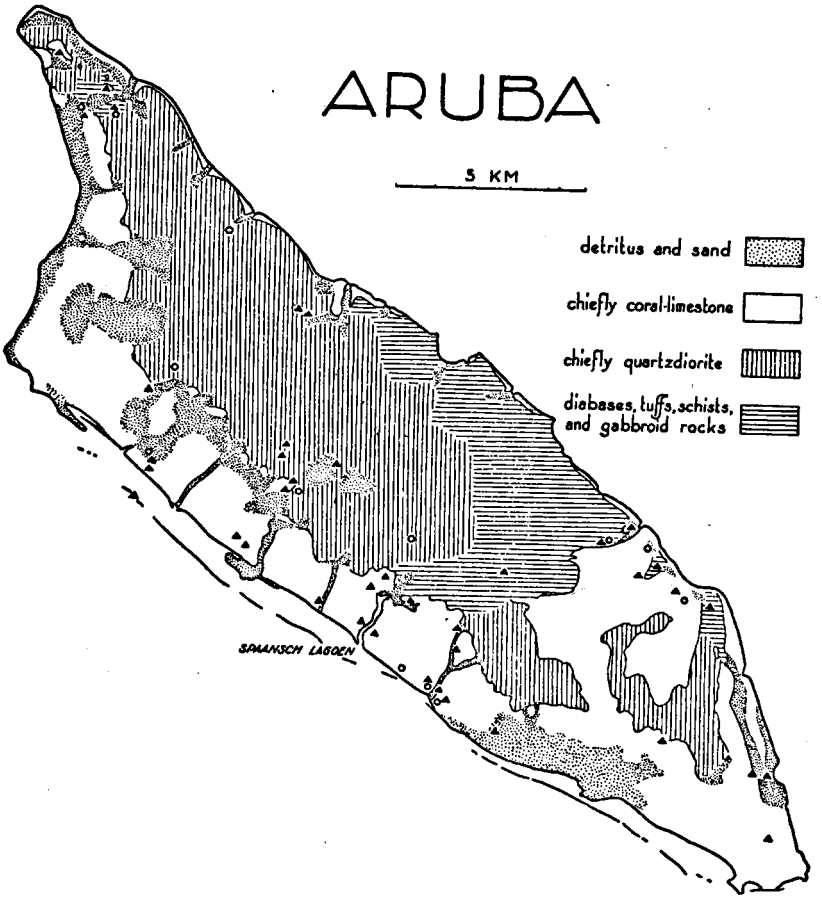

Fig. 14. Aruba. (from Westermann's geol. map)

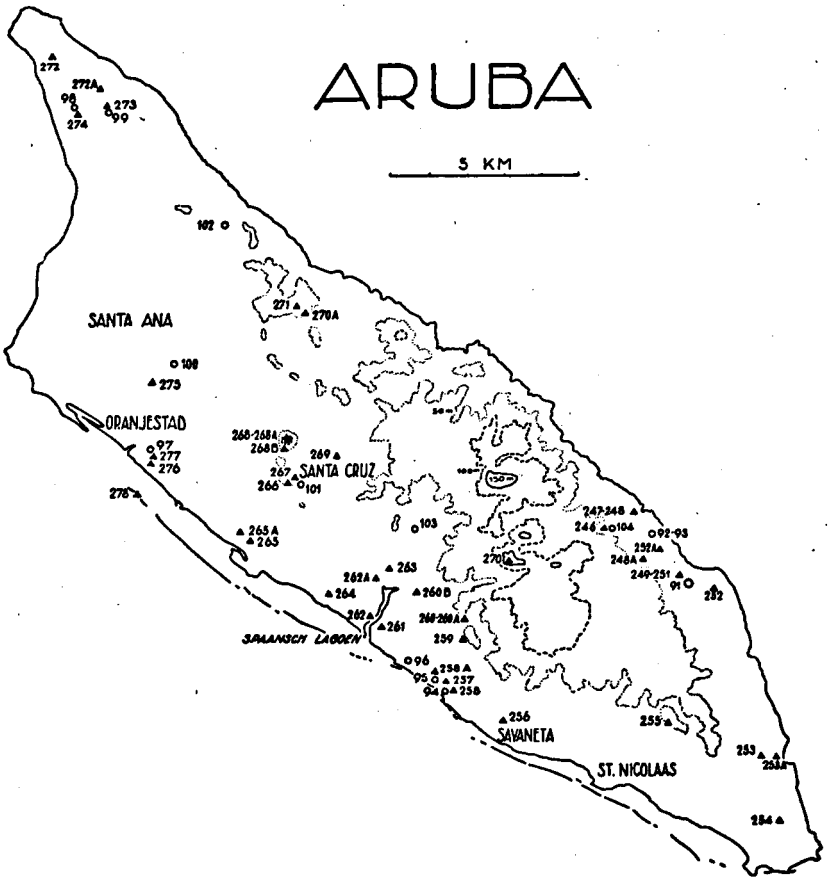

Fig. 15. Aruba; with stations, contour intervals of 50, 100 and 150 m. (from Netherl. Govern. maps)

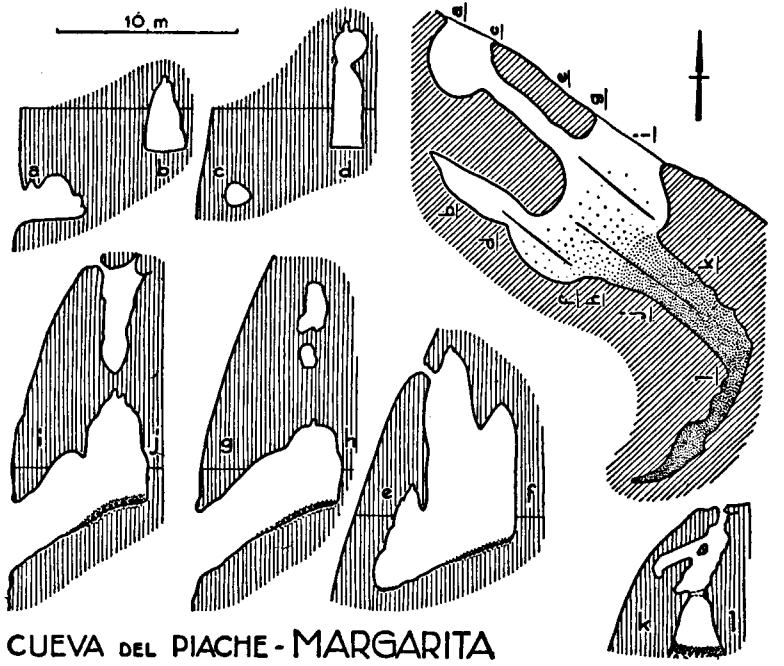

Fig. 16. Cave of El Piache, Margarita, roughly surveyed; marble-schists, abt. 300 m high. In the groundplan the stippling indicates an accumulation of bat-manure; the straight lines indicate the strike of the principle, nearly vertical rock-fissures. Stat. 141 is situated near the entrance, St. 142 in the most southern part of the cave.

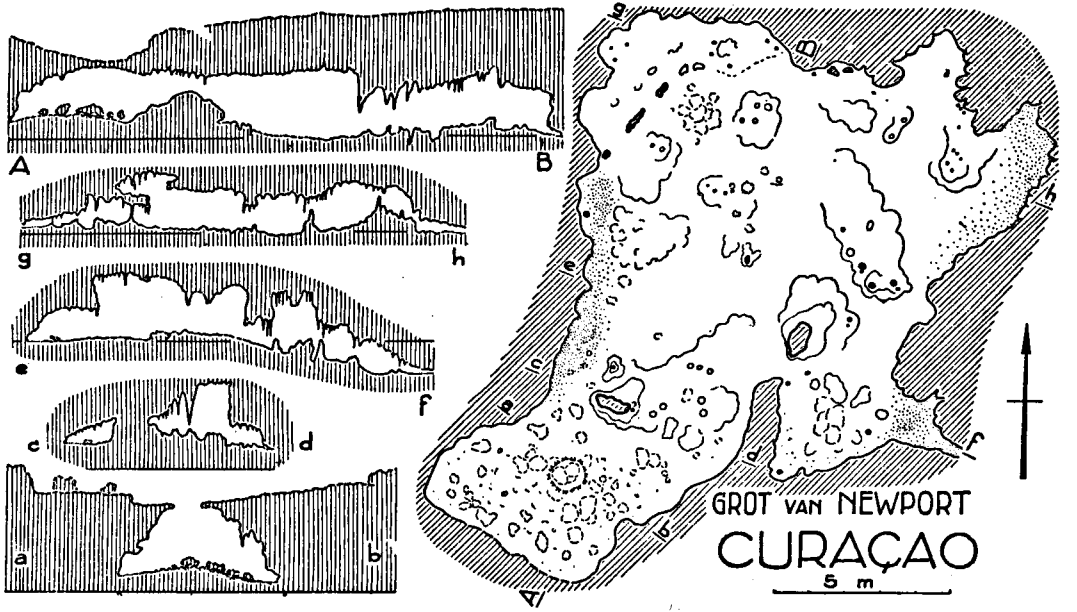

Fig. 17. Cave of Newport, Curaçao; coral-limestone, 3—7 m high. Stat. 208 is situated near the entrance, St. 209 in the northeastern part of the cave.

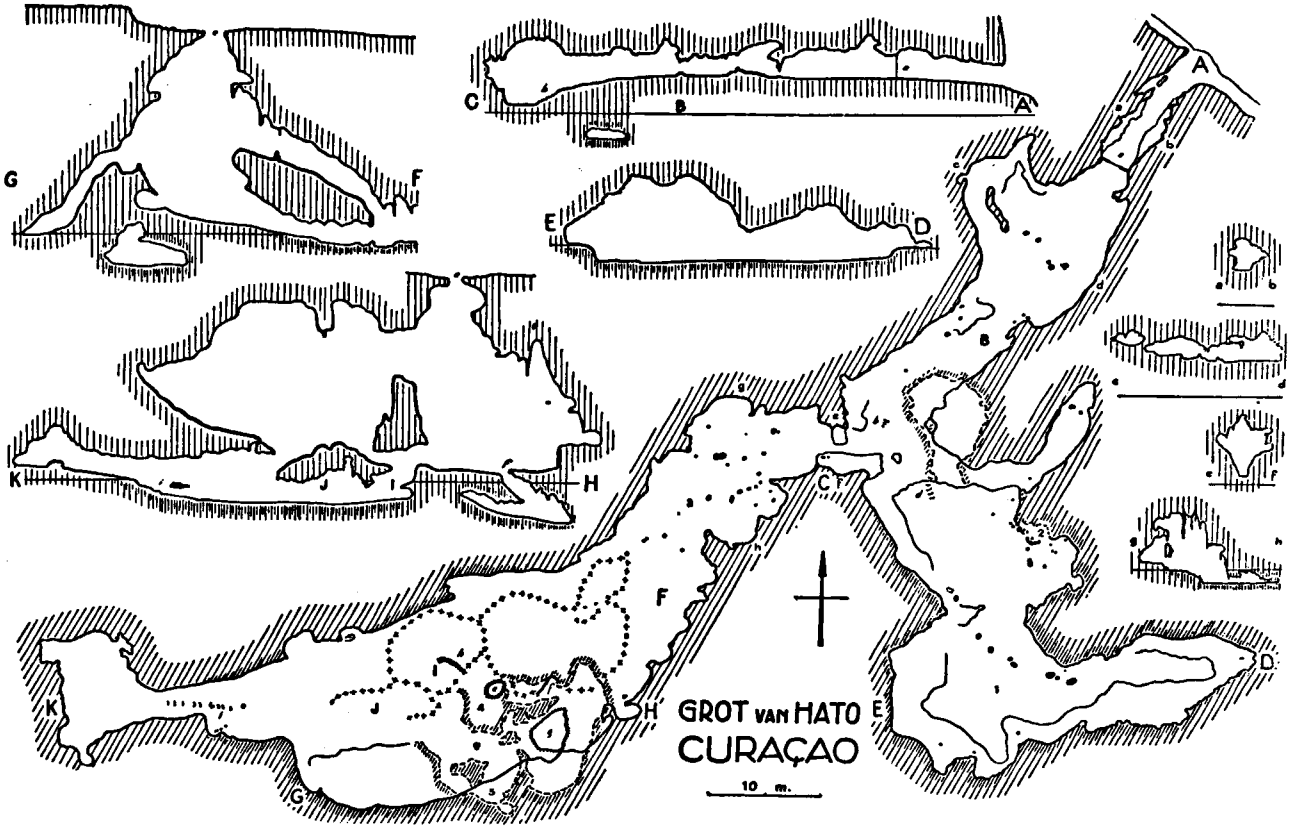

Fig. 18. Cave of Hato, Curaçao; coral-limestone, 45—67 m high. 1 - Kamber di Noche, Stat. 219A; 2 - exposure of cavern-water in the Kamber di Awa, St. 73; 3 - Kamber di Pilar, St. 219; 4 - Kamber di Ventana, St. 218. a - door, giving admittance; b, d, h, i - roughly hewn steps; c, f, g - apertures in the floor, giving admittance to lower caverns; e - opening in the roof.

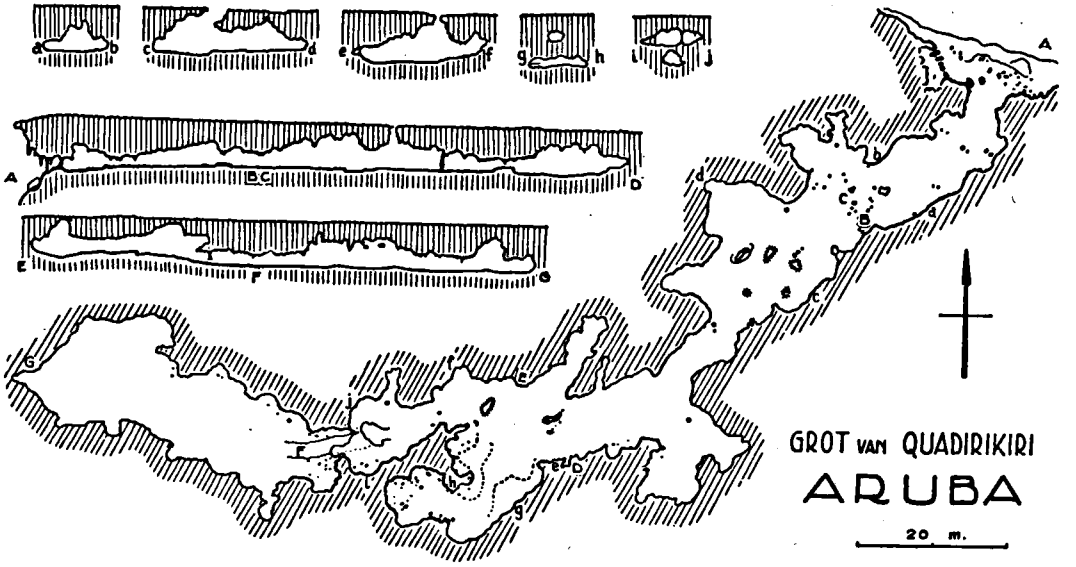

Fig. 19. Cave of Quadirikiri, Aruba; coral-limestone, 24—32 m high. Stat. 250 is situated at cross-section, e-f, St. 251—251A at length-section F-G.