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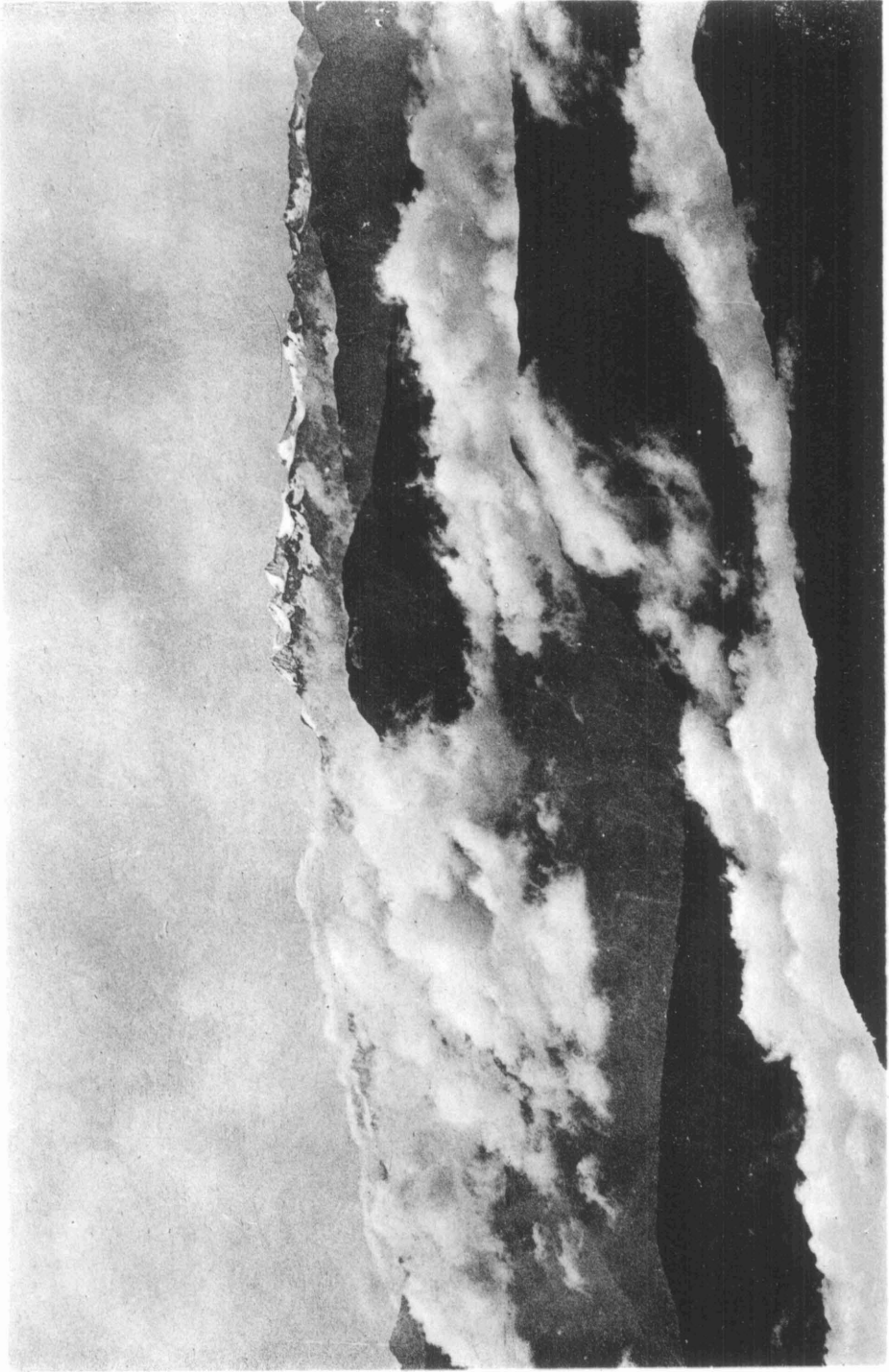
**The Amphibians and Reptiles of the
Sierra Nevada de Santa
Marta, Colombia**

BY

ALEXANDER G. RUTHVEN

WITH A DESCRIPTION OF THE REGION BY M. A. CARRIKER, JR.

ANN ARBOR, MICHIGAN
PUBLISHED BY THE UNIVERSITY
SEPTEMBER 15, 1922



THE SIERRA NEVADA de SANTA MARTA—MAIN RANGE

Photographed from near summit of Mt. San Lorenzo

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ALEXANDER G. RUTHVEN,
Director of the Museum of Zoology,
University of Michigan.

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THE AMPHIBIANS AND REPTILES OF THE SIERRA NEVADA DE SANTA MARTA, COLOMBIA

BY ALEXANDER G. RUTHVEN

(With a description of the region by M. A. Carriker, Jr.)

INTRODUCTION

The explorations of the University of Michigan in the Santa Marta region have had as the principal object the study of the distribution of several groups of animals abundant in the tropics. It is believed that geography should be emphasized by museums, that the most reliable results at the present time are to be obtained by the study of the distribution of particular groups by persons acquainted with these groups systematically, and that certain problems can best be studied in particular regions.

The groups which have received principal attention in the study of the Santa Marta region are the Formicidae, Amphibia, and Reptilia. Considerable work has been done on the Crustacea, and rather extensive collections have been made in other groups, but the ants, amphibians, and reptiles are the groups studied in sufficient detail to permit of the drawing of general conclusions upon the distribution. This paper contains descriptions of the field work and the region studied and a discussion of the distribution of the amphibians and reptiles.

THE FIELD WORK

The specific problems in the distribution of the reptile-amphibian fauna of the Santa Marta Mountains region which were to be investigated were two: to determine more exactly the nature and place of the changes in the fauna which evidently take place in western Venezuela or eastern Colombia, and to obtain more data on the responses of these groups to changes in altitude. It is probably well known to herpetologists that a number of reptiles and amphibians found in northern Venezuela do not occur in western Colombia and that a number of northern Colombian species do not occur in Venezuela, but there has been no evidence of the nature and extent of the changes in the faunas nor data by which the place could be more accurately fixed. Besides being in the general region of the above-mentioned faunal change, the Santa Marta Mountains seemed to offer exceptional opportunities for studies in the altitudinal distribution of reptiles and amphibians. The abrupt rise from sea level to heights perennially covered with snow and the tropical location of the region promised a considerable fauna and sharply delineated distributions.

The first expedition was sent to the region in 1913. The party, consisting of A. S. Pearse, F. M. Gaige, and the writer, spent eight weeks,

from July first, on the west end of the range. During this time collecting was done from the coast at Santa Marta to the bench at 8,300 feet (the Cerro Quemado) on San Lorenzo, the territory covered being a strip through the villages and haciendas of Santa Marta, Bolivar (I)¹, La Tigra (II), Minca (III), Agua Dulce (IV), and Cincinati (V), and on the lowlands at La Gaira, Cienega, and Fundacion. Subsequent to this time M. A. Carriker, Jr. made collections which supplemented the series obtained at the west end of the range and provided information on the fauna of the north side of the range from Don Diego to snow-line. In 1920 the writer with Mr. Gaige again visited the range, and during June obtained additional information on the fauna of the forested area on San Lorenzo, exploring the great valleys on the east side of San Lorenzo and the headwaters of the Rio Cordova. In July and August Mr. Carriker, Mr. Gaige, and the writer went to Riohacha by boat, and, securing mules from the Indians, worked entirely around the range by way of Arroya de Arenas, Fonseca, San Juan de Cesar, Valle de Upar, Valencia, and Fundacion, arriving at Santa Marta on August 13. The localities at which collecting was done are given in Mr. Carriker's account which follows.

In the field an attempt was made to obtain data on habits, ecological distribution, and exact limits of ranges, in the belief that the most detailed geographic and ecological data are needed in the interpretation of relationships and distributions. Anyone acquainted with the secretive habits of the amphibians and reptiles, and giving consideration to the size of the region, the diversity of conditions, and the number of species comprising the fauna, will understand the difficulties of the task. No one can appreciate better than the writer the incompleteness of the results. The nature of the field work in itself limited the areas and the forms that could be studied in detail. However, it has seemed that the publication of the results is justified in several ways: The reptile-amphibian fauna was practically unknown; there is a distinct possibility that the natural conditions will be greatly changed in the near future; and certain conclusions, bearing on the general problems which were attacked, are possible from the data.

Acknowledgments: It is with great pleasure, but with considerable difficulty, that the writer attempts to acknowledge the assistance received during the progress of this study. The expeditions were made possible by Dr. Bryant Walker, who has so consistently supported several of the activities of the Museum. In the field the assistance and hospitality of Mr. and Mrs. Orlando L. Flye, Mr. and Mrs. M. A. Carriker, Jr., Mr. Robert Sargent, and Mr. William Flye contributed so largely to the success of the work that it is not exaggerating to say that to them belongs in considerable part the credit for the results obtained. The indebtedness of the members of the University of Michigan expeditions to these persons cannot be satisfactorily expressed, but it should be pointed out that such knowledge as we have of the fauna of the Sierra Nevada de Santa Marta is in no small part due to the assistance and advice which Mr. Flye has so freely and

¹ These numbers are used on the map to indicate the location of the haciendas.

kindly given to collectors, and to the careful field work of Mr. Carriker. The writer also wishes to express his indebtedness to his companions in the field, M. A. Carriker, F. M. Gaige, and A. S. Pearse. Their loyalty and indefatigable efforts to advance the work on the reptiles and amphibians, although principally interested in other groups, made it possible to obtain a large amount of data that otherwise would not have been secured, and contributed to the pleasure of the field work.

The writer is under obligations to Mr. Samuel Henshaw and Dr. Thomas Barbour for the loan of material in the Museum of Comparative Zoology, and to Dr. Henry W. Fowler and the authorities of the Academy of Natural Sciences of Philadelphia for the opportunity of examining the specimens obtained by Mr. J. A. G. Rehn and Mr. Morgan Hebard in 1921. He has also had considerable assistance from Dr. Thomas Barbour, Dr. George Boulenger, and Miss Joan Procter in the identification of specimens, and from Dr. Leonhard Stejneger in the settling of problems in nomenclature.

The writer congratulates himself on being able to publish a description of the region by Mr. Carriker. Certainly no one is more familiar with the area, and no one who has visited it is better fitted to describe the conditions from the biological standpoint. The writer has been able to spend much time in the field with Mr. Carriker, and fully agrees with the interpretations of the conditions given in his account.

DESCRIPTION OF THE SANTA MARTA REGION

(With comments on the zoological work which has been done there and a list of localities)

BY M. A. CARRIKER, JR.

The preparation of this paper was suggested by Dr. Ruthven at the time of his second expedition to this region in the summer of 1920. He argued that the information the writer possessed as the result of personal observations over an extended period should be published as an aid to future workers as well as to those who have already made extensive biological studies here. It is due to his enthusiasm and encouragement that I was induced to undertake the work, and it was with his help that the outline of the paper here presented was prepared.

The writer first arrived in Santa Marta in 1909, and with the exception of about two years spent in various parts of the interior of Colombia, has been more or less a constant resident in the region, living in the lowlands near Santa Marta and in the mountains within a radius of twenty-five miles of that city when not engaged in making trips to other parts of the Nevada. (See map following Plate XII.)

As one approaches Santa Marta from the sea (Pl. I, fig. 1) the beautiful snowcapped peaks (see frontispiece) forming the apex of the range are visible for many miles and present an almost irresistible attraction to any lover of the wild and unknown spots of the earth, but especially to the

naturalist, who cannot but be fascinated by the prospect of collecting in this great, isolated, almost unknown mountain mass. The region received the attention of some of the earliest naturalist-explorers who visited Colombia, and many species of animals and plants were described from the meagre collections made here, but the fauna and flora are still largely unknown. To the biologist the interesting features of the Sierra Nevada de Santa Marta are that it is a lofty mountain mass, rising abruptly from sea-level and entirely separated from any other mountain range or system, that it has undoubtedly never been connected with the nearest mountain range—the eastern Andes of Columbia,—and the diversity in conditions. The diversity in ecological conditions is probably exceeded in few areas of the same size, as the range rises from the sea and from lowlands which are arid wastes, or covered with semi-arid woodland or dense humid forests; there are scores of miles of mountain slopes covered in places by a dense tropical forest, in others by semi-arid woodland, and in still others by great savannas or bare, rock-strewn slopes; and the upper regions constitute a vast solitude of *paramos*, extending from the timber-line up to the eternal snows.

In animal and plant life the region is very rich, and there are apparently a large number of endemic species. Of all of the groups represented, only the mammals, birds, reptiles, and amphibians have received particular attention, and even in these groups there is still much to be discovered. The greater part of the region at all altitudes is a vast wilderness, unknown and uninhabited, and the number of biological and archaeological problems is legion.

In this paper I will attempt to give, as nearly as possible, the information on the physical and biological conditions I have accumulated during the past nine years. Since the published data are meagre, this information should be useful to those who shall be able to continue the exploration and study of this remarkable region and its exceedingly rich flora and fauna, and to those who have already done some work in the range, but who do not have a comprehensive idea of the region as a whole and the relations which the different parts bear to each other and to the adjoining areas. It should also assist in preventing useless duplication of work and aid future workers to select untouched fields.

It should be pointed out here that biological work in the Santa Marta range should be done at once if it is to be done at all. There is now beginning a colonization of the mountains which may, in a few years, wipe out the great forest areas and make such changes in the natural conditions that it will be most difficult, if not impossible, to arrive at a correct knowledge of the original composition and distribution of the flora and fauna. There are two colonization schemes on foot now in Germany, with the Sierra Nevada de Santa Marta as their objective, while great interest has been aroused in the region throughout Colombia, and a large amount of land has been taken up during the past two years. A new road has been opened, beginning at Fundacion, the present terminus of the Santa Marta Railway, and extending into the mountains a distance of 25 to 30 kilometers and to

an altitude of about 6,000 feet. Other roads are being projected by the Government and by private interests, and with these once opened it is a foregone conclusion that all the forested country within reach of them will soon be reduced to pasture land and cultivated fields. Already the greater portion of the humid forest, occupying the lowlands on the west side, between Cienega and Fundación, has disappeared, and to get at undisturbed conditions representing this habitat it is now necessary to go to the great forests of the Ariguani, about thirty miles south of Fundación.

The Field Work of the Writer: I began collecting birds in the Santa Marta district in 1911, arriving at the city of Santa Marta late in May. The first work was done at the *hacienda* Cincinnati (formerly known as Valparaiso). This is the largest coffee plantation in the region and lies on the northwest slopes of Mt. San Lorenzo, between 3,000 and 5,000 feet. It is surrounded by forest extending downward to the foothills and upward to the crest of the mountain, which attains an elevation of 8,300 feet at the western end. More or less continuous work was done at Cincinnati and on San Lorenzo during June and July, and in August, lower down, between Mamatoco and Cincinnati, at La Tigrera and Minca, and Agua Dulce. No more collecting was done until March of the following year, when an attempt was made to reach the Sierra Nevada proper by way of the ridge connecting it with San Lorenzo. Three weeks were occupied in this attempt, which was finally given up as impracticable, after an elevation of about 8,000 feet was reached on the main ridge leading to the *paramos*. There was no trail of any sort, nothing but unbroken forest, and trail had to be cut with machetés. After reaching an altitude of about 8,000 feet progress was checked by an impenetrable mass of brush and huge bromelias from four to ten feet in height. Water was very difficult to secure and birds extremely scarce, so that, after a couple of days of heart-breaking work in an attempt to pass this barrier, the trip was abandoned and the party returned to Cincinnati. After this failure to reach the Nevada, work was continued at Cincinnati and around Mamatoco until the end of April, when I returned to the States for a much needed vacation, having been in the field constantly for nearly three years.

My return to Santa Marta was made in September of 1912, accompanied by Mrs. Carriker. Some intermittent collecting was done in the vicinity of Cincinnati during the remainder of 1912 and the early part of 1913.

In April, 1913, accompanied by Mrs. Carriker, who had now acquired some skill in the preparation of specimens, I again began intensive work which continued almost uninterruptedly during the remainder of 1913. The first locality worked was the valley of the Tamocal Creek, between Mamatoco and La Tigrera. Later the vicinity of Mamatoco and Santa Marta was examined, and several trips were made to Gaira and to the beach beyond. In May a trip was made to the *hacienda* Las Vegas, situated at an elevation of from three to five thousand feet above sea level on the northeast slopes of the Horqueta, near one of the sources of the Rio Men-

daguaca. Two weeks were spent here and very thorough work was done. Birds were not abundant, however, and the ground was broken and the forest difficult to penetrate. The venomous snake known as "Fer-de-lance" was entirely too common to be agreeable and several narrow escapes spoiled the pleasure of collecting.

After returning from Las Vegas, camp was established at Minca for two weeks, and the slopes between 1,500 and 2,500 feet were thoroughly worked, but the heavy rains interfered with collecting.

From July 6, to August 3, work was done at Cincinnati, on San Lorenzo and near Mamatoco, during which time many new forms were added to the list and many loose ends of the problems of local distribution were caught up.

On August 6, a trip was made to Fundacion in company with Dr. A. G. Ruthven and Mr. F. M. Gaige, of the University of Michigan, and Dr. A. S. Pearse, of the University of Wisconsin. Two weeks were spent here with splendid results. The region proved to be a most interesting and fertile field for all members of the party, and many forms new to the general region were taken.

After the return from Fundacion some time was spent looking for particular forms in the vicinity of Mamatoco, Bonda, and Gaira, after which a trip was made on September 26, to Cienega Grande. The party embarked from Pueblo Viejo (near Cienega) in a big "Bongo" or dug-out canoe, with a smaller canoe in tow for shooting purposes. The first stop was made at Playa Caiman, near the northwestern corner of the Cienega, where camp was made on a narrow strip of sand beach separating the Cienega from the sea. All water was brought from near Pueblo Viejo, where it had been carried in canoes from the mouth of the Aracataca River. Life here was a constant torture by day and by night because of the hordes of mosquitoes and sand-flies, which not even a solid muslin canopy would keep out. Our only relief was when there was a brisk breeze from the sea, but it was not the season for the sea breeze, and it came but seldom. Needless to say, all possible haste was made to escape from such an undesirable locality, and after five days we broke camp and fled to the open Cienega in our big canoe, hoping to get at least one good night's sleep. We did sleep, but so soundly that it was not until morning that we discovered that we had been raided during the night by vampire bats, and the whole party was covered with blood-stains from the many bites of these bats. It may seem unreasonable to the uninitiated that we could have been thus bitten and not be disturbed in our sleep, but the fact is that there is no pain produced at the time of the bite, nor indeed for some hours afterward. I had ample proof of this while collecting vampires in an old tunnel in Venezuela. I caught the bats in an insect net and then seized them carefully by the nape of the neck and thrust them into cyanide bottles. Their skin is very loose around the neck and several times they succeeded in wriggling about and nipping my fingers. On such occasions I never knew I had been bitten until I saw the blood flowing from the wound.

After a bath and breakfast we put up our sail and headed for Trojas

de Cataca, a fishing village built on piles over the water at the mouth of the Aracataca River. We secured quarters in a comparatively new house and made ourselves fairly comfortable, although the odor of drying fish was very disagreeable for several days until we became somewhat accustomed to it. It was a pretty sight to see the little fleet of fishing canoes sail away at dawn in search of the great schools of *Lisa*. When luck was good the canoes would return between three and four o'clock, loaded to the gunwales, and then there was pandemonium let loose in the village. Singing, shouting, whistling, and laughing, while everyone big enough to wield a knife joined in the task of cleaning them for drying, this operation usually consuming half of the night. When the catch was very great the entire night was spent in festivities.

Practically all shooting in this vicinity was done from a canoe along the shores of the lagoon or up the streams entering into it, for at this season of the year the shores of the Cienega are inundated for a long distance inland. Herons, terns, and ducks were abundant, while the forests were teeming with parrots and monkeys. Occasionally a Manatee was seen at the mouth of the river, but none were secured. October 3 to 14, was spent here and many aquatic forms were secured. Little or no work was done between the return from Cienega Grande and our departure for the Sierra Nevada in January of the following year.

On January 10, with Mrs. Carriker and one Colombian assistant, I left Santa Marta for the north coast, going by land, with pack mules, as far as Don Diego. The trail was a trail in name only and was almost impassable. Three and a half days were consumed in reaching Don Diego. The trail passes through Mamatoco and Bonda, and thence along the road to Don Amo for a short distance, when it turns off to the left and crosses over into the valley of the Jordan, passing through Calabaso and Cacagua-lito, thence down the Jordan to the Rio Piedras, then down the Rio Piedras to the sea. From here the open beach is followed to Don Diego, except where detours inland are necessary to cross the rivers Mendaguaca, Guachaca, and Buritaca.

We arrived at Don Diego at dusk, after thirteen hours in the saddle; tired, hungry, and covered with bites of black flies, sand-flies, mosquitoes, and wood ticks, the latter being still attached in myriads to our persons. A hurried rub-down with kerosene removed the ticks, after which a delightful sea bath somewhat restored our flagging spirits, and a good supper provided by our genial host, Mon. Barbier, completed the restoration.

The whole northeast coast and the hills up to 3,000 feet or more contain more insect pests than any place I know of in Colombia, excepting some portions of the Atrato basin, and Don Diego proved no exception to the general condition. The attacks of flies and mosquitoes can be checked to a certain extent by the use of "dopes" or nets, but there seems to be no effective relief from the ticks, which cannot be entirely avoided and are, in many places, a serious drawback to the best field work.

Don Diego is a French plantation which at the time of our visit was

largely abandoned, and is now entirely so. It is in the heart of the heavy, humid forest which reaches to the very beach all along the northeast coast east of the Rio Piedras. A month was spent here, not because we wished to stay, but because we could not get away, since the trip to Dibulla was to be made by sea in a large dug-out canoe, and the canoe was not forthcoming. To secure the canoe it was necessary to make the trip to Dibulla, which I did, accompanied by our assistant, and riding the two mules, while Mrs. Carriker remained in Don Diego. After two days of strenuous endeavor and the promise of an exorbitant sum, a canoe and crew of five men were secured. We embarked in the evening, with a fresh northeast wind astern, and reached our destination early next morning. Then followed a half day of frenzied packing and at 4 P. M. we embarked and attempted to put to sea. There is no harbor of any sort at Don Diego, merely an open beach, and in passing the second line of breakers we were nearly swamped and were forced to return to shore, with much of our outfit wet and damaged by the salt water. The next afternoon we made another attempt which was more successful, and we reached the open sea with only a slight wetting in the outer line of breakers. Thirty-six hours were spent in getting to Dibulla, bucking the wind and strong current. We arrived at dawn, nearly exhausted from the cramped position in the canoe and lack of proper food.

No pack animals were available in Dibulla, and it became necessary to send to Pueblo Viejo for them. In the meantime we spent ten days very profitably in collecting around the *hacienda* La Victoria (near Dibulla), where we had been most hospitably received. No collecting had ever been done here and much interesting material was secured. Our baggage was taken to Pueblo Viejo on oxen, while we rode our own saddle animals. Owing to the slowness of the oxen we were compelled to spend a night on the road, reaching Pueblo Viejo at about 2 P. M. the second day. We pitched camp on the banks of the Rio Ancha, about half a mile from the village, thus escaping the too persistent visitors, including pigs and dogs, of the town. W. W. Brown had done considerable collecting at this place, but nevertheless much new material was secured and many new records made. Pueblo Viejo is only about 2,000 feet above sea level, surrounded by broken country, which has for the most part been cleared and has now reverted to scrub or savanna. Our old friends, the wood ticks, which were so numerous both at Don Diego and Dibulla, were much in evidence there and caused no end of annoyance. After returning from a morning's shooting it was almost always necessary to strip completely, sponge off with kerosene, and then bathe in the river to remove both ticks and kerosene, while the clothing went into a can of boiling water. From this base the valley and heights of Chirua were worked, as well as the valley of the Rio Ancha above for a long distance, and also the Macotama Valley as far up as Santa Cruz.

We secured oxen from the Indians of San Miguel for the transportation of our equipment to that village, a special trip having been made there

for that purpose. We arrived at San Miguel late in the evening, spending the night in the "guest house" of the village, and crossing the river the next morning to the plateau opposite where a camp site had been prepared in advance. The whole of the Macotama Valley, from where the road enters it below Santa Cruz up to the *paramos*, is largely deforested, the mountain slopes being largely unbroken savanna, except in the ravines, the only forest left being along the crest of the ridges and on the upper slopes. As a rule, what woodland was left was invariably on steep north exposure, land unsuitable for cultivation by the Indians.

We spent five weeks in camp at San Miguel, using that as a base for all work from there (5,500 feet) up to the snow line. An unfortunate, though unavoidable misunderstanding with the old chief, brought about by our failure to present him with a large jug of rum, was the cause of our not being able to secure oxen for moving our camp to higher altitudes. He even forbade us to shoot on the *paramos*, but we paid no attention to him, promptly going up the valley the next day to 10,000 feet, without hindrance.

Virgin forest was found at San Miguel only at long distances from camp, which made it necessary to spend many nights in the field in order to get the morning shooting, sleeping sometimes in the forest on the ground and other times in deserted Indian huts. No guides could be secured from the Indians, so that we were reduced to "following our noses" until we found what we wanted. The first time I went up to Lake Macotama I started at 5 A. M. on muleback, riding up to 9,000 feet, where the mule was left and the journey continued on foot. At noon the lake was reached (15,000 feet), where lunch was eaten, after which I returned to camp, reaching it at 7 P. M. with a good bag of birds, but well tired out. Lake Macotama certainly rivals many of the Alpine lakes in beauty and grandeur of scenery. In shape like a half horseshoe, it is about three-quarters of a mile long and from 300 to 400 yards in width, and is almost surrounded by beetling crags and cliffs of nearly naked rock rising to a height of about 1,400 feet above the surface of the lake. Down on one side, less precipitous than the rest, dashes a little stream of water from the melting snows above. The colors of the lake are exceedingly beautiful. Along the grassy shores the water is pale green, gradually becoming darker green, then merging into blue-green, light blue, and finally into the deepest ultramarine, showing that the lake must be of profound depth.

Later, when we all went up to the snow, we left camp very early, taking the two mules, Mrs. Carriker mounted on one and a pack on the other. We again left the animals at 9,000 feet, dividing the pack between the hunter and myself. We reached the lake at 4 P. M., ready to drop from fatigue, for the packs contained food for three days, blankets, guns, ammunition for three days' shooting, camera and aneroid. Camp was made on the lake shore under the lee of a gigantic boulder. We secured a good supply of fire-wood, ate supper, and turned in, to pass a wretchedly cold and miserable night, with the temperature down to 26° F. Next morning, after a hasty breakfast, we started by moonlight at 4 A. M. to climb

the cliff along the course of the little stream, which seemed to be the only feasible mode of ascent to the heights above. The top was reached after an hour of hard climbing, and another lake, a small and shallow one, was discovered there, from which stretched a comparatively gentle slope up to the snows. Respiration now became more and more difficult, and halts more frequent and longer. Our native helper succumbed to mountain sickness and was of little use until the following day, after we had descended below 12,000 feet. At last the snow was reached and its glittering slopes ascended for some distance, to an altitude of approximately 17,500 feet. To our keen disappointment, we now discovered that further advance along this route was impossible; for here began a knife-edge ridge of jagged rock which extended nearly a mile to the slopes of the main snow peak, the passage of which appeared an utter impossibility. To approach the heights above from any other direction meant a descent of at least 2,000 feet into another valley opening out toward the north, in which lay another fairly large lake. From this valley an uninterrupted slope leads up to the highest point of the Nevada. Such a detour meant at least another day, or even two, and we had insufficient food to make the attempt. We turned back and spent the rest of the day shooting in the valley below snow-line, where birds of several species were fairly common, one of which was the strikingly handsome humming-bird *Oxygogon cyanolaema*, which feeds largely on the flowers of the "Frailejon," and which is peculiar to the Sierras of Santa Marta. In the little stream above the upper lake we discovered numerous individuals of a fine new amphibian, later described by Dr. Ruthven as *Atelopus carrikeri*. On the shores of Lake Macotama was taken a single specimen of our beautiful North American warbler, *Geothlypis trichas*, the first record for South America.

After another disagreeable night on the shores of Lake Macotama, we started back to San Miguel, collecting along the way, and reached camp without mishap late that evening. I afterwards made another trip to the lake with my hunter, sleeping the first night a short distance below the lake, where we had a more comfortable camp, and on the second night in an Indian hut at 11,000 feet. On this trip the *paramos* between 11,000 and 15,000 feet were thoroughly worked and much valuable material collected.

Later in April, after a few showers had warned us that the rains were near, we broke camp, sent to Pueblo Viejo for oxen (the chief still being disgruntled), and started for the coast, where we arrived in four days. From Dibulla we proceeded by canoe to Riohacha, reaching there in one night's travel. A week was spent at Riohacha in strenuous collecting. The intense dry heat of the sandy wastes and low scrub around the town were very trying, after having descended so rapidly from the cold temperature of the high altitudes, and we found it impossible to stay out after 9:30 A. M. Fortunately, the thorny scrub surrounding the town was fairly swarming with birds, so that with three hours' shooting enough material was secured between the two of us to keep all hands busy the remainder of the day in preparing it.

A few more days of collecting would have been desirable, but a schooner

was leaving for Santa Marta, and since transportation between these places is very uncertain we could not afford to let the opportunity go by. We embarked in the evening, and at dawn of the second day reached Santa Marta, after a calm and uneventful voyage, just four months from the day we had started. Altogether it was a most successful trip, although many difficulties and delays were experienced which might easily have been avoided had it been possible for us to secure in advance even the most meagre information about the region we intended to visit. While the Indians were extremely shy and distrustful of us, they were honest and inoffensive, never molesting us in any way or coming near our camp during our absence.

After the trip to the high altitudes some time was spent in revisiting certain localities on the west end of the range to supplement collections. Evidently the next work to be done was a reconnaissance of the east and south sides of the range, and in 1920 the opportunity presented itself. In July and August Dr. Ruthven, F. M. Gaige, and I went to Riohacha from Santa Marta in a small schooner.

We worked at Riohacha for ten days, and then, with mules secured from the Indians, made a trip entirely around the Nevada, by way of Fonseca, San Juan de Cesar, Valle de Upar, Fundacion, and Cienega. The trip was most successful as a reconnaissance, and even more than this, as detailed work was done on the reptiles and amphibians, and at the same time sufficient data was secured to clear up numerous questions on the nature of the vegetation of the southern slopes and contiguous lowlands and the distribution and origin of the fauna of that side.

It will be clear from this account that while much has been accomplished both by previous workers and ourselves, there still remains a vast amount of detailed work to be done. To be worth while, collecting must be carefully done, for the diversity of conditions and the differences in altitude within short distances render collections with general data almost valueless.

Previous Biological Investigations: The late Mr. H. H. Smith arrived in Santa Marta in May, 1898, with his wife and two other assistants. They made their first headquarters at Bonda, where they remained for a considerable period, working the surrounding country for long distances. Mr. Smith himself did no collecting of birds or mammals, and probably secured but few reptiles and amphibians, confining his efforts to botanical and entomological work, in which he was, I understand, most proficient. All vertebrates collected were taken by native hunters employed by him, so that as a consequence we have a vast collection of skins labelled "Bonda" which in many instances came from places far removed from that village, both in actual distance and especially in altitude. Bonda lies in the valley of the Rio Manzanares, at about 200 feet above sea level, but near the foothills of the Horqueta Mountain, so that a collector starting out from Bonda might easily reach an altitude of 3,000 feet or more in a day's shooting. For this reason it is impossible to use much of Mr. Smith's data for plotting altitudinal distribution of species. This is especially true of his work

done at Bonda, although it holds good also for many specimens labelled "Valparaiso" and "El Libano." The Valparaiso of Smith is today the *hacienda* Cincinnati, and El Libano is the mountain ridge lying between Cincinnati and the adjoining coffee estate of La Victoria, which descends from the Cerro Quemado of San Lorenzo. There is no doubt that Mr. Smith took every precaution to label his specimens correctly, but when native hunters are employed it is not possible for a person who is unfamiliar with the local topography to tell from a hunter's description just where each specimen was secured. Also, the hunters themselves do not always remember and are very apt to give fictitious localities for specimens when they have forgotten the true one. In those days the importance of altitude in determining the distribution of species was not appreciated and most collectors paid little attention to it, so that they might be working on the slope of a mountain, with headquarters at 4,000 feet, and make collections from 2,000 to 6,000 feet or more, and give all specimens the locality of the base of operations.

Mr. Smith later spent some time at Don Diego, where Mrs. Smith was very ill, and while a great amount of material was collected there much of it was lost, and no detailed report was ever made on the remainder by any institution. Mr. Smith's work in the Santa Marta region was confined to the following roughly outlined sections: The valley of the Rio Manzanares from Mamatoco upwards, covering the lower slopes of the Horqueta and extending northward over the Matagiro Valley and the median part of the valley of the Jordan, at Cacagualito and Calabaso; the northwest slopes of San Lorenzo, between 2,000 and 7,000 feet, between Minca and the upper slopes of the Cerro Quemado; the vicinity of the town of Cienega (sometimes called San Juan de Cordoba) and southward as far as the Rio Orihueca, and lastly at Don Diego.

It is a pity that his specimens could not have been more carefully labelled as to altitude, because a great quantity of skins were made which would now be of inestimable value in plotting the local distribution of species in the regions above enumerated. He deserves, nevertheless, great credit for what he did accomplish, as does Mrs. Smith, because she superintended all the bird and mammal work and did much of the taxidermy herself. They worked in the region at a most difficult time, as it was during the late revolution, which caused them no end of annoyance. Also, the country around Santa Marta was much more of a wilderness then than now, with almost no roads or trails and very few settlements in the mountains.

Mr. W. W. Brown arrived at Santa Marta shortly before Mr. Smith and almost at once made his headquarters at Bonda, staying with Mr. Orlando L. Flye, who was in charge of the electric power plant at Bonda. All the material collected by Mr. Brown in the vicinity of Bonda and Santa Marta was labelled "Santa Marta," and is, as a consequence, worse than useless for plotting distribution, since it is actually misleading in many cases. After working at Bonda he went to the Sierra Nevada, where I have little knowledge of his work except what was given me by two men living in

Pueblo Viejo, who had been employed by him as hunters during all his activities on the north slopes of the Sierras. Contrary to Mr. Brown's statements that he himself collected all of his specimens, I have unquestionable first-hand information that both in Bonda and in the Sierras, at least at Pueblo Viejo, San Miguel, and the *paramos*, he did little or no shooting, employing native hunters for that purpose, while he prepared the specimens. As in the case of Smith's data, I would hesitate to use any distributional records based solely on Brown's collections, unless supported by other data. Mr. Brown worked both sides of the Sierras, at Pueblo Viejo (then San Antonio), Chirua, Santa Cruz, San Miguel, and Macotama on the north slopes, and San Sebastian, Pueblo Viejo, and El Mammon on the south slopes, as well as the intervening *paramos* of Macotama, Chiruqua, and Chinchicua. Notwithstanding the fact that he passed through Dibulla and Riohacha and traversed the road from the latter place to Valle de Upar, no collecting was done in any of these regions, so that the first definite information secured concerning their bird fauna was by the writer at Dibulla and Riohacha in 1914 and along the road from Riohacha to Valle de Upar and thence around to Fundacion in 1920, when attached to the University of Michigan expedition.

It is to be understood that I have no reason for making these comments upon the work of Brown and Smith other than the desire that our knowledge of the fauna of the region should be free from the confusion caused by inexact records.

Geographical Situation: The geographical boundaries used for the region discussed in this paper (*cf.* map) are as follows: On the north and northwest the Caribbean Sea; on the northeast and east the Goajira Peninsula, or, more exactly speaking, the Rio Rancheria (called Calancála on its lower reaches), up to where it turns abruptly northwest to enter the Sierras; from this point on the Rio Rancheria on a straight line to San Juan de Cesar, on the Rio Cesar; thence down the Rio Cesar to where it divides into two channels (Caño Corredor and Caño Matanza); from this point in a more or less straight line to Alto de las Minas, passing through Camperucho, and thence to Ariguaní; from there the trail to Fundacion, the terminus of the railway from Santa Marta; and from Fundacion a line to the south end of the Ciénega Grande and thence across to Playa Caiman and the sea. The line running across from the Rio Cesar to Ciénega Grande is a purely arbitrary one, since it does not designate the boundary of any known habitat. However, the upper Rio Cesar and Rio Rancheria represent an actual faunal and physiographical boundary between the Sierra Nevada and the eastern Andes, and I have used no records from localities on the slopes or foothills of the eastern Andes, such as Villanueva and Manuare (included by Simmons). The lower Rio Rancheria is also an arbitrary boundary line, since it traverses the arid Goajira Peninsula and cuts through a distinct faunal area which is well represented around Riohacha. Thus we have in the mountain mass an absolutely isolated area containing its own distinctive habitats and faunal characteristics, into which

enter but two outside influences, that of the Magdalena basin on the southwest and that of the central plateau of Venezuela through the Goajira Peninsula on the east.

The great mountain mass known as the Sierra Nevada de Santa Marta is, roughly speaking, in the form of a trihedron, with the San Lorenzo and Horqueta peaks and outlying ridges forming the northwest edge; the end of the long spur ridge which disappears in the big bend of the Rio Rancheria, the northeast edge; and the great southwestern buttress between the Rio Ariguani and Guatipuri, which ends at Alta de las Minas, forming the southwestern edge. The vertex of the trihedron, massive central peaks, covered with perpetual snow and rising to an altitude of not less than 18,000 feet (probably more), lies somewhat nearer to the northwestern edge. The base of the north face of the trihedron is about 90 miles long, that of the southeastern face about 120 miles, and that of the western face about 90 miles.

It will be noted that the Santa Marta Mountains have a remarkably small base for the heights attained. There is an almost complete absence of foothills between the points forming the three angles of the trihedron, the mountains rising rapidly and in many cases very abruptly from the surrounding plain, which is for the most part but a few hundred feet, or less, above sea level. Consequently, there are no broad valleys anywhere on the lower slopes of the mountains, and the numerous rivers rush down from the high altitudes to the plains below, carrying vast quantities of silt which is dumped into the Rio Magdalena, the Cienega Grande, and the Caribbean Sea. It is only in the Cienega Grande that an adequate idea may be obtained of the immense amount of material which has been carried down by these streams. In this great lagoon the detritus has extended the shore line for long distances and filled up what was evidently once a deep arm of the sea, until today it is but a shallow lagoon with mangrove swamps encroaching upon it from all sides. No less than seven large rivers drain the north slopes. On the south side are four magnificent streams, all having their source in the snow, while on the west side are six of nearly equal size. The largest streams are the Rancheria, Badillo, Guatipuri, Ariguani, and Fundacion. The existing maps of this region are very inaccurate in many respects, particularly in the plotting of the rivers. They convey an erroneous impression of the mountain ridges separating the various drainage basins, the long, bold ridge running east into the great bend of the Rio Rancheria being poorly indicated, as well as the one, even higher and wider, which ends at Alto de las Minas, forming the southwest apex of the triangle.

The mountain valleys are narrow and V-shaped, with little or no flood plain until the plains are reached, where they burst out into the surrounding lowlands and deposit great masses of boulders and gravel in parallel ridges resembling lateral glacial moraines. The slopes of the mountain valleys are, for the greater part, steep, and in many instances precipitous, especially on the south sides of the ridges, which would suggest a tipping up of the strata in some remote geologic time. The ridges are for the most part nar-

row, even knife-edged, the crests often being but a narrow wall of rock, in places but a few feet in width along the crest. As the higher altitudes are approached, and one emerges above the "cloud zone," where the precipitation is less, the ridges become broader and more rounded, with remains of plateaus and gentle slopes. The valleys are broader and shallower, and on the vast *paramos* surrounding the snow peaks are to be found great undulating tracts of open moorland, broad valleys, and gentle slopes, with many small, picturesque lakes.

These mountain lakes were possibly caused by glacial action in the remote past, and many of them have been nearly filled with silt from above in comparatively recent times, but at the present day no true glaciers exist in the Sierras, to my personal knowledge, unless some very small ice masses are included under the term. I doubt whether any very large glaciers ever existed in the Sierra Nevada de Santa Marta, since I have been able to identify no moraines. I suspect the cause of this absence of glaciers to be the complete isolation of the range and the lack of great buttressing foothills and mountains such as abound in the Andes. The rapid and unopposed ascent of the superheated air from the lowlands and its direct action on the snow masses above cause a much higher temperature and higher snow-line than would otherwise be the case at these altitudes.

The topography of the Sierra Nevada de Santa Marta might be considered to indicate that the range is young, but this does not necessarily follow. Traces of volcanic action are wanting and the exposed strata show clearly that the range has been thrust up. The exposed rock is largely granite and in the greater part of the region the subsoil is a peculiar decomposed granite, abounding in fine particles of mica. While clay deposits are present in many districts, they are decidedly less common than the decomposed granite. I have seen limestone in only one small district, on the road between Fonseca and San Juan de Cesar, where the road skirts the base of the foothills. This limestone area is but a few miles in length (east and west), although it may extend far out into the valley.

The narrow knife-edged ridges in many places seem to be the result of great vertical masses of hard rock which resist erosion along the tops of the divides and maintain the steep slopes. Ridges composed almost entirely of great masses of boulders and solid rock are very common. In addition to the resistance of the rocks and soil to erosion, it must be remembered that the east, north, and west slopes of these mountains from the lowlands to the timber line are clothed with a dense forest growth, and that on the south slopes, while the forest growth is largely absent and the topography is nearly the same as on the other slopes, the ridges are inclined to be broader and more rounded. The conditions thus seem to favor the persistence of a youthful topography.

Climate: The seasons are more or less the same on the different slopes and the contiguous lowlands, although the humidity and the temperature vary greatly on the different exposures, due principally to the trade winds. The surrounding lowlands possess the usual tropical heat of these latitudes,

tempered on the north coast by the trade winds and sea breezes, but are very hot on the west and south sides during most of the year. Ascending the mountains, the temperature gradually lowers. Between 4,000 and 5,000 feet is an ideal climate, having a minimum temperature of about 60° F. and a maximum of 80°, where an open fireplace is a great comfort at times and woolen clothing almost a necessity, especially during the rainy season from 5,000 feet upwards. When 8,000 feet is reached the minimum drops to an average of about 54°, and it is always chilly in the shade, while in the open the direct sun's rays are blisteringly hot around midday. At 9,000 feet, or a little above, the mercury drops to 46° F. The above temperatures are taken from San Lorenzo, and are from 4° to 5° higher than at corresponding elevations on the western slopes of the main Sierras. The frost line varies with the season and the exposure, but is probably somewhere near 11,000 feet. The lowest average limit of snow is somewhere near 16,000 feet, rising on the southern exposures during the dry season to 17,000 or even 17,500 feet, and dropping down to 15,000 in the sheltered valleys of the north slope. There are times during the dry season when heavy falls of snow occur as low as 13,000 feet, but this snow never lasts more than from twenty-four to forty-eight hours, usually falling during the night and melting during the following day. On the north slopes of the mountains there is a far greater humidity and lower temperatures than on other slopes at corresponding elevations. The climate at Pueblo Viejo (2,000 feet) approximates that of 4,000 feet on San Lorenzo and the west slopes, while that of San Miguel (5,500 feet) corresponds closely with that of the Cerro Quemado de San Lorenzo, which has an elevation of 8,000 feet. These differences in conditions on the north slopes apparently exert a powerful influence on plant and animal life on that side, causing a corresponding descent in altitudinal distribution. At Don Diego the heavy mountain forest extends down to the very edge of the narrow coastal plain, and the upper foothills fauna descends with it, literally squeezing out the lower foothills forms from this region or forcing them to mingle with those of the coastal plain fauna below.

There are two distinct and well-marked seasons, the rainy and the dry, the former covering the months of April to November, inclusive, over the greater part of the mountains from 3,000 feet upward. Below 3,000 feet the seasons of rain are retarded or extended by local conditions. On the northern side, from the Rio Frio around to the Rio Piedras, the rains do not begin before May or June, and usually are over by the end of October, while on the north side, from the Rio Piedras to beyond Dibulla, they begin as early as March, and often continue as late as the end of December. Even during the dry season the north exposure of the Sierras is refreshed by almost daily fog banks, caused by the condensation of the moisture carried by the trade winds, when they come in contact with the cool vegetation of the mountain slopes. The great southern exposure of the Sierras receives a much smaller amount of moisture than any of the other portions, which is divided into two periods, at least in the lowlands and foothills, much resembling the seasons of the interior of Colombia. The spring rains fall

in April and May, while the greater part of June, July, and August are nearly without rain, the heavy rains coming in September and October. The cause of the scarcity of rain on the south side is, at first glance, hard to explain, but after a careful study of the topography and prevailing winds had been made a plausible explanation was arrived at. The prevailing winds are the northeast trades, which sweep in, moisture laden, from the Caribbean. The south slopes of the Sierras are, to a great extent, sheltered from these winds by the long spur ridge forming the southeast apex of the trihedron. The trade winds are low-flying, not extending, as a rule, to more than a thousand feet, or less, above the earth's surface, unless they meet with some obstacle which deflects them upward. The northeast spur ridge of the Nevada forms this obstacle, and its northern slope, covered with a dense forest of massive trees, receives the first impact of the winds, condenses the greater portion of the moisture carried by them, and then deflects them upward and over it to the south slopes of the mountains, but not until they have lost the greater part of their moisture, and little or none is left to be condensed into rainfall there. Farther to the south the winds sweep into the valley of the Rio Rancheria unopposed, and thence through to the Rio Cesar Valley, the height of land between having no effect on them, and having been thoroughly heated as they traversed the long stretch of arid wastes composing the Goajira Peninsula, they are drying winds. These strong northeast winds sweep through the great valley between the Sierra Nevada and the eastern Andes, drive back the gentle, moisture-laden land breezes from the Magdalena Valley and prevent their entrance from the southwest beyond a certain point. To the north of the southwest angle of the Sierra Nevada the moisture-laden winds from the Magdalena reach the west slopes of the Sierras unopposed and discharge their moisture there, giving an abundant rainfall during the rainy season on this side and its contiguous lowlands.

Vegetation of the Plains: The vegetation of the region under discussion is diversified. Beginning with the lowlands, we have, on the north side of the mountains, extending from the mouth of the Rio Piedras to a point beyond Dibulla, a heavy growth of forest, consisting of large, tall trees and very little tangled undergrowth, which extends almost to the sea beach. This may be strictly termed a humid tropical forest, but it is not jungle-like in its characteristics. Beyond Dibulla the forest gradually changes, merging first into the "dry forest," such as is prevalent around Santa Marta, and then to low, thorny scrub and cacti, prickly pear, etc. (Pl. VII.) A small, slender fan palm is abundant from Dibulla to Riohacha and as far south as Barbacoas, growing most commonly in the open parts of the scrub on low spots which are flooded during the short rainy period. This palm was not observed in any other section. Near the mouth the banks of the Rio Rancheria are clothed with mangroves, while higher up, above the influence of the tide, the same class of trees and shrubs are found which are found in similar situations around Santa Marta.

Following the trail from Riohacha southward to Fonseca, the vegeta-

tion is similar to that around Riohacha until the Rio Camarones is reached at Barbacoas, and where the foothills begin. The flood-plain of the river here is very wide in places and heavily timbered with massive trees, intermingled with dense undergrowth, while the low hills are covered with the semi-arid type of low woodland, abounding in shrubbery and small trees, the whole region showing the effect of a very low humidity. After leaving Barbacoas the trail soon begins to wind up into the foothills of the great northeast spur-range. The forest becomes heavier and heavier, with less and less undergrowth, until at an elevation of perhaps 3,000 feet the forest is composed entirely of tall, massive trees, with little or no undergrowth. This forest undoubtedly extends westward unbroken over the whole northern flank of the Sierras. The trail crosses the range at an elevation of approximately 5,000 feet, then descends to the Rio Rancheria above Fonseca. The heavy forest of the north slopes extends unbroken up to the crest of the divide and slightly over it, but there is an almost instantaneous change after crossing the crest; the dense forest of large trees gives way to an open woodland of small trees and tangled underbrush, even the species changing almost entirely.

Descending the slope, the woodland becomes sparser, acacia-like forms and cacti soon appear, and there are tracts of open savanna. Lower in the foothills and upper parts of the valley we have again the same vegetation as along the trail between Riohacha and Barbacoas. The flood-plain of the Rio Rancheria is heavily forested, like that of the Camarones at Barbacoas, except in the vicinity of Fonseca, where it has been deforested. However, as elsewhere noted, these forests of the river flood plains derive their moisture more from the subsoil rather than from the rainfall. From Fonseca to San Juan de Cesar the trail is close to the base of the foothills over a cactus- and acacia-covered plain, and the height of land separating the basins of the Rio Rancheria and the Rio Cesar is so inconsiderable that it is scarcely noticeable as one crosses it. There is but one small stream descending from the foothills between Fonseca and San Juan, and this was dry when we crossed it. The adjacent foothills are either sparsely clothed with low scrub or grass, or are bare and rocky slopes.

From San Juan de Cesar to Valle de Upar the vegetation is practically the same, except for the forests of the Badilla River flood-plain, which is very broad and well wooded. The acacia-like shrubs and trees and cacti abound everywhere else, with some slight approach to savannas in places, especially near Badilla and above the flood-plain of the Rio Guatipuri. The flood-plain of the Guatipuri is very extensive as one approaches Valle de Upar, with many canals and irrigation ditches, but on the south side of the river the land is higher and the arid woodland is largely in evidence. This same condition continues southward (at least along the trail) for about five miles, except that cacti and acacias are less abundant and other species of trees and shrubs begin to appear, and then the dry woodland changes gradually into a fairly heavy flood-plain forest which extends southwestward, with but few breaks, to a point some ten miles south of Valencia de Jesus. This is, in greater part, a magnificent lowland forest, consisting of many

large spreading trees, intermingled with smaller trees and considerable undergrowth. However, it is not properly a humid forest, since the types of trees are those of the drier woodland, developed to a more luxuriant degree, rather than those of the true humid forest, leading one to believe that the moisture, on which depends its luxuriant growth, is drawn from the subsoil rather than from the surface water of the rains. There is no doubt, however, that the rainfall is greater south of Valle de Upar than to the north of it, and these valley forests evidently extend unbroken down to the Rio Cesar and thence to the Magdalena River, because the bird fauna present here is strictly Magdalenan and very different from that to the north of Valle de Upar. This forest (along the trail) ends very abruptly at a small creek, the character of the soil changing equally abruptly, which leads me to believe that the presence or absence of luxuriant forest may be dependent to a considerable degree on the character of the soil, or, more strictly speaking, the subsoil, which I have found to be usually an extremely hard, impervious formation wherever savannas are found in the lowlands. This association of savanna and hard subsoil does not, however, hold good on mountain slopes. The savannas of the Macotoma Valley and elsewhere, I am led to believe, are the results of deforestation and repeated, systematic burning on the part of the inhabitants, rather than to any lack of humidity or nature of the soil.

As mentioned above, the flood-plain forest at Valencia ends abruptly to the west, changing to scattered clumps of low trees and tangled shrubbery, intermingled with areas of savanna. (Pl. VIII, fig. 1.) The savanna is not typical, however, as certain easily recognized and characteristic species of grasses and shrubs are absent. The whole plain from here on to Camperucho is very flat, trees and shrubs become less frequent and the tract of savanna larger and larger, until the woodland is confined to the immediate banks of the little streams which descend at rather frequent intervals from the nearby foothills. As Camperucho is approached the country becomes slightly rolling and hilly, for not far beyond here the trail crosses the last remnant of the great southwest spur-ridge. Here in this hilly country the savannas present a truly typical aspect, true savanna grasses and shrubs being present.

Soon after leaving Valle de Upar the trail again approaches the very margin of the foothills which rise abruptly from the level plain, a peculiar characteristic noted from the time we left Fonseca. From here on to Camperucho the trail is never far from the foot of the hills which present the same barren aspect all the way across from Fonseca. Higher up savannas abound, but from about 3,000 feet down little or no grass is present, except for scattered areas, while the narrow valleys and ravines and lower slopes of the valleys are slightly wooded.

Soon after entering the savanna district, south of Valencia, numerous large palms began to appear, becoming more and more numerous until we were traveling through a veritable forest of giant palms growing out of clean, open savannah. This same palm, locally known as "Coroso," is abundant over the whole western lowlands as far as Santa Marta, growing

up to an elevation of about 1,000 feet, but never *naturally* in open savannah. In fact, the seeds will not germinate except in damp, shaded places, such as in the shade of the forest. Since these palms are so abundant over practically all of the savanna areas between Valencia and Camperucho, it leads one to believe, together with other facts, that these savannas are not natural, but also the result of deforestation and burning, partly intentional and partly accidental, of a drier, more open class of woodland, which, growing over a very hard, impervious subsoil, would not readily reproduce itself after having once been destroyed. The argument that the palm would have been destroyed by such fires is erroneous, because this palm was seen in many instances burned around the base so deeply that not half of the original volume of the trunk was left, yet the trees were still luxuriant and strong and bearing as large seed clusters as the unburned individuals.

After crossing the savanna-clad hills of Alto de las Minas, we dropped down abruptly into another and distinct region of forest. In some places it was damp and dense, but for the most part it was rather light and open, with much tangled undergrowth. The country is more undulating, the soil more gravelly and less fertile, conditions which continue from Alto de las Minas to the Fundacion River, except in the small valleys and on the great flood-plain of the Rio Ariguani. The forests of the Ariguani are truly magnificent, consisting of gigantic trees and a sparse undergrowth; they are dense and gloomy, even at mid-day. Typical humid forest types of birds prevail, and one is reminded of the forests of the Sinú, lower Atrato, and eastern Panama and Costa Rica. Giant creepers and lianas and the peculiar parasitic fig tree abound, although epiphytes are not particularly abundant. The foothills, from Alto de las Minas northward, are also clad with a forest which extends unbroken upward. From the Fundacion River to a point slightly north of Rio Frio the lowlands were originally clothed with luxuriant humid forest, but this has been nearly all cleared away between the lower edge of the foothills and the swamps which extend back from the Cienega Grande for many miles, while vast banana plantations and pastures have taken its place. The original forest here was in many parts very similar to that of the Ariguani, but not so heavy, I imagine, and with more undergrowth and wild plantains. Just beyond the Rio Frio there is again a very abrupt change from fertile banana farms to desolate salt plains covered with a scanty growth of acacia scrub and cacti, with a great deal of a peculiar salt-bush, common at Riohaca and between Donjaca and Gaira, near the sea beach. Soon after crossing the Rio Cordoba the same class of dry, thorny, scrubby woodland appears which was so common around Riohacha and between Valle de Upar and Fonseca. This condition continues on to Santa Marta (Pl. I, fig.2) and around to the Rio Piedras, but extending here to a considerable extent up over the lower foothills to nearly 1,000 feet in many places and much more in others, especially on the ridges. The valleys of the streams are well wooded, however, and the acacias are less abundant than on the east and south sides of the Sierras. The shores of the Cienega Grande are all low and swampy and flooded for a long distance inland during the period of high water on the Magdalena

River, while the outer fringe of vegetation is largely composed of mangroves. It is a paradise for water fowl, while many shore birds are present on the sandy strip between the lagoon and the sea and on the open wastes around the town of Cienega.

Foothill Vegetation: The vegetation of the foothills presents few abrupt changes, excepting those on the south side, which have already been described. The hills on the north side, from Rio Piedras to far beyond (northeast) Barbacoas, and those on the west side from Alto de las Minas to the Rio Cordoba, are heavily forested, much more heavily, however, on the north side than on the west, where the forests of ridges between the valleys have a tendency toward the "dry forest" of the foothills around Santa Marta. (Pl. III, fig. 1.) This foothill forest is composed of medium-sized trees, with much tangled undergrowth (except on the north side), and contains many deciduous trees, which remain bare during the dry season and thus give the undergrowth a chance for more extensive development.

On the whole, the foothill forest is most uninteresting. It contains very few epiphytes, very few lichens, and almost no moss, the only redeeming feature being the many beautiful ferns in the damper, more shaded parts. It is choked with vines, brush, and bamboo grass, is difficult to penetrate, and contains very few characteristic species of birds, mammals, or reptiles. This condition extends upward from 1,500 to 2,500 feet on the northwest and western sides, the higher elevation corresponding to the narrow ridges and the lower to the valleys. At these altitudes a gradual change takes place and the foothill woodland merges into the mountain forest. On the north slope this change is less apparent, the mountain forest, by reason of the greater humidity, extending down over the foothills for the most part practically to the edge of the costal plain, but the foothill area is, nevertheless, largely devoid of mosses and lichens and epiphytes, which nowhere appear abundantly until the lower edge of the "cloud zone" is reached.

Mountain Forest: At about 2,000 feet a marked change is noticed in the character of the forest. Deciduous trees disappear almost entirely, ferns become very abundant on north and west slopes, and a few bromeliads and orchid-like plants appear high up in the tops of the trees. The trees become gradually taller, more slender, and set closer together. Certain distinctive lowland and foothill types disappear altogether, to be replaced by others. At about 3,000 feet a slender, graceful palm known as Maquenque, puts in its appearance, and the underbrush changes from wiry brush and bamboo grass to a low, broad-leaved palm and to more succulent types of shrubbery. Lichens are now abundant on many species of trees, while bromeliads are more common and lower down. From 3,000 feet up to 6,000 feet there is little change in the vegetation, merely in the diminishing or disappearance of some species and the increase or appearance of others, but the types remain about the same. Between 4,000 and 6,000 feet the trees seem to attain their maximum development, and truly magnificent forest areas are present at these altitudes under favorable soil and slope conditions. The

Maquenque palm, so common lower down, disappears at 5,000 feet, but the low, broad-leaved species, "Cola Gallo," becomes more abundant, so that in many places it forms almost the only undergrowth present. On the northeast slopes of the Sierras, also on San Lorenzo and the Horqueta, there is a most unusual development of tree moss in the cloud zone. Between 6,000 and 8,000, or even 9,000 feet, these slopes are drenched with rain or cloud mist almost daily, and as a consequence this moss attains such a growth as to choke out most of the smaller epiphytic growth, only the hardier Bromelias being able to withstand it. Not only the trunks of the trees are solidly carpeted with it, but the branches and even slender twigs are completely enveloped with close-set filaments from one to three inches long. (Pl. II; Pl. III, fig. 1; Pl. IV, Pl. V.)

A magnificent palm, resembling the Royal Palm, is also abundant on the north slopes between 4,500 and 6,000 feet, appearing often in large groves, the great plume-like tops towering above the other forest growth. Above 6,000 feet the size of the forest trees gradually diminishes, except in sheltered valleys. Bromeliads and orchids become more abundant in individuals and species and now grow low down on the trunks of the trees as well as on the branches. Four very distinct species of bromelias were noted on San Lorenzo between 5,000 and 8,000 feet. At 7,000 feet the type of forest growth changes rapidly, giving way to trees of a hardier character, many with small, close-set leaves of dark, glossy green. They are not so tall, more branching, and less symmetrical in shape. Different types of undergrowth also appear. Bamboo grass and bamboo cane become the dominant undergrowth in many places, often completely choking out every other variety of smaller growth. Such tracts of bamboo grass and cane are nearly impenetrable, except by the hardest kind of cutting with a machète, and they contain little in the way of animal life. At about 7,000 to 7,500 feet and upward as far at least as 9,000 feet, on all open or exposed ridges, especially those which have been burnt, a peculiar large bromeliad with great recumbent stalks grows along the ground. (Pl. VI.) These plants harbor many species of amphibians and insects and hold a considerable amount of water in their crowns, even through the dry season. Coarse brake ferns of several species are abundant, especially where fire has passed, extending from 4,000 to 8,000 feet or more. Countless species of smaller ferns abound at all altitudes, from 1,500 feet to timber-line, from the most delicate of maidenhairs to the great tree ferns. There are also present on San Lorenzo, from 7,000 feet upward, great numbers of an exceedingly tall and slender palm, known locally as the "wax palm," and apparently very similar to, or identical with, the palms which are so abundant in the central Andes in the vicinity of Quindío Pass. I have no recollection or note of the presence of these palms in the Sierra Nevada proper. From 7,000 feet up to timber-line there is little change in the types of vegetation, certain species of trees and shrubs disappear, to be replaced by others of similar type. The trees, however, become lower and more branching, and on exposed ridges are gnarled and twisted, while nearly all are smothered in masses of many curious forms of epiphytes, mosses, and lichens. At timber-line the change

from low forest to open moorland is sometimes very abrupt, though as a rule gradual, the trees becoming smaller and smaller and gradually giving way to shrubbery and bushes intermixed with coarse grasses.

Paramo Vegetation: The immense *paramos* or moor-like tracts of land extending from timber-line to the perpetual snow present many curious types of plants. Naturally the prevailing vegetation is grass, of many species, but numerous varieties of bushes and shrubs are present, as well as many kinds of annual flowering plants of considerable beauty and bright colors. The most peculiar and characteristic form of the *paramo* is the great mullein-like plant known as "Frailejon," of which there seems to be but one species in the Sierra Nevada de Santa Marta, three very different varieties being found in the Sierra Nevada de Chita, in the eastern Andes. The leaves as well as the stalk are thick and woolly. In favorable spots it attains to a considerable size, but I never found it more than five to six feet high in the Santa Marta Mountains. In the eastern Andes it is often seen growing from fifteen to eighteen feet in height, with the trunks from eight to ten inches in diameter. The flower buds are enclosed in a mass of silky wool, of a pale greenish yellow, or golden yellow, very beautiful just as they begin to open, of large size and in clusters of four to eight. Humming-birds feed almost exclusively on these flowers in season, especially *Oxygogon*, while the seeds furnish the bulk of the food for the many sparrows of the *paramo*.

Mountain Savannas: Great tracts of savanna are present on the southern slopes of the Nevada and on the north slope in the Macotama and Rio Ancha valleys, also to a lesser extent in the Palomina, all more or less above 2,000 feet. The cause of these savannas has been a debated question and has not, I believe, been satisfactorily explained in many cases. It is a practical certainty that where such savannas occur above 2,000 feet and are in a zone belonging to, or surrounded by, a forest belt, such as those of the north slope, they are due to deforestation and persistent burning. The fact that in regions of extensive savannas the rainfall and consequent amount of humidity is less is an effect of, rather than a cause for, the presence of the savannas, because the absence of forest growth always lessens the amount of atmospheric condensation.

Colombia is a country which has been populated in certain sections for many years, and the valley south of the Sierra Nevada de Santa Marta is one of the oldest of these, it having been settled early in the sixteenth century. The town of Valle de Upar was founded before the colonization of North America began. Deforestation and systematic burning, covering a period of from one to four centuries, must inevitably destroy large areas of forest, while the natural flora to follow in such cases would be the hardy grasses which constitute the vegetation of the present savannas. Several instances tending to prove this theory have come under my personal observation, covering a period of but nine years, so that if obvious results can be obtained in that short time, what might not take place in a period covering several centuries. Not only have the southern slopes of the Sierra

Nevada been settled by the Spaniards and their descendants for nearly four hundred years, but they found there upon their arrival a large population of Indians, living largely by agriculture, the remnants of which still exist on those southern slopes and in the three valleys of the north slope which today show large areas of savanna. It is an absolute certainty that the savannas on the north and west slopes have been caused entirely by deforestation and burning done by the Indians. I am also inclined to believe that the southern slopes of the Sierras were at some time forested to a much greater extent than at the present day and that their present barren condition has been brought about largely by deforestation and burning. A mountain savanna when once started, and burned over every year at the end of the dry season, will spread very rapidly, for with each burning the surrounding woodland is killed for distances varying with the character of the underbrush and the steepness of the slope, the fire often running up a steep slope through the forest for miles before dying out. The Colombians as well as the Indians invariably burn over the savannas every year, just before the spring rains, to remove the hard, woody grass stems and to stimulate the growth of tender fresh grass for their livestock. It is probable that the original forest growth of the southern slopes was not dense owing to the lesser amount of precipitation there, brought about by natural topographical conditions, as elsewhere explained, and for this reason was the more readily destroyed by fire. Once destroyed, its replacement was an impossibility, owing not only to repeated burnings but to diminishing rainfall, due to the absence of woodland. Probably the most striking confirmation of the recent formation of savannas at the foot of the southern slopes, is the fact that there is an *entire absence* of any reptilian or amphibian fauna peculiar to natural savanna, all the forms taken on these savannas being the same as those present in the surrounding and adjacent forest or scrub.

General Character of the Faunas, Mammalian and Avian: Taken as a whole, the fauna, especially the bird fauna, of the Sierra Nevada de Santa Marta, is not an abundant one, as represented either by species or individuals, when compared with that of many parts of the Colombian Andes. The great group of fruit-eating tanagers, so abundant in all three ranges of the Andes, is conspicuously absent here, but three species of *Tanagra* being found from sea-level to timber-line. *Buthraupis* and *Compsocoma* are entirely absent, while *Poecilothraupis* and *Ramphocelus* are represented by but a single species each. The other great fruit-eating groups, the parrots, toucans and trogons, are also poorly represented from the foothills upwards. Parrots are abundant in the lowlands of the west and parts of the south side. In the mountains proper but four species of parrots, two of trogons and three of toucans are found, which is a mere bagatelle as compared with the Andes, especially the parrots. This undoubtedly shows that the forest growth, which is very different from that even of the eastern Andes, offers little in the way of fruits and berries. On the other hand, insectivorous forms are more abundant, especially the *Dendrocolaptidae* and *Formicariidae*. Hummingbirds are also poorly represented everywhere, and present in small numbers, with the exception of a few

very hardy, wide-ranging forms of the lowlands. However, above 4,000 feet there are not more than about a dozen species of Trochilidæ, a very poor showing as compared with either range of the Andes. Monkeys are rarely seen above 2,000 feet, and very uncommonly above the costal plain. In Venezuela I have taken *Mycetes* up to 7,000 feet, where it was apparently not rare, according to local report.

Among the mammals, the wild pigs and agoutis are the most abundant, ranging from sea-level to at least 8,000 feet. Tapirs are fairly common above 3,000 feet. Deer are nowhere common, except the large species found in the delta region of the Magdalena, which in reality hardly belongs to the region under discussion. Rodents and squirrels seem to be abundant nearly everywhere up to at least 6,000 feet, as well as marsupials and foxes; the latter, however, are not, as a rule, seen above 2,500 feet, although I saw a pair at Vista Nieve at 5,000 feet.

A description of the amphibian-reptile fauna is given by Dr. Ruthven.

Conclusion: The great inaccessibility, solitude and isolation of the Sierra Nevada de Santa Marta have been the chief causes of the fragmentary nature of the biological work done there, and until better means of travel and communication have been opened up there are numerous large areas which will remain unexplored and unknown. A few regions, such as Mount San Lorenzo and the Horqueta, which are easy of access, have been intensively worked along several lines, and certain accessible portions of the lowlands may easily be studied, especially the banana district. However, the bulk of the region, both lowlands and highlands, is accessible for intensive biological study only by means of well-equipped expeditions with considerable time and money at their disposal. Such expeditions could, however, be easily organized and carried out by the combined efforts of several large and well-equipped scientific institutions, each one furnishing one or two experts in certain branches of biology, and bearing its corresponding quota of the expenses. Such expeditions, under capable leadership, and composed of men accustomed to work in the tropics or other wild and uninhabited regions, could obtain important results, and there would be no duplication of field work, with consequent loss of time and money. There is probably no other portion of the American tropics which today offers such a promising field for intensive biological study as the Sierra Nevada de Santa Marta. The work already done has been entirely too fragmentary and widely separated to lead to many definite general conclusions, especially concerning such broad problems as faunal origin and relations. Too much mere reconnaissance and too little intensive study of life history and distribution have been done. In the present sketch (for with our present knowledge it can be classed as nothing more than a sketch) there has been little attempt to arrive at many definite conclusions. An attempt has been made to set down the facts as known to the author, with the hope that they may stimulate further work in this most interesting field and serve as a basis for intensive study.

List of Localities Referred to by Simons, Brown, Smith, Carriker, and the University of Michigan Expeditions.

Alto de las Minas. Point on the trail between Valencia de Jesus and Fundacion, where it crosses the lower extremity of the great southwest spur ridge of the Sierra Nevada. Probably not more than 600 feet above sea-level, and three days' journey from Fundacion.

Ariguaní. A cattle ranch of considerable extent which has been opened up on the Rio Ariguaní at the point where the Valle de Upar trail crosses it. It is in the heart of the great lowland forest, about thirty miles south of Fundacion, and at no great distance from the lower edge of the foothills.

Aqua Dulce. Plantation on San Lorenzo, altitude about 3,000 feet.

Arroyo de Arenas. A cattle ranch and regular stopping place for pack trains and travellers journeying between Riohacha and Fonseca. It is a long, hard day's march from Riohacha, and the first point at which good water and forage can be obtained. It lies at the edge of the flood-plain of the Rio Camarones (called Barbacoas here) and is probably about 500 feet above sea-level. Outside of the flood-plain forest the vegetation consists of low woodland of the dry forest type, acacias and cacti being conspicuous.

Badillo. Once a flourishing little town, but now a miserable collection of huts, situated on the trail between Fonseca and San Juan de Cesár, and near the Badillo River. To the southwest of the town lies the heavy woodland of the river flood-plain, while to the north the vegetation consists of dry acacia-like scrub and cacti, interspersed with patches of open savanna-like areas. The foothills are but a few miles distant.

Barbacoas. A tiny hamlet at the crossing of the Rio Barbacoas, about two miles south of Arroyo de Arenas.

Bolívar. A small farm and lowland station of the Santa Marta Coffee Company, from which pack mules start for the *hacienda* Cincinnati. It is about five and a half miles from Santa Marta, a mile and a half from Mamatoco, and about 100 feet above sea-level. The prevailing vegetation, outside of the irrigated areas, consists of low, semi-arid woodland, acacias and cacti. The nearby Jamonacá Creek Valley is rather heavily wooded and offers good collecting ground.

Cacagualito. A small farm, now abandoned, at which Mr. Smith collected. It lies on the trail between Bonda and the north coast, by way of the Quebrada Jordan and the Rio Piedras. It is between 800 and 1,000 feet above sea-level, on the ridge separating the valley of the Matajira and Jordan, and lies in the foot-hills section of the semi-arid coast belt.

Camperucho. A small settlement of scattered houses on the trail between Valencia de Jesus and Alto de las Minas, a hard day's journey from Valencia. It is in a rolling, hilly region, on a remnant of the same ridge as Alto de las Minas, and not more than 400 to 500 feet above sea-level. It is largely a region of savannas and scattered clumps of scrubby woodland.

Cerros de Caracas. A broad, well-defined mountain range of the Sierra Nevada proper, beginning just below San Miguel, at the Rio Macotama, at an altitude of about 5,000 feet, and rising abruptly to about 8,000 feet, then gradually to about 13,000 feet, where it ends in a jumble of jagged, naked pinnacles of rock, which form a barrier to further ascent to the snow-capped peaks above. The whole of the eastern end and southeastern flank has been denuded of forest, but the northwest side is steeper and forested to the crest.

Chinchicúa, Valley of. A locality given by Simons as having an altitude of 6,500 feet, and situated on the south slopes of the Nevada a short distance below San Sebastian.

Chinchicúa, Pass of. Pass at head of valley of same name, having an altitude of 11,000 feet. Locality used by Simons.

Chirúa. The name of a large valley and the small stream which drains it. Situated on the northeast slopes of the Nevada, at an altitude of from 2,000 to 5,000 feet, and empties into the Rio Ancha at Pueblo Viejo. The valley is nearly enclosed by mountains rising on the south side to about 5,000 feet, known as the Heights of Chirúa. The valley is sparsely inhabited by Indians, and nearly the whole of the lower portion has been deforested in years gone by, and is now covered either with grass, low scrub, or cultivations of the Indians.

Chirúa, Heights of. The mountain ridge lying on the southwestern side of the valley of Chirúa, with an elevation of about 5,000 feet.

Chirúqua, Paramo de. The immense *paramo* lying on the crest of the Nevada to the south of the upper Macotama River and to the east of the snow peaks, with an altitude of from 11,000 to 15,000 feet. This is doubtless the *paramo* de "Curigua" of Sievers. The name Chirúqua was used by Brown, and I followed his nomenclature without taking the precaution to verify it, so that I do not know which name is the correct one. Lake Macotama, mentioned elsewhere in this report, lies at the northwest end of this *paramo*, at 15,000 feet elevation. This *paramo* may be reached either from Pueblo Viejo on the north slope or from San José on the south slope. It is easier of approach from the north side, where a good Indian trail leads from Pueblo Viejo over to the Macotama River, thence up that stream through Santa Cruz, San Miguel, Taquina, Macotama, and on up to the *paramo*. This trail is passable for oxen or a good mule, and the *paramo* may be reached from Pueblo Viejo in two days.

Cienega (formerly known also as San Juan de Cordoba). A city of between 15,000 and 20,000 inhabitants, twenty miles by rail from Santa Marta, and situated on the sea coast, just at the northeastern corner of Cienega Grande, the great brackish lake lying between the Sierra Nevada and the Magdalena River.

Cincinnati. A large coffee plantation lying on the western slopes of Mount San Lorenzo, between 3,000 and 5,500 feet. This plantation was known as Valparaiso at the time Smith and Brown collected here. It is a

fine collecting field, and has been visited by all naturalists who have come to Santa Marta. The plantation is about nineteen miles from Santa Marta, and is reached by the road leading out through Mamatoco, Tigrera and Minca.

Concha. A small bay southeast of Santa Marta, also the short creek and valley emptying into it. There is a small stock farm there belonging to a resident of Santa Marta. It is the first indentation of the coast beyond Tagánga, and the second from Santa Marta Bay.

Copéi. A stopping place for travellers and pack trains on the trail between Ariguani and Camperucho, about fifteen miles south of Ariguani. It is in the heavy lowland forest.

Corazones. A little hamlet near Valle de Upar, between that town and Badilla, and not far from the Rio Guatipuri. It lies just between the Guatipuri flood-plain forest and the dry scrub of the open country.

Dibulla. A squalid village on the coast about half-way between Santa Marta and Riohacha, and about three miles east of the point where the trail leaves the coast for the Sierra Nevada, by way of Pueblo Viejo and San Miguel.

Donama. A small farm, now nearly abandoned, lying on the divide between the head of the Matagiro Valley and the Rio Piedras, at an elevation of about 1,500 feet. It is on the trail between Bonda and the plantation Las Vegas. It is just between the "dry forest" area of the Santa Marta coast belt and the humid forest of the north slopes of the Sierras, the valley of the Rio Piedras being largely in the latter zone.

Don Diego. An old plantation (now practically abandoned) belonging to a French company, and situated on the north coast at the mouth of the Don Diego River, one of the largest rivers draining the north slopes. There is a trail leading to it from Santa Marta, going out by way of Mamatoco, Bonda, Calabaso, Jordan, thence down the Rio Piedras to the coast, and then following the beach. This trail is almost impassable through disuse and lack of repair. The place is much more easily reached by sea from Santa Marta. The region around Don Diego is heavily forested, has a heavy rainfall and is very rich in animal life.

Donjaca. A flag station and passing point for trains on the Santa Marta Railway between Gaira and Cienega. It is on the coast, and lies in the semi-arid coast belt of scrub and cacti.

El Libano. A name used by Mr. Smith for a point on the northwest slope of San Lorenzo with an altitude given by him of 6,000 feet. It is in the upper part of what is now known as the plantation of La Victoria, which adjoins Cincinnati on the east. Conditions are practically the same as around Cincinnati.

El Lorenzo (see San Lorenzo).

El Mammón. A locality at which Mr. Brown collected in the Sierra Nevada, and given by Dr. Allen as having an altitude of 8,000 feet. It is on the south slopes of the Sierras, a short distance above San Sebastian.

Fonseca. A small town on the Rio Rancheria a few miles below the point where it breaks out of the foothills into the valley lying between the Sierra Nevada and the eastern Andes. I do not think it can be more than 500 feet above sea-level. Except for the heavy woodland of the Rio Rancheria flood-plain, the surrounding country supports a vegetation very similar to that encountered all along the trail between Riohacha and Arroya de Arenas, viz., low open scrub of acacia-like trees and cacti. It lies on the main trail between Riohacha and Valle de Upar.

Fundación. A large cattle ranch and travellers' station on the trail between Camperucho and Alto de las Minas, on the Rio Garupal. The prevailing vegetation in the immediate vicinity is savanna and scattered clumps of low, tangled woodland, largely of the "dry forest" type.

Fundación. A small village at the southern terminus of the Santa Marta Railway. The name Fundación really applies only to that portion of the town lying on the north side of the Rio Fundación, which has been built up since the railway reached that point. The part of the town on the south side of the river is the old settlement existing before the arrival of the railway and was called Buena Vista. This name is still used by the inhabitants of the region to the south, but as a rule the name Fundación is now used everywhere for the town as a whole. The country to the south and west of the town is broken and hilly, with a more open forest in which many types of trees belonging to the "dry forest" are present. To the west and north the forest has been largely cleared away, but was originally of the heavy, humid type, similar to the Magdalena basin and the Ariguaní.

Gaira. A small village on the Santa Marta Railway about eight miles from Santa Marta and not far from the sea. With the exception of the land under irrigation and the narrow valley of the Rio Gaira, the whole region is very arid, with an abundance of thorny scrub and giant cacti.

Guallabol or *Guayabol.* A locality given by Simons, and which I cannot locate definitely. It is given as having an elevation of 3,000 feet, and must be somewhere on the south slopes of the Sierras, since there is no such place on either the north, northwest or west sides.

Jordan. A locality used by Smith. It is situated on a small stream of the same name, which empties into the Rio Piedras, and lies between the Matagiro Valley and the hills along the coast east of Santa Marta. The head of the valley is in the semi-arid coast belt, while the lower portion is heavily forested like the valley of the Rio Pedras, being really in the transition zone between the semi-arid and the humid of the north coast. It is reached by the trail out from Bonda, which leads to the coast at the mouth of the Rio Piedras and thence to Don Diego and Dibulla.

La Concepcion. A locality used only by Brown, and given as having an altitude of 3,000 feet. It is always given in connection with localities on the north slope, and from the species listed as taken there I would judge that it was on the top of the mountain ridge which the trail crosses in going from Pueblo Viejo to San Miguel.

Las Flores. A small farm and lowland station belonging to the *hacienda*

Vista Nieve. It lies on the cart road between Mamatoco and La Tigra, about a mile from the village of Mamatoco and five miles from Santa Marta.

Las Nubes. A coffee plantation on the northwest slopes of the mountain known as La Horqueta, adjoining San Lorenzo on the north. The mountain has an elevation of about 7,000 feet, while the dwelling house of the plantation is at about 5,000 feet. It is reached by the road running out from Mamatoco through Masinga. The local conditions are about the same as around the *hacienda* Cincinnati. Mr. Smith did some collecting here.

Las Pavas. A small hamlet and travellers' station on the trail between Alto de las Minas and Copéi, on the Fundación-Valle de Upar road. It is at the point where the heavy lowland forest begins, after dropping down from the highlands of Alto de las Minas.

Las Taguas. A point lying on the south slope of San Lorenzo Mountain at an altitude of about 5,000 feet, at the head of the Valparaiso Valley. The stream is a tributary of the Rio Cordoba, which empties into the sea near Cienega. It is a heavily forested, humid region, and has been visited only by the writer and the University of Michigan expeditions.

Las Vegas. A coffee plantation situated on the northeast slopes of a long spur ridge of the Horqueta Mountain, near the headwaters of the west branch of the Rio Mendaguaca. It lies between 3,000 and 5,000 feet in a region of heavy humid forest peculiar to the north slopes of the Sierras. A locality at which only the writer has collected.

Loma Larga. Name of a small region of scattered small farms and travellers' stations on the trail between Riohacha and Fonseca, and situated about fifteen miles south of Arroya de Arenas. It lies in the foothills of the great northeast spur range of the Sierras and is heavily forested except where clearings have been made. The altitude is probably about 2,500 to 3,000 feet. Visited by the University of Michigan Expedition in 1920.

Macotama. At present but a tiny Indian village, but formerly the tribal centre of the whole Arahuaco population of the north side of the Sierras. It is still the place of residence of the chief "medicine man" or "doctor," as the Indians call him. It lies in the valley of the Rio Macotama about ten miles above San Miguel. The village itself does not have an altitude of "8,000 feet" as given by Bangs, but the mountains rise on either side of the valley to a height of from 11,000 to 12,000 feet. The elevation of the village itself is about 7,000 feet. There is no forest left in the valley here, except a tract on the east side, which has been largely cut over by the Indians. A few trees and scattered shrubbery remain along the river itself and in the ravines. The village lies on a shelf on the right-hand side of the river, ascending, and the mountain on that side is clothed only in grass as far as the eye can reach, with rarely a clump of low bushes. Visited by Mr. Brown and the author.

Macotama, Paramo de. I have applied this name to the *paramo* on top of the range to the east of the village of Macotama, and which extends southward to join the backbone of the Sierras at the Chirúqua Pass. I am

quite positive that this is also designated by Mr. Brown as the *paramo* de Macotama. This *paramo* does not attain an elevation of more than 12,000 feet and has less shrubbery than the Chirúqua *paramo*.

Mamatoco. A small village four miles east of Santa Marta, on the Manzanares River and on the road to Bonda and Masinga. It is less than fifty feet above sea-level, with hills to the north and east, and with flat land to the south and west, much of which is under irrigation. It is in the semi-arid coast belt.

Manzanares. A small farm and travellers' station on the trail between Valencia de Jesus and Camperucho, about six miles from Valencia. It lies in the heavy forest belt of the Rio Cesar (described elsewhere in this paper) and is rich in animal life of all kinds. The University of Michigan Expedition spent several days here.

Marocaso. One of Mr. Simons' localities, at an altitude of 2,000 feet, near the Rio Rancheria, on the south slopes of the Sierras. (According to Dr. Allen.)

Masinga or *Masinga Vieja*. A small hamlet about ten miles from Santa Marta in an easterly direction. It is on the Manzanares River about two miles above Bonda, and presents the same conditions as at that place. Mr. Smith collected extensively here.

Mimca (misspelled Minea by Salvin and Godman). An old, abandoned sugar plantation in the foothills at 2,000 feet elevation, and about fourteen miles from Santa Marta on the road to the *hacienda* Cincinnati at the point where it crosses the Rio Gaira, but not near the head of that river, as stated by Dr. Allen. It is more or less in the transition zone between the "dry forest" of the lower foothills and the mountain forest, but more inclined to the latter. Many small clearings have been made in this vicinity during the past three years. Collections were made here by Simons, Smith, both expeditions from the University of Michigan, and by the writer.

Naranjo. A locality mentioned by Mr. Smith, and situated on the Rio Piedras just below its junction with the Rio Jordan. Altitude about 500 feet.

Onaca. A coffee plantation near Las Nubes, but lower down on the mountain slope and more to the north. Altitude given as 2,500 feet. Mr. Smith collected here, but the writer has never visited it. It is reached by the trail leading out through Masinga.

Palomina. An Indian village on the north slopes of the Sierras, on the river of the same name, and at an altitude of 5,000 feet (as given by Mr. Brown). There is a small hamlet on the coast at the mouth of this river which must not be confused with the Indian village at which Mr. Brown collected. I did not visit this locality, but according to all authentic reports which I have been able to gather it has been but slightly deforested, there being but a small area of savanna here.

Paramo (see Chirúqua and Macotama). A word here as to just what is meant by a *paramo* may not be out of place. It is that portion of the high mountain ranges of the tropics which lies between timber-line and the

snow-line or the crest of the range, as the case may be, with a minimum altitude of more or less than 10,000 feet, but varying considerably in different regions. In the eastern and central Andes of Colombia there exists a heavy "temperate zone" forest which extends up as high as 12,000 feet in many places, but this forest is absent in the Sierra Nevada de Santa Marta, where *paramo* conditions begin at about 10,000 feet. The lower parts of the *paramo* contain more or less of an abundance of small gnarled trees and shrubs intermingled with bushes and coarse grass, the greater the quantity of moisture present the more abundant the shrubbery. As the altitude increases the gnarled trees disappear, the shrubs become more stunted, the bushes lower and tougher, while the grasses increase. Certain species of hardy little bushes persist to the very snow-line, as well as the "Freilejon."

Pueblo Viejo. A village whose inhabitants are entirely Colombians, situated on the north slopes of the Sierras at an altitude of 2,000 feet, on the Rio Ancha, several miles above its confluence with the Rio Macotama. It is nearly a two days' journey with pack animals from Dibulla over a trail not of the best. It is just at the edge of the "Indian country," few or no Indians living below this point.

Pueblo Viejo. Another village on the south slopes of the Sierras, not far from San Sebastian, with an altitude of 8,000 feet (as given by Dr. Allen). This locality must not be confused with the preceding, since conditions between the two are entirely different. The country around the present village is largely savanna.

Pueblo Viejo. There is a third village known as Pueblo Viejo which should be mentioned here, although it does not appear in scientific literature, but it might be confused with the two preceding localities by future collectors. It lies on the narrow spit of land separating Cienega Grande from the sea, a short distance to the west of the town of Cienega, and at the point where the Cienega Grande empties into the sea.

Punto Caiman or *Playa Caiman*. A point on the coast of Salamanca at the northwest corner of Cienega Grande. The coast of Salamanca is the narrow strip of sand which separates Cienega Grande from the sea, and is nowhere more than two or three miles wide. It is covered in many parts with shrubbery and small trees, while the Cienega shore is thickly populated with mangrove, with only an occasional open beach. Water birds are abundant, also several small land birds. The most abundant animals here are the omnipresent mosquito and sand-fly, which make life a misery at all hours of the day and night. Visited once by the writer, who trusts that the visit will never have to be repeated.

Quebra Concha (contraction for Quebrada Concha). The small creek draining the Concha Valley and emptying into Concha Bay.

Quebra Mojada (Quebrada Mojada, spelled by Dr. Allen "Mojaba"). A small creek flowing into the Manzanares River about midway between Mamatoco and Bonda, and dry most of the year. Mentioned by Smith.

Riohacha. A town of about 5,000 inhabitants on the north coast about

ninety miles from Santa Marta to the east, and the metropolis of the Goajira Peninsula. It lies about a mile to the west of the Rio Rancheria (or Calancála, as it is called here), which river is the dividing line between the Departamento de Magdalena and the Territory of the Goajira. It is reached only by sea from Santa Marta, the trail by land being impossible of consideration. The sole means of transit are small schooners, which leave much to be desired in the way of accommodations, and to persons who are poor sailors this trip is a veritable torment in the windy season. The vegetation of the surrounding country is a low, thorny scrub, containing many acacia-like forms and an abundance of cacti of various species. It is exceedingly dry for the greater part of the year and the heat is terrific. However, from the standpoint of the naturalist it is an exceedingly interesting region, introducing as it does a fauna quite distinct from that of any other part of the region under discussion.

San Antonio. This is the old Indian village, now non-existent, which lay about three miles to the south of the present village of Pueblo Viejo (the first mentioned in this list). It was destroyed by the government soldiers in the late Colombian revolution because some of the Indians had been persuaded to take up arms with the revolutionists. Its inhabitants were scattered among the Indian hamlets higher up in the Sierras.

San Juan de César. One of the most flourishing towns of the valley, lying to the south of the Sierra Nevada and situated on the river of the same name (Rio César). It is about a half day's journey to the southwest of Fonseca and in the same arid belt of thorny scrub as the latter place. From here the road branches, one branch passing by way of Villanueva and the other by way of Badilla, but uniting again at Valle de Upar.

San Francisco. A small Indian hamlet in the valley of the Rio Ancha about six miles above Pueblo Viejo (on the north slope of the Sierras). The mountain slopes on both sides of the valley are bare of forest, especially on the right-hand side (ascending), where the slopes are very precipitous and rocky. On the left-hand side the higher slopes are still wooded for a considerable distance. Visited by Mr. Brown and the writer.

San José. An Indian village on the south slope of the Sierras, on the trail between Atanquez and the Chirúqua Pass. According to Simons, the only collector who has visited it, it has an altitude of 5,000 feet.

San Lorenzo. A huge, isolated mountain peak lying to the northwest of the main Sierra Nevada, but connected with it by a ridge having a minimum elevation of about 5,000 feet. The whole mountain down to the foothills is densely forested, except where it has been cleared for purposes of cultivation. This forest is heavier and more humid on the east and south slopes. The crest of the mountain is in the form of a sharp ridge running nearly east and west for a length of six to eight miles. The western end, known as the Cerro Quemado, has been largely deforested by fire during the last twenty years, and has an elevation of about 8,000 feet. The remainder of the crest is forested to the very top, while the eastern end attains an elevation of a little over 9,000 feet. All the collecting done by Mr.

Smith here was on the western slopes of the Cerro Quemado up to perhaps 7,000 feet, which would account for his failure to secure quite a number of species found near the top. The vegetation of this mountain has been described elsewhere. The summit is reached by trails running up from the *haciendas* Cincinnati and Vista Nieve.

San Miguel. The largest village and the headquarters today of the Arahuaco Indians of the north slopes of the Sierras. It is situated on the right-hand side of the Macotama River (ascending), at an altitude of 5,500 feet, on a small, bench-like plateau jutting out from the mountain side about 200 feet above the river. The mountain rises abruptly behind it to the west to an elevation of not less than 9,000 feet, and is entirely bare of woodland. Opposite the village, on the other side of the river, is a much more extensive bench. Here the Indians have many small farms of vegetables and sugar cane, while the other side of the valley is devoted to grazing purposes entirely. The mountain slope also rises very abruptly from the bench land on the east side, and is wooded up to near the crest, which is overgrown with shrubbery and huge bromelias. Mr. Brown made San Miguel his headquarters for some time, as did also the writer.

San Sebastian. A village, largely of Indians, on the south slopes of the Sierra, at an altitude of 6,700 feet (according to Dr. Allen). It is mentioned by both Brown and Simons. It is in a region composed largely of savannas.

Santa Cruz. A tiny Indian hamlet on the east bank of the Rio Macotama, between Pueblo Viejo and San Miguel, with an altitude of 3,000 feet. Dr. Allen gives the altitude as 8,000 feet, an obvious error.

Santa Marta. A city of about 10,000 inhabitants and the capital of the Departamento de Magdalena, possessing one of the finest harbors on the Colombian coast. The immediate vicinity is a semi-arid region, of little rainfall, where irrigation is the only possible means of agriculture. The natural vegetation consists of thorny scrub and cacti, except along the banks of the Rio Manzanares, where a more luxuriant flora finds a footing. A flat plain extends eastward from the town for about five miles, a considerable portion of which is poorly irrigated and mainly devoted to pasture land. To the north of this plain are rugged hills extending down the coast to the east as far as the Rio Piedras, while to the south are the foothills of San Lorenzo. One of the oldest towns in Colombia, established early in the sixteenth century.

Sierra Nevada. Evidently many of Simons' labels bear the locality name of "Sierra Nevada," with the altitude. Such localities must of necessity be on the south slopes of the Sierras, since he did little work on the side near Santa Marta, and none on the north slopes. On some of the writer's labels this designation is also used, together with the altitude, for the region immediately to the southeast of San Lorenzo, where work was done from 5,000 to 8,000 feet.

Taganga (misspelled "Tayanga" by Dr. Allen). A small fishing village

in the bay of the same name, close to Santa Marta harbor and only separated from it by a low range of hills. Name used by Smith.

Tambor Ridge (see Cerros de Caracas). This was the name used by the writer on his labels before the correct name of the locality had been ascertained.

Taquina. A small Indian hamlet nearly midway between San Miguel and Macotama, on the west bank of the river, on a beautiful large bench several hundred feet above the river bed. Mr. Brown does not use the name, which is rather strange. Just below the village a small mountain stream enters the Macotama from the west, called by the Indians Sē-kai-én, which I meant to explore, but was not able to do so for lack of time. It evidently rises in the snow, and has a lake at its source, according to the Indians.

Tierra Nueva. A point on the Rio Aracatáca about five or six miles above its mouth at the Ciénega Grande. It is the first high ground met with in ascending the river—that is, ground that is not submerged by the overflow from the Ciénega during the period of high water. It is a region of heavy humid forest with much tangled undergrowth.

Tigrera or *La Tigrera*. A point on the road from Santa Marta to the *hacienda* Cincinnati, about seven miles above Mamatoco. The new cart road extending from Mamatoco up towards San Lorenzo has now reached a point about four miles above La Tigrera, in the valley of the Jamonacá. Tigrera is about 600 feet above sea-level and lies in the lower reaches of the foothills, in the narrow valley of the Jamonacá.

Trojas de Catáca. A small and very unique fishing village on the edge of Ciénega Grande at the mouth of the Rio Aracatáca. The houses are built on piles driven into the mud over four to five feet of water. The inhabitants subsist entirely by fishing, selling the fish in the towns of Ciénega and Barranquilla. It is reached only by boat from Ciénega or Pueblo Viejo.

Tucurínca. A banana plantation belonging to the United Fruit Company, on the Santa Marta Railway between Sevilla and Aracatáca, at which the writer collected.

Valencia de Jesus. A small, wretched-looking village, surrounded by second-growth scrub, about twenty-five miles southwest of Valle de Upar on the main trail which encircles the Sierras on the south side. It is in the heart of a considerable forest belt. Simons mentions this locality, while the University of Michigan Expedition did considerable collecting at Manzanares, about six miles southwest of it.

Valparaiso (see Cincinnati).

Valle de Upar (often spelled Valle Dupar, though the correct spelling is that given at the margin). The principal town of the lowland district between the Sierra Nevada and the eastern Andes. It is on the Rio Guatapurí, a short distance above its confluence with the Rio Cesár, and is one of the oldest settlements of Colombia, having been established by the Spaniards shortly after the founding of Santa Marta, early in the sixteenth cen-

tury. It has sadly deteriorated, but still shows signs of former opulence. It cannot be more than 500 to 600 feet above sea-level.

Victoria, La. A coffee plantation on the north slopes of San Lorenzo, adjoining the *hacienda* Cincinnati on the east and north. There is also another plantation of the same name near Dibulla, on the sea coast, where the writer worked some years ago.

Vista Nieve. A new plantation established by the writer a few years ago, lying on the south slopes of San Lorenzo, with lands reaching from 3,000 to 8,000 feet. A region of heavy mountain forest. It is reached by the same road leading to the *hacienda* Cincinnati, passing through that plantation and continuing on around the mountain about four miles.

THE REPTILE-AMPHIBIAN FAUNA AND ITS GEOGRAPHICAL RELATIONS

Summary of the Known Fauna: But few zoologists have visited the Santa Marta range. Previous to 1913 only two collectors seem to have collected reptiles and amphibians in the mountains, W. W. Brown for the Museum of Comparative Zoology of Harvard College, and H. H. Smith for the Carnegie Museum, and these men gave particular attention to other groups. The published records are those of the Museum of Zoology of the University of Michigan and a paper by Lawrence Griffen² which includes the snakes obtained by Smith.

The writer has had the material collected by Brown and Rehn and Hebard (in 1920), through the courtesy of the Museum of Comparative Zoology and the Academy of Natural Sciences of Philadelphia, besides the specimens obtained by the expeditions of the University of Michigan, but he has been able to examine but two of the specimens of the Smith collection. The material studied represents 93 species and includes all but seven of the thirty-one snakes recorded by Griffen, if from his list are excluded four species: *Leptophis rostralis*, of doubtful locality; *Epicrates cenchria fusca*, a color variety of doubtful validity; *Micrurus columbianus*, a synonym, and *Atractus badius*, which is evidently identical with the species referred to in this paper as *Atractus irridescens*. The seven species listed by Griffen which have not been seen are *Helminthophis bondensis*, *Bca cooki*, *Leptophis bocourti*, *Spilotes pullatus*, *Oxybelis fulgidus*, *Rhinostoma guianense*, *Micrurus corallinus*.

It is very clear that much more field work must be done before the components of the fauna, the habitats, and the exact distribution of many of the species are accurately known, particularly since the records of Brown and Smith cannot be used for detailed studies. (See page 15.) It is believed, however, that the data obtained by the University of Michigan expeditions is sufficiently detailed to permit certain deductions to be made. An attempt was made to work out the breeding habits of the species, when these were likely to throw light on the distribution, and much time was spent in the field to get representatives of every species in each habitat and region and to determine the limits of range of each species. These data

² *Memoirs of the Carnegie Museum*, VII, pp. 163-227.

SPECIES	DESERT SCRUB	DRY FOREST	MODERATELY WET FOREST		CLOUD FOREST	REMARKS	
	SANTA MARTA TO BOLIVAR (50 FT)	BOLIVAR TO MINCA (2200 FT)	MINCA TO AGUA DULCE (3500 FT)	AGUA DULCE TO (4500 FT)	4500 FT TO (8300 FT)		
AMPHIBIANS							
	3						
	2						
	1			NOT BREEDING?	NOT BREEDING		
	3	ELSEWHERE ON LOWLANDS				BROMELIAS 1 BROMELIAS 1 NOT IN BROMELIAS 1	PROBABLY HIGHER
	1	-----					
	1	ELSEWHERE ON LOWLANDS					
	5					BROMELIAS 1 BROMELIAS ? 1 NOT IN BROMELIAS 1	HIGHER HIGHER
	16					NOT IN BROMELIAS 2	
	LIZARDS						
		1		?			
		3		?			
		2					
		1		.			
		3				
		3			CLEARINGS		
1				CLEARINGS			
1				CLEARINGS	CLEARINGS		
1							
SNAKES							
	17						
	1		?				
	1						
	1	ELSEWHERE ON LOWLANDS					
	2	ELSEWHERE ON LOWLANDS					
	1	ELSEWHERE ON LOWLANDS					
	1	ELSEWHERE ON LOWLANDS					
	1	ELSEWHERE ON LOWLANDS					
	1	ELSEWHERE ON LOWLANDS					
9	19	23	8 (NOT INCLUDING LIZARDS OR TOAD NOT BREEDING)		18	PROBABLY HIGHER	

Vertical distribution of common amphibians and reptiles in the Santa Marta region.



were preserved with the specimens. It may at least be said for the data that they are more detailed than those often used as the basis for conclusions upon the environmental factors in distribution.

Nature of the Materials: Although in a way a truism, it cannot too often be reiterated that any attempt to summarize the distribution of the terrestrial cold-blooded vertebrates must, to be convincing, take into account the secretiveness, the apparent rareness, and the inconspicuousness of many species which make collecting in these groups fortuitous in no small degree. It is quite obvious that these attributes of the components of a fauna make it difficult to determine with accuracy the limits of ranges, but it is too often ignored in the practice of listing species of doubtful range by habitats, zones, etc., suggested by the distribution of a part of the fauna, with the result that the faunal areas receive support from records which should not be considered adequate for the purpose. If the field work is carried on in detail and over a considerable length of time, it is possible even in the groups under consideration to reduce the species of unknown range to a relatively small number, and it would seem to be the best practice to exclude from summaries those forms so rare or secretive as to be represented in the collections only by a few specimens from one place. The exclusion of rare forms can only lead to erroneous results when such species constitute a considerable part of the fauna.

Vertical Distribution: To obtain data on the distribution of the species with altitude a detailed study of the fauna of the northwestern slope of San Lorenzo was made. The conditions on this slope are very favorable for the study of the vertical distribution of amphibians and reptiles. Located in a region which supports a large fauna in these groups, rising rapidly from sea-level to a height of 9,300 feet, and possessing great differences in climate and vegetation within the space of a few miles, it is to be expected that on this mountain the upper and lower limits of ranges will be rather sharply defined and zonal distribution, if present, conspicuous. Moreover, the region is accessible and as easily studied as such a region can be, since trails have been cut to 8,300 feet and it is possible to obtain living quarters at different elevations.

It will be clear from Mr. Carriker's description of the region that the vegetation in the San Lorenzo region changes from a desert flora to a xerophytic forest flora at about 100 feet, from a dry forest type to a wet forest type at about 2,200 feet, the latter becoming a humid jungle type above 4,500 feet. The greatest difference exists between the dry and wet forests. The plains have, or evidently originally supported a considerable growth of xerophytic trees, and above 2,200 feet, while the wet forest becomes wetter with increased altitude, the change is gradual and the flora is of about the same nature. At about 2,200 feet the change in the type of forest on the ridges takes place within a short distance. There is also at this point a marked change in the fall of the streams, so that it may be said that above this altitude there are no ponds or pools, whereas lower down these are often found in the broader valleys and on the plains. It is possible that in larger valleys pools are to be found at somewhat higher

altitudes, but in general it may be said that the moderately wet and wet forest area above 2,200 feet is without standing water except in the bromelias.

The habitats of reptiles and amphibians may be analyzed as follows:

Habitats below 2,200 feet:

Terrestrial

Ravine forest: Restricted to the lower part of the ravines; trees large, forming rather dense shade; ground litter well developed, but dryer than in the forest above 2,200 feet.

Scrub forest: On the ridges and in clumps on the plains; trees small, scraggly, giving little shade, interspersed with a spare growth of cacti, xerophytic herbs and shrubs; ground litter very little. (Pl. I, fig. 2; Pl. III, fig. 1.)

If the amphibians and riparian forms are excluded, there are few differences to be observed in the fauna of these two terrestrial habitats, probably because of the limited extent of the ravine forests. On the other hand, ground and arboreal species may be recognized.

Aquatic environments: Streams (shallow and larger lower down and swifter but with pools in the hills); ponds few in number and usually with much vegetation. The fauna is without aquatic species near the foothills, except possibly *Kinosternon integrum*, consisting of amphibians with aquatic larval stages and such riparian forms as the iguana and basilisk.

Habitats above 2,200 feet:

Terrestrial

Forest: Tropical rain forest, becoming gradually wetter from its lower limits; trees large, forming dense shade; a deep layer of forest litter. Cloud forest, in general like the rain forest, but cooler and more humid, large bromelias. (Pl. II; Pl. III, fig. 2; Pl. IV; Pl. V, fig. 2.) Fauna divisible into three groups—the arboreal, bromeliadiculous, and ground forms.

Artificial clearings

Aquatic environments: Streams small and torrential, without aquatic species of reptiles and amphibians. (Pl. V, fig. 1.)

It will be seen that seven associations of species of reptiles and amphibians are recognized: the ground species, arboreal species, and aquatic species below 2,200 feet; and the ground species, arboreal species, bromeliadiculous species, and artificial clearing species above 2,200 feet. It will also be noted that these associations may be grouped into two major habitats—the forest below 2,200 feet (in large part scrub forest and small ravine forests and open cactus areas, dry litter with higher temperatures and low humidity) grading through rain forest above 2,200 feet into a cloud forest (dense forest, deep wet litter, large bromelias, lower temperatures, abundant rainfall). The aquatic habitat below 2,200 feet furnished no strictly aquatic forms.

It is clear that the bromelias must be considered a minor habitat for the groups under consideration. The Bromeliaceae are in general an important habitat in the wet forest above 4,500 feet. (Pl. V, fig 2; Pl. VI.) The list of species found in these plants is as diversified as similar lists for other localities,³ and includes earthworms, leaches, peripati, isopods, myriapods, cockroaches, spiders, Heteroptera, beetles, scorpions, insect larvae (flies, dragonflies, beetles), a salamander, and frogs of several species. However, lists of species taken in bromelias may be misleading, for all of the forms found in these plants are not, strictly speaking, bromeliadiculous. In bromelias are to be found species which are apparently confined to this habitat and those which are found here occasionally but quite as often, and in some cases much more commonly, in other situations affording concealment, such as under bark, in hollow trees, and in masses of vegetable debris lodged in trees and shrubs. It would seem to be best to restrict the term bromeliadiculous to those species which for the most part breed in the bromelias, and to those which, if not breeding there, occur principally in these plants. Under this definition one salamander, *Oedipus adspersus* (viviparous), and two frogs, *Eleutherodactylus cruentus* and *E. delicatus*, are bromeliadiculous forms in the Santa Marta Mountains, and *Eleutherodactylus sanctae-martae*, and *E. insignitus* may prove to be.

The distribution of the more common amphibians and reptiles found on the northwest slope of San Lorenzo is summarized in the following table. The cross-section made may be located by the towns and plantations given at the head of the chart. (Facing p. 40.)

It is to be understood that the data on the distribution of the snakes is fragmentary. This is to be expected, since collecting in this group is well known to be fortuitous in any region. The data is not without value, however, when it is considered that every species taken above 2,200 feet and not yet found on San Lorenzo below this altitude is known to occur on the lowlands in northern Colombia. This fact, with the further one that only one lizard and six frogs, a total of seven species out of forty-two common species (including the snakes), are not known from below 2,200 feet, shows clearly that the fauna has been in large part and probably entirely derived from the lowlands.⁴

A study of the table will reveal a certain amount of zonal arrangement of the species. Only five species, three amphibians, one lizard, and one snake out of nineteen desert forms have not been found above the desert, and of these at least the snake certainly occurs higher. Similarly, of a fauna of twenty-three species found in the dry forest, fourteen forms are known to occur on the desert, and of the nine forms not taken on the desert three are snakes and six are lizards, all of which will probably be found to occur there, as all but one have been found elsewhere on the lowlands. It is evident that the fauna of the dry forest and desert are prac-

³ Compare Ohaus, *Ent. Zeitung, Stett.*, 1900, pp. 211-212, 237-240; Calvert, *Ent. News*, XXII, pp. 402-411; Scott, *Ann. and Mag. Nat. Hist.*, X, pp. 424-438.

⁴A similar condition was found by the writer in the San Francisco Mountains, New Mexico. *Bul. Amer. Mus. Nat. Hist.*, XXIII, 603.

tically the same, the ranges of but few of the species being affected at the common boundary of the more open plains and scrub forest.

There is a decided difference in the fauna roughly below and above 2,200 feet. Of a total fauna of twenty-three species in the dry forest, thirteen species do not occur above 2,200 feet, five others occur higher only in clearings, and still another is not known to breed above that altitude, so that nineteen out of the twenty-three species are naturally limited in upward range between 2,000 and 2,500 feet. The four species which range higher are snakes. It will be noted that seven of the lizards out of sixteen dry forest forms have not been found above 600 to 800 feet. These seven undoubtedly range higher and were not found between 800 and 2,200 feet because careful collecting could not be done in that region. The upper limit may be placed tentatively at 2,000 feet, because they have not been found at 2,200 feet, although some doubtless drop out well below this altitude. In brief, then, none of the amphibians of the desert and dry forest (six species) apparently breed above 2,200 feet; the only lizards of these habitats (16 species) ranging above this altitude are five which are found in artificial clearings, and it is the distribution of the snakes which seems to be little affected, four species out of six ranging higher.

None of the eight forms found in the moderately wet forest, between 2,200 and 4,500 feet, are peculiar to this area. A number of forms have not been found below it in this region, but these all range above it into the cloud forest. The cloud forest fauna consists of eighteen species, of which twelve have not been found below 4,000 to 4,500 feet. These are nine amphibians, one lizard, and two snakes. Moreover, of the eight forms which enter the moderately wet forest three forms (one amphibian and two snakes) do not range entirely through the area, one (an amphibian) reaches 2,200 feet, and four (snakes) are found in the dry forest. In other words, out of eleven forms of lizards and amphibians found in the cloud forest not one occurs below 2,200 feet, and the cloud forest and dry forest faunas are thus entirely different in respect to the lizards and amphibians and overlap only when the snakes are added.

As has been said, the moderately dry forest has no peculiar forms, but is composed of species which range below or above it, or in both directions. It is thus to be considered as an intermediate zone in the distribution of the reptiles and amphibians, and the fauna of the slopes falls into three groups, distinct as to species—a desert and dry forest group, twenty-four species; a cloud forest group, fourteen species; and a group of forms of general distribution, four species (of snakes). This vertical distribution corresponds to the vertical distribution of dominant terrestrial habitats.

Environmental Factors in the Vertical Distribution: It should be clearly understood by geographers that geographic data yield only indirect evidence of the environmental factors in distribution. It would be easy to attribute the apparent zonal distribution above described to temperature, to moisture, to the nature of the ground cover, or other factors, but this would be pure assumption. The writer has expressed the opinion⁵ that no

⁵ *The Geographical Review*, X, pp. 241-248.

one factor will account for the distribution of a fauna, and that zonal distribution of faunas based on temperature differences probably does not occur on mountains. It should be understood that this is not equivalent to saying that there can be no such thing as zonal distribution on mountains. Indeed, it may be accepted as a corollary of the proposition that the environment as a whole controls the distribution of each species, that when a large number of conditions are changed at about the same place a considerable part of the fauna may be affected. It has been shown that the dominant habitats change at 2,200 feet, and this means a change in many conditions of life. It is clear that zonal distribution occurs on San Lorenzo, and the data indicate that temperature is probably not the principal factor.

As stated, nine dry forest forms have not been found on the desert at Santa Marta. Of these, eight have been found in dry forests elsewhere on the plain. If there is a difference between the fauna of the desert and dry forest, the factors are not evident.

Of the lowland forms which do not get above 2,200 feet, five (lizards) go a little higher and three range from 100 to 2,300 feet higher in artificial clearings. This suggests that some other factors than temperature are, under natural conditions, effective at this point in limiting the upward range on San Lorenzo of the species of this group.

Of the cloud forest species in all groups (18), twelve are known to occur here or elsewhere in northern Colombia on the lowlands, which again suggests that on San Lorenzo the temperature of this area is not the only condition which limits the lower range of the species. It is to be noted that of the fourteen species known from the cloud forest and not lower than 2,200 feet, ten are amphibians which quite certainly do not lay the eggs in water, one being viviparous and nine more or less certainly known to lay eggs which produce young in the adult form, while three, possibly four, are associated with bromelias which do not descend lower. Furthermore, at least one lowland amphibian seems to be limited in its upward distribution by the absence of standing water above 2,200 feet, since it occurs well above that altitude apparently without breeding. In the cloud forest, the nature of the forest, the absence of standing water and the humidity are evidently factors with which to reckon.

The wet forest comes down to the coast on the north side of the mountains. Carriker (see p. 20) concludes from a study of the birds that the forest fauna on that side also comes down to sea-level, a conclusion that is substantiated by the occurrence at Don Diego of *Phrynonax poecilnotus* and *Phyllobates subpunctatus*, species not found below 2,200 feet on San Lorenzo. This lowering of the wet forest habitat is probably due in large part to a greater rainfall, and while the temperatures are also lower it is not possible that they are as low as in the cloud forest. The greater humidity and the forest are quite as likely to be critical conditions as is the temperature.

There is no reason to believe that the distribution of snakes is less effected by differences in temperature than that of lizards, and yet the data, while fragmentary, show less response on the part of the snakes to the

differences that exist between the dry forest and the cloud forest. The principal difference in habits between the two species in the groups in this region is in food habits, the lizards being largely insectivorous, the snakes mostly carnivorous. Certainly the food supply for lizards is much more different in the cloud forest and in the dry forest than it is for the snakes.

Taking into consideration the known altitudinal distribution and the habits of the species, the conclusion seems warranted that an absence of standing water and greater humidity and more shade above 2,200 feet⁶ may be important factors in limiting the downward and upward migration, respectively, of the cloud forest and lowland amphibians, and that the more open conditions below 2,200 feet are more favorable than those in the wet forest for at least five of the lizards found below 2,200 feet, as they occur above this altitude when clearings are made.

It should not be inferred that the writer denies the influence of temperature in limiting the vertical distribution of particular species in this region. It is only meant that particular temperatures are not clearly responsible for the zonal distribution. It is quite possible that when several species are stopped at approximately the same place, in some cases a temperature difference may be the cause, while with others other factors may be operative. This view is quite in harmony with physiological data, and on San Lorenzo other factors are probably operative, since the abrupt change from desert to cloud forest is attended by changes in many environmental conditions for animals.

Relations of the Cloud Forest Faunas: The fact that, while the lizards and amphibians of the cloud forest are limited in their downward range in the moderately wet forest on the northwest slope of San Lorenzo, five out of the eleven species not found below 2,200 feet are known to occur elsewhere on the lowland, is more than evidence that temperature is not the only controlling factor in the vertical distribution, but would seem to indicate clearly that this fauna is or has been continuous with a lowland fauna containing many of the species found on San Lorenzo only above 2,200 feet. To obtain information on the origin of the cloud forest fauna, work was done at Don Diego and a trip was made entirely around the range from Riohacha to Fundación. In the work on the east and south sides of the range the lizards received principal attention, in the belief that being more easily collected they would be most likely to yield dependable results in the short time which could be devoted to the work. The distribution of the species is summarized in the accompanying chart.

From the chart it will be evident that a desert or dry forest extends from Santa Marta to Riohacha on the west, south, and east sides of the range, and that as far as the lizards are concerned it is the principal fauna of the lowlands. Of a total fauna of twenty-four forms only nine have not been taken at Santa Marta, where there is no heavy lowland forest. Of the nine forms not taken at Santa Marta four are distinctly forest species (*Mabuya agilis*, *Tupinambis nigropunctatus*, *Loxopholis rugiceps*, and *Polychrus spurrelli*), and it is believed to be significant that these species

⁶ Conditions unfavorable for the development of eggs laid on the land.

Santa Marta below 2200 feet	Fundacion to Valle de Upar	San Juan to Fonseca	Loma Larga and Arroyo de Arenas	Rihacha	Don Diego	Principal habitats
1	1+2	1	1	1	1	Desert
15	3	8	6	3	2	Low woods
	13	(1)	1	1	1	Dry forest and low woods
	(1)	(3)	3	1	1	Desert and dry forest
	1	1	1	1	1	
	(1)	(1)	(1)	1	1	
	1	1	1	1	1	
	19	16	15	7	6	Low woods

Distribution of common lowland lizards in the Santa Marta region.

•have only been taken at Don Diego, Aracatáca, Fundación, Valencia, Las Pavas, and Arroyo de Arenas.

As has been pointed out, the desert and dry forest is replaced by lowland forest in the valleys of the Aracatáca, Fundación, and Ariguaní, and by a dryer but still heavy forest in the valleys at Valle de Upar, San Juan de Cesár, and Fonseca, while at Loma Larga, Arroyo de Arenas, and Don Diego the forest is heavy. The occurrence of the four species named above at least indicates a wet forest element in the general fauna at the places mentioned, and since two of the cloud forest forms (*Phyllobates subpunctatus* and *Phrynonax poecilonotus*) have been taken at Don Diego, and since others (*Lepidoblepharis intermedius* and *Cryptobatrachus fuhrmanni*) have been taken in the Choco, it may be confidently expected that at least a part of the cloud forest fauna reaches the lowlands in the large valleys at the west end of the range and has been derived along this route from the lowland forest fauna of the Magdalena basin.

The large number of forms apparently peculiar to the cloud forest suggests that this almost completely isolated habitat possesses an endemic fauna. This can be determined only when much more is known about the reptile and amphibian fauna of Colombia.

The Distribution of the Desert and Dry Forest Fauna: It is well known to herpetologists that the faunas of Venezuela and western Colombia are different in many respects. The differences suggest a break in the distribution of a number of forms in eastern Colombia or western Venezuela. Too little is known of the distribution of most of the species to permit of the locating of the place or places where the change takes place for many species, but the distribution of the lowland forms in the Santa Marta Mountains region apparently throws some light on the problem.

The chart (p. 47) shows that on the south side of the range many of the lizards do not range beyond certain localities in a particular direction. It is evident that since the principal range of the species is not indicated and there are many chances that the distributions are not accurately known, this summary cannot be relied upon to reveal the eastern and western limits of all of the forms included. There are, however, several forms which here approach the range of near relatives or whose range is definitely enough known to indicate the nature of the relationships of the faunas of the two regions. Many forms are common to Venezuela and Colombia. Some eastern forms, e.g. *Hyla venulosa* (not included in the chart), occur as far west as Fundación, while one, *Tropidodactylus onca*, stops at Riohacha. *Ameiva bifrontata*, a Venezuelan form, is replaced between Fonseca and Valle de Upar by *Ameiva bifrontata divisus*, a Colombian form. One Colombian species, *Phyllobates subpunctatus* (not shown in the chart), does not get farther east than the Don Diego region, and is replaced by a nearly related form in Venezuela, while *Ameiva maculata* and *Cnemidophorus lemniscatus gaigei* enter western Venezuela at least before being replaced by other forms. These facts indicate that there is no sharp break between the faunas of Venezuela and Colombia, and that the eastern and western forms which enter the region are limited in range at different places.

LIST OF SPECIES

CAUDATA

Oedipus adspersus (Peters).—San Lorenzo, 4,500 to 7,000 feet; Rio Frio, 1,000 m. (U. S. National Museum); heights east of San Miguel, 6,000 to 7,000 feet (M. A. Carriker). Found principally in bromelias in the trees and on the ground; occasionally found in decaying logs and stumps or under decaying leaves.

This is a viviparous species, and both young and adults were taken in the bromelias.

SALIENTIA

Phyllobates subpunctatus (Cope).—San Lorenzo, 2,200 to 7,000 feet; heights west of San Miguel, 7,000 feet, and Don Diego (M. A. Carriker). A ground form generally found near water, and usually occurring in numbers where there are small clearings grown up to grass and herbaceous plants.

Although common, this species is a difficult one to collect and study in the Santa Marta Mountains. The breeding habits and tadpole have been described (Ruthven and Gaige, *Occ. Papers, Museum of Zoology, Univ. of Michigan*, No. 10). The eggs have not been found, but they are evidently laid on the land. Adult males carrying tadpoles have been found from June 4 to July 14.

Venezuelan specimens examined (La Gaira and San Esteban) are *P. trinitatus*, as stated by Barbour and Noble (*Bull. Mus. of Comp. Zool.*, LXIII, pp. 401-402). This species can be distinguished from *P. subpunctatus* by the fact that it either has a dark bar across the chest, or the throat, chest and belly are dark, but there are other distinctions between the forms. The only structural difference which the writer has found is in the roughness of the skin of the dorsal surface. Over most of the body the skin is smooth or slightly granular, but in the lumbar region it tends to be more granular, and in *P. trinitatus* is raised into more or less numerous and prominent warts. Of 20 specimens from Trinidad, 14 have distinct warts in the lumbar region, and in 6 Trinidad specimens and 3 Venezuelan specimens the warts are small, and few in number. Of 18 Santa Marta specimens of *P. subpunctatus*, one has a few faint indications of warts, in others the skin is granular or smooth.

Notwithstanding a general similarity, the specimens from Trinidad and Venezuela (*P. trinitatus*) can be distinguished from those from Santa Marta (*P. subpunctatus*) by differences in the coloration. In the latter the black or blackish brown lateral stripe is very distinct and is usually bordered above by a light stripe which may extend around the snout, but at any rate is usually well defined forward to the eye. In Trinidad and Venezuelan specimens the dark line is less distinct and the light band is also much less distinct and often absent. In every specimen of *P. trinitatus*, except the very dark ones, the lateral dark band is widened or divided posteriorly to the eye, involving from a fourth to three-fourths of the tympanum and reaching the limb insertion. In *P. subpunctatus* the black band is a little widened on the neck and includes but the upper margin of the

tympanum. Specimens of *P. trinitatus* are frequently so dark that the dorsal coloration is obscured, but when this does not include the ventral surface the gular band is distinct. Both in *P. trinitatus* and *P. subpunctatus* the coloration of the sides consists of a variegated pattern of black or brown and light brown, dull yellow or white. In the former the dark colors predominate and the light colors have the form of light spots or dots and nearly always a short streak extending forward from the groin. In one specimen there is an angular light line below the black band in front of the arm. In *P. subpunctatus* the light color is more extensive and usually forms a reticulated pattern or conspicuous round spots, and the pale streak from the groin is seldom as definite as in Trinidad specimens and is usually absent.

Geobatrachus walkeri Ruthven.⁷—San Lorenzo, 5,000 to 9,300 feet. Taken under leaves on the ground in the forest and under stones and the stems of bromelias in the clearing at 8,300 feet. Very common in the latter habitat. (Pl. XI, fig. 2.)

The coloration is more variable than indicated in the original description. Most of the specimens are dark olive gray to olivaceous black above; the belly is gray in appearance due to the combination of a blackish wash and minute white dots. Some specimens have russet dots on the dorsal surface, and a few are brick red above, vinaceous rufus in the inguinal region, and Hay's russet on the belly. A narrow white or ochraceous tawny vertebral line may be present.

Atelopus ignescens (Cornalia).—San Lorenzo, from 5,000 to 7,000 feet. A forest form, the adults of which have not been found at a lower elevation than about 6,500 feet; young, recently hatched, were common in the quebrada Viernes Santo, from July 15 to July 24, at an altitude of about 5,000 feet.

The specimens agree closely with the descriptions, and if they are correctly referred to this form it is probable that the species will be found at lower levels in some of the large wooded valleys, such as that of the Ariguani. The adults were taken on the ground in the forest, two of them in copulation on June 5. The smallest immature specimens were found at the margin of a stream, but there was evidently a later migration, for after the middle of July larger young were found several rods from the water. No eggs were found. The adults are very variable in color. The belly may be light orange yellow, apricot orange, pale ochraceous salmon, or dragons-blood red; the ground color of the back varies from olive to black.

Atelopus carrikeri Ruthven.⁸—Paramo de Macotama, 8,000 to 16,000 feet (snow-line). Taken along small streams, some of them rivulets from melting snow, by M. A. Carriker. Not known from other localities.

According to Mr. Carriker this amphibian has a very offensive odor.

Hypopachus pearsei Ruthven.⁹—Fundación. Found only under logs about an open marsh where they were rather common. (Pl. XI, fig. 3.)

⁷ *Occ. Papers, Mus. of Zool., University of Michigan*, No. 20.

⁸ *Occasional Papers, Museum of Zool., Univ. of Mich.*, No. 28.

⁹ *Proc. Biol. Soc. Wash.*, 1914, 77.

Gastrophryne ovale (Schneider).—Fundación. Only two specimens observed, both under logs in low woods.

Eleutherodactylus insignitus Ruthven.¹⁰—Heights east of San Miguel, 6,000 to 7,000 feet (M. A. Carriker). Taken in bromelias on the ground and in trees.

Eleutherodactylus cruentus (Peters).—San Lorenzo, 5,000 to 8,300 feet; heights east of San Miguel, 6,000 to 7,000 feet (M. A. Carriker). Mostly found in bromelias, either on the ground or in trees. (Pl. XII, figs. 4, 5.)

The habitat of this form is evidently the bromelias. In the forest at 5,000 feet on San Lorenzo it is to be found in numbers in the trees, the bromelias at this altitude being mostly above ten feet on the trees. From about 6,000 to 8,300 feet the bromelias grow lower down on the trees and on the ground in open places, but the frog is still confined to them. It is very abundant in the large bromelias which dominate the flora of the clearing at 8,300 feet.

The breeding habits have been described by Ruthven.¹¹ The eggs have not been found elsewhere than in bromelias. The breeding season is evidently long. Carriker collected eggs at San Miguel on April 24; and on San Lorenzo, in 1913 and 1920, many sets were found as early as June 9 and as late as July 25, the entire period during which the species was under observation. The observed dates of hatching are June 15, 19, 28, 30, July 1, 22-25. This indicates that the eggs are laid at different times during the rainy season. The number of eggs in a set is uncertain, for it has not been determined whether or not the females lay all of the eggs in one group. Often two or more sets may be deposited closely together, but whether by the same or by different females has not been determined. Usually from four to eight eggs are laid in one cluster, for when larger numbers are found in one group it is possible to distinguish more than one set. The adults are silent and retiring during the day, concealing themselves in the axils of the leaves; but at night they are active, the "song" being a rather harsh "check, check."

Eleutherodactylus carmelitae, new species¹²

(Pl. XI, fig. 1; Pl. XII, fig. 1.)

Diagnosis: To be distinguished from *E. sanctae-martae* Ruthven by the following characters: eye larger, tongue entire, tympanum less than one-half the orbital diameter, nostril equidistant from eye and end of snout; and from *E. megalops* Ruthven by greater size and larger eye, obovate tongue, larger disks (those of third finger larger than ear), smooth or finely granular texture of dorsal epidermis, narrower interorbital space (much narrower than upper eyelid), smaller palmar and sole tubercles, and in the position of the nostril.

Description: Tongue obovate, entire behind. Vomerine teeth in two short, transverse groups close together behind the choanae. Head as broad

¹⁰ *Occ. Papers, Mus. of Zool., Univ. of Mich., No. 34.*

¹¹ *Occ. Papers, Mus. of Zool., Univ. of Michigan, No. 11.*

¹² Named for Mrs. M. A. Carriker, to whom the members of the several expeditions are indebted for valuable assistance in the field work.

as long; snout rounded, with rounded canthus rostralis, longer than diameter of orbit; nostril equally distant from eye and end of snout. Interorbital space much narrower than upper eyelid; tympanum about one-fourth the diameter of orbit. Fingers free, first shorter than second; toes free; disks moderately developed, that of the third finger larger than the ear; metatarsal tubercles small. The hind limb being carried forward, the tibio-tarsal articulation reaches between the eye and nostril. Skin smooth above and below, except that the region of the tympanum is granular; a glandular fold above the ear.

Green above, with black markings consisting of two spots on the snout, a cross band between the eyes, two streaks on the occiput, a W-shaped mark on the shoulders, followed by some short, irregular bands. Sides of head paler, with black bands radiating from the eye, one along the canthus rostralis, two downward and one along the auricular fold, the first three narrowly bordered with greenish white. Sides of body pale green with irregular markings. Chin and throat pale drab with small, white spots; lower surfaces elsewhere white, in some specimens bright yellowish-green in life.

Type specimen, total length 33 mm., hind-leg 59 mm., head 12 mm.

Type Specimen: Museum of Zoology, University of Michigan, Catalog No. 54,528; Quebrada Viernes Santo (5,000 feet), San Lorenzo, Santa Marta Mountains, Colombia; July 16, 1920; Alexander G. Ruthven, collector.

Habitat: Most often found under rocks in shallow streams, occasionally under leaves on the bank of streams, 5,000 to 8,200 feet, San Lorenzo.

Notes on Paratypes: The paratypes show little variation. In nine specimens the ear is from one-fourth to one-third the diameter of the eye and the heel reaches the anterior margin of the eye or the end of the snout when the hind limb is extended along the side. The ground color of all specimens is green, and the dorsal markings show a tendency to form longitudinal bands in some individuals.

Remarks: This species is apparently near *Eleutherodactylus surdus* Boulenger, from western Ecuador. As far as shown by the description of the latter, it differs in having an exposed, although somewhat indistinct, tympanum and a much narrower interorbital space.

Eleutherodactylus megalops Ruthven.¹³—San Lorenzo, 5,000 to 8,000 feet; heights east of San Miguel, 6,000 to 7,000 feet (M. A. Carriker). Only observed among leaves on the forest floor. On San Lorenzo very common from 5,000 to 7,500 feet; above 7,500 feet found in small numbers; not observed in the cleared area between 8,000 to 8,300 feet. It is possible that the species is debarred from the latter habitat by the more open conditions and that it reaches higher elevations in the heart of the range. (Pl. XII, fig. 3.)

During the day what was apparently the song of this species was heard constantly throughout June and July, but the eggs could not be discovered.

¹³ *Occ. Papers, Museum of Zool., Univ. of Michigan, No. 39.*

With little doubt, the latter are laid under the forest litter and probably in the ground, the young hatching in the adult form. During the last few days in June tiny, evidently recently hatched, young were found in numbers in the forest. The material is very confusing, for the variations in coloration and in the glandular ridges are great, but the writer is now convinced that it represents but one species.

Eleutherodactylus sanctae-martae Ruthven.¹⁴—San Lorenzo, 4,500 to 9,300 feet; heights east of San Miguel, 6,000 to 7,000 feet, and heights east of Taquina, 8,000 to 9,000 feet (M. A. Carriker). Evidently a ground form, since 10 of the 25 specimens found were among leaves on the forest floor. One specimen taken at 5,000 feet was in a bromelia that had fallen to the ground, and four were in bromelias growing on the ground. Nothing has been learned of the breeding habits of the species.

Eleutherodactylus delicatus Ruthven.¹⁵—San Lorenzo, 4,500 to 8,000 feet. In 1913 three of these tiny frogs were found among leaves on the forest floor, and in 1920 two more adults were taken in bromelias. It is difficult to determine if the species is strictly a bromeliadiculous form, for it is so small as to be easily overlooked in tearing apart the plants. Eggs were discovered in the decaying leaves and litter at the base of the outside leaves of the bromelias growing on the ground at 8,000 feet, where they are easily overlooked. They are small, the membrane is tough and stained by the decaying vegetation, and the eggs are not united into masses or glued to the leaves. The young are born in the adult stage, and before hatching have a large, thin and transparent tail like that of *E. cruentus*. No recently laid eggs were found: six taken on June 21, 1920, hatched the same day.

In one adult the hind legs are not cross-barred. Another adult individual taken in 1920 differs from the original description in having a distinct tympanum, a longer hind leg (the heel reaching the nostril), in having a dark stripe from the end of the snout to the anus, and in possessing large, flat warts at the angle of the jaw. This specimen represents an extreme variation, for the recently hatched young are like this specimen, like the type, or intermediate in respect to the characters mentioned.

Ceratophrys calcarata Boulenger.—Fundación. Taken in the low forest and in the open country.

Several heads were found in forest pools, but living specimens were only seen at night. The species is much feared by the natives, evidently because they believe that the pugnacious habits indicate noxiousness. When disturbed the enormous mouth is opened widely and the frog snaps viciously at the disturber. Individuals experimented upon would seize a finger and allow themselves to be carried about for several minutes. The specimens agree closely with the original description, except that the tympanum may be distinct or indistinct.

Pleurodema brachyops (Cope).—Santa Marta; Aracatáca (Rehn and Hebard). Taken at night along irrigation ditches.

¹⁴ *Occ. Papers, Museum of Zoology, University of Michigan*, No. 39.

¹⁵ *Occ. Papers, Mus. of Zool., Univ. of Mich.*, No. 43.

Pleurodema pusilla (Ruthven)¹⁶.—Santa Marta to Bolivar; Gaira; Fundación; Fonseca; Arroyo de Arenas. Found about ponds and marshes at the west end of the range and about pools in the low forest at Fundación, on the bank of the Rio Rancheria at Fonseca, and under rocks near pools in the bed of the Rio Barbacoa at Arroyo de Arenas.

Dr. Boulenger has (*in litt.*) referred the specimens described as *Paludicola pusilla* to *Paludicola*. It certainly does not belong to this genus as restricted by Méhely,¹⁷ but is nearer to *Pleurodema* as defined by that author. The sternum has a long style terminated by a small, slightly cleft xiphisternum.

Leptodactylus typhonius (Daudin).—Fundación. Generally distributed, occurring in the clearings, about the open marshes, and in the low forest. During the day found under logs and fallen leaves, but active at night and easily taken in numbers by the aid of a headlight.

The specimens show two types of coloration, some having regularly arranged transverse spots, others a broad, pale vertebral stripe.

Leptodactylus pentadactylus (Laurenti).—Fundación; Valencia; Arroyo de Arenas; Don Diego (M. A. Carriker). Generally distributed at Fundación, being found under logs during the day and by headlighting at night. At Valencia observed both in the forest and on the savanna, in the latter habitat under logs. Taken at Arroyo de Arenas under stones at pools in the bed of the Rio Barbacoa, and at Don Diego in the forest.

The specimens have been identified by Dr. Boulenger.

Leptodactylus bolivianus Boulenger. —Santa Marta to Bolivar; Fundación; Valle de Upar; Don Diego. On the banks of streams and ditches. Specimens were found under logs and in dense grass during the day and by headlighting at night, the species being active at night.

The material has been compared with the type by Miss Joan Procter. It may be noted here that the writer cannot separate the Santa Marta specimens from paratypes of *Leptodactylus insularum* Barbour¹⁸ from Saboga Island in the Bay of Panama.

Eupemphix pustulosus (Cope).—Santa Marta to 2,200 feet; Fundación; Valencia; Don Diego. On the desert at Santa Marta found about the ditches and marshes, and on the lower slope of San Lorenzo near streams in the wooded ravines. At Fundación found about the forest pools and under logs in the clearings and about the grass marshes. The Valencia specimens were taken in the flood-plain forest and under logs on the savanna. The Don Diego specimens were collected in the low forest. This species has the form of sternum described for *E. natteri* by Méhely.¹⁹

Bufo marinus (Linnæus).—Santa Marta to 4,500 feet; Gaira; Fundación; Loma Larga (observed). This species doubtless occurs in all localities about the mountains. On San Lorenzo it apparently does not breed above 2,200 feet, although it is not rare between 2,200 feet and 4,500 feet.

¹⁶ *Occ. Papers, Mus. of Zool., Univ. of Michigan*, No. 30.

¹⁷ *Ann. Hist. Nat. Musei. Hung.*, II, 1904, p. 213.

¹⁸ *Bull. Mus. Comp. Zool.*, 1906, 46, p. 228.

¹⁹ *Ann. Hist. Nat. Musei. Hung.*, II, 1904, p. 217, Pl. XVIII, fig. 9.

Bufo granulatus Spix.—Santa Marta to 2,200 feet on San Lorenzo; Gaira; Fundación; Aracatáca (Rehn and Hebard); Valencia; Valle de Upar. Found in damp places (about streams, ditches, ponds, etc.), on the desert and savanna, and in the flood-plain forest at Valle de Upar.

Hyla crepitans Wied.—Fundación; Aracatáca (Rehn and Hebard); Palomina and La Concepcion (W. W. Brown); Arroyo de Arenas. At Fundación headlighted about the open ponds and marshes, both on the ground and in bushes; at Arroyo de Arenas taken in the flood-plain forest. On August 8, 1913, the species was breeding in numbers in an open marsh at Fundación.

Hyla wilsoniana Cope.—A single specimen taken in a clearing at Fundación is referred to this species.

Hyla underwoodi Boulenger.—Aracatáca (Rehn and Hebard); Fundación. Headlighted in an open marsh at Fundación. Of four specimens from Fundación two are tan with four brown stripes and two are silvery with one gray stripe on each side.

Hyla venulosa (Laurenti).—A large adult taken in the forest at Fundación. The specimen is indistinguishable from specimens taken in British Guiana.

Cryptobatrachus fuhrmanni (Peracca).—San Lorenzo, 4,000 to 5,500 feet. Found along the streams in the quebradas, the adults among rocks and under leaves, the young clinging to rocks in the streams. (Pl. XII, fig. 2.)

In using the name *Cryptobatrachus fuhrmanni* the writer does not wish to give the impression that he is convinced Noble²⁰ is in error in referring the species to Peters' genus *Hyloscirtus*. At least to the satisfaction of the writer, however, Noble has clearly established neither its generic identity with *Hyloscirtus bogotensis* nor its family relationships. In 1913 Boulenger identified certain specimens from the Santa Marta Mountains as a new genus of the family Leptodactylidae, and the writer described these under the name of *Cryptobatrachus boulengeri*. Later, in 1920, suspecting that the specimens thus described were immature individuals and males of *fuhrmanni*, an effort was made to secure a series of specimens, and with this material at hand it is evident that only one form is to be recognized. The writer believes that Peracca was in error in referring the form to the genus *Hyla*. The fact that the sacral diapophyses are not dilated separates it from most of the forms in that genus. No characters are given in the description that makes it impossible to place it in the genus *Hyloscirtus*, but until a comparative study can be made of *Hyloscirtus bogotensis* and the form under discussion the writer prefers to consider Peters' species as one of doubtful generic affinities.

Noble places *fuhrmanni* in the family Leptodactylidae because it has "the cylindrical diapophyses of the leptodactylids," "the form of the sacral diapophyses is of more diagnostic value than the shape of the terminal

²⁰ *Bul. Amer. Mus. Nat. Hist.*, XXXVII, 803-807.

²¹ *Occ. Papers, Mus. of Zool., Univ. of Michigan*, No. 33.

phalanges," and "claw-shaped phalanges are to be expected in the leptodactylids." In the opinion of the writer, these conclusions are not convincing.

Fry²² has shown of the Leptodactylidae that "the Australian members of this family exhibit all stages between that of Heleioporus with considerably dilated diapophyses and the [cylindrical] condition shown in South American genera." It remains to be pointed out that not all of the neotropical leptodactylids have cylindrical diapophyses,²³ and that among the forms usually referred to the Hylidae there are considerable differences in the form of these processes, cylindrical, slightly dilated and expanded diapophyses being represented. It would thus seem to be clear that the form of the sacral diapophyses is not to be depended upon as a character distinguishing two families.

If the form of the sacral diapophyses is not a reliable family character, then the association of a particular shape with T-shaped or claw-shaped phalanges does not indicate the diagnostic value of the form of the terminal digital phalanx. The hypothesis that the claw-shape is derived from the T-shape, and that the former is to be expected among the leptodactylids, is interesting and will possibly be found to be true, but it must be admitted that at the present time the claw-shape prevails among the hylids with dilated diapophyses, and it is only found in the leptodactylids if such forms of doubtful affinities as *evansi*, *goeldi*, and *fuhrmanni* are placed in this family on the basis of that unreliable character the form of the sacral diapophyses. In view of the variations in the form of the sacral processes, it would seem either that the two families should be combined or that they should be separated on the basis of the form of the terminal digital phalanx, until more data is secured.

While it is uncertain whether one or more families are represented by the species now referred to the Hylidae and the Leptodactylidae, some progress may be made in the classification by revising the genera and segregating the species most alike in the totality of their characters. *Evansi*, *goeldi*, and *fuhrmanni* are alike in having claw-shaped digits, cylindrical diapophyses with somewhat dilated cartilaginous head, bell-shaped gills in the larval period,²⁴ and in that the female carries the eggs on the back and the young are born in the adult stage. It is proposed that these forms be united under the generic name of *Cryptobatrachus* until the identity of Peters' *Hyloscirtus* is established. The genus may be referred to the Hylidae until the value of the form of the terminal digital phalanx is fully understood. The writer is inclined to believe that the presence of cup-shaped gills in the larval stage indicates a close relationship between *Gastrotheca*, *Cryptobatrachus*, and *Ceratohyla*, whether or not it is believed that the

²² *Proc. Roy. Soc. Queensland*, XXVII, p. 73.

²³ Noble has recently described a form with T-shaped phalanges and slightly dilated diapophyses (*Bul. Amer. Mus. Nat. Hist.*, XLII, pp. 441-443).

²⁴ Boulenger states that "no traces of gills are to be seen in the embryo of *H. goeldi*," but in the description of *Hyla evansi* he states that the larva has "allantois-like membranous respiratory organs. In this respect it agrees with *Hyla goeldi* Blgr., to which it is nearly related, and with *Ceratohyla bubalus* Esp." *Proc. Zool. Soc. London*, X, p. 209.

three genera have diverged far enough to warrant their separation into different families.

Phyllomedusa tarsius (Cope).—Aracatáca; Fundación (observed). Dense woods in flood-plain forest. A single specimen is referred to this species, although it is not typical. The hind limbs are shorter than in the specimens of *P. tarsius* examined, the heel extending to the middle of the tympanum instead of to the anterior border of the orbit; the parotoids are indistinct, and the white markings around the vent, characteristic of *P. tarsius*, are lacking.

Hylella pearsei, new species²⁵

Description: Tongue subcircular, slightly emarginate behind. Head broader than long; snout as long as diameter of orbit; loreal region high, oblique; interorbital space broader than upper eyelid; tympanum indistinct, about one-third the diameter of eye. Fingers webbed at base, first shorter than second; toes two-thirds webbed; disks of fingers and toes well developed, those of fingers larger than tympanum. The hind limb being carried forward, the tibio-tarsal articulation reaches the posterior margin of the eye. Skin smooth above; belly and an area below the thighs coarsely granular; a dermal fold from axilla to groin.

Above pale brown with numerous small, round, dark-brown spots, a poorly-defined brown band posterior to the eye, limbs without well-defined markings; ventral surfaces pale yellow.

Length, head and body, 14 mm.; length of head, 5.5 mm.; width of head, 6 mm.

Type Specimen: Museum of Zoology, University of Michigan, No. 54,639; Fundación, Santa Marta Mountains, Colombia; August 11, 1913; A. S. Pearse, collector.

Habitat: Taken in tall grass in an open marsh.

Remarks: Noble (*Bull. Amer. Mus. Nat. Hist.*, XLII, pp. 441-445) has recently placed one of the species hitherto referred to *Hylella* (*H. buckleyi* Boulenger) with the Leptodactylidae. *H. pearsei* has the claw-shaped terminal phalanges of the Hylids.

SAURIA

Gonatodes fuscus (Hallowell).—Santa Marta to about 800 feet on San Lorenzo; Fundación; Aracatáca (Rehn and Hebard); Las Pavas; Valencia; Valle de Upar; Fonseca; Riohacha. Very common in the desert scrub and dry forest and on walls in towns in the localities given above, apparently less common in the valley forests. Often found in logs, but generally on trees, particularly those which are partly decayed. Eggs laid in decaying wood.

Gonatodes vittatus (Lichtenstein).—Don Diego (M. A. Carriker); Palomina (W. W. Brown); Arroyo de Arenas; Fonseca. A very common species on and in logs and on trees in the forests at Arroyo de Arenas and Fonseca.

²⁵ Named for the collector of the type specimen, Dr. A. S. Pearse.

Phyllodactylus ventralis O'Shaughnessy.—Santa Marta to about 100 feet, San Lorenzo; Riohacha (observed). Only five specimens taken, of which two were in buildings in Santa Marta and Bolivar, one was found under a stone on the desert at Santa Marta (another was observed in a rock slide), and two were under the bark of standing trees in the dry forest above Bolivar. The one observed at Riohacha was in a house.

Thecadactylus rapicaudus (Houttuyn).—Bolivar to 600 feet, San Lorenzo; Las Pavas; Tucurinca (Rehn and Hebard); Arroyo de Arenas; Valencia; Fonseca. Found in the dry forest on San Lorenzo and in the valley forests in the other localities recorded. During the day only taken under the bark of trees; observed at night running about over the tree trunks.

Lepidoblepharis intermedius Boulenger.—San Lorenzo (5,000 feet). This species was described in 1915 as *Pseudogonatodes furvus*²⁶ just before the writer received Boulenger's description. The type of *P. furvus* Ruthven has been compared with Boulenger's material by Miss Joan Procter, and it is her opinion that they represent the same species. It should be noted that the Santa Marta Mountains specimen is much larger than the larger of the two specimens from the Choco.

Lathrogecko sanctae-martae Ruthven.²⁷—Bolivar to 600 feet, San Lorenzo; Tucurinca (Rehn and Hebard); Fundación; Las Pavas; Valencia; Fonseca; Arroyo de Arenas. The very small size and secretive habits of this lizard make it easily overlooked. All but two specimens were found on the ground under leaves and logs. Two specimens were found in a decayed stump. During the hottest part of the day they are more active and can be seen darting about among the leaves.

Anolis solifer Ruthven.²⁸—Known only from the type specimen, Catalog No. 6,549, Museum of Comparative Zoology, taken at La Concepcion by W. W. Brown.

Anolis gaigei Ruthven.²⁹—San Lorenzo from Bolivar to 4,000 feet; Fundación; Tucurinca (Rehn and Hebard); Pueblo Viejo (M. A. Carricker); Pueblo Viejo and Palomina (W. W. Brown); Las Pavas; Valencia; Loma Larga; Arroyo de Arenas. Usually found on the ground or on grass or bushes.

While this anole has been found on San Lorenzo practically throughout the dry forest and up to 4,000 feet in the wet forest, it is apparently rather rare below 600 feet and above 2,700 feet, and above 3,000 feet is restricted to artificial clearings. It was found to be abundant from 2,000 feet to 2,700 feet. It was not a common form at Fundación, Las Pavas, Valencia, Loma Larga, and Arroyo de Arenas, but this observation means little in view of the short time spent at these places.

Anolis solitarius Ruthven.³⁰—San Lorenzo, 4,500 to 6,000 feet; Pueblo

²⁶ *Occ. Papers, Mus. of Zool., Univ. of Michigan*, No. 19.

²⁷ *Occ. Papers, Museum of Zoology, Univ. of Michigan*, No. 21.

²⁸ *Occ. Papers, Museum of Zoology, Univ. of Michigan*, No. 32, pp. 4-5.

²⁹ *Occ. Papers, Mus. of Zool., Univ. of Michigan*, No. 32, pp. 6-8.

³⁰ *Occ. Papers, Mus. of Zool., Univ. of Michigan*, No. 32.

Viejo (M. A. Carriker); Palomina (W. W. Brown). This species is difficult to collect, as it frequents the heavy forest and is apparently not abundant. Only one specimen was taken as low as 4,500 feet on San Lorenzo; the others observed in this region were between 5,000 and 6,000 feet. In the forest on San Lorenzo about six were observed in two months' work, two on the ground, the others on ferns and vines to a height of 20 feet on trees. Most of the specimens taken were secured in the large quebrada of Viernes Santo, in 1920, where, owing to the width of the stream, the forest canopy is broken and there is a riparian association of low shrubs and trees. In this habitat the lizard was found on the small trees and shrubs.

Norops auratus (Daudin).—Santa Marta to 2,200 feet, San Lorenzo; Aracatáca (Rehn and Hebard); Fundación; Las Pavas; Valencia; Valle de Upar; Arroyo de Arenas; Palomina and Pueblo Viejo, 8,000 feet (W. W. Brown). Common in open woods and in clearings; generally found on grass and low bushes; abundant about the open marshes at Bolivar and Fundación.

Tropidodactylus onca (O'Shaughnessy).—This species was only found at Riohacha, and in but one place—a desert flat between the town and the Rio Rancheria. It was apparently not common. All of the specimens taken (17) were on the ground. It is very shy and at the slightest cause for alarm dashes into a hole.

It is to be noted that the adpressed hind limb does not reach the border of the eye, as stated by Boulenger, but the posterior border of the ear.

Polychrus spurrelli Boulenger.—Aracatáca (Rehn and Hebard). Taken from stomach of *Leptophis occidentalis*.

The specimen is referred to *P. spurrelli* with some doubt. It corresponds to the description of that form and differs from *P. marmoratus* in the scutellation of the body, but it is like the latter in having a gular denticulation.

Basiliscus barbouri Ruthven.—From Santa Marta to 2,200 feet; Gaira; Fundación; Valencia; Valle de Upar; Loma Larga; Palomina and La Concepcion (W. W. Brown). Apparently common in the localities in which it was found, occurring only along the streams, where it is generally found on rocks, logs, etc., near the water, occasionally in bushes up to a height of about twenty feet. When alarmed, individuals frequently dash across the water on their hind legs, and occasionally adopt this method of locomotion on land. (Pl. IX, fig. 1.)

Leiocephalus erythrogaster (Hallowell).—Bolivar to 2,000 feet; Tucurina (Rehn and Hebard); Valencia. Only observed on the ground and on logs and rocks in dry forests.

The species is secretive and apparently somewhat local in distribution in the localities in which it was observed.

Iguana iguana (Linnæus).—Santa Marta to about 600 feet, San Lorenzo; Aracatáca (Rehn and Hebard); Fundación; Valle de Upar; San Juan de Cesár; Fonseca and Arroyo de Arenas (observed); Riohacha.

Where there are deep ponds or streams (e. g., Fundación and Valle de

Upar) this lizard is generally abundant on the shores, frequenting the branches overhanging the water, from which they throw themselves when alarmed. In the regions where the streams are shallow the species is apparently less abundant, does not have this habit, and, while occurring along the streams, seems to be more generally distributed. At Riohacha old and young individuals were found in the desert scrub at a distance of a mile from water, in this habitat running about on the ground like the large *Ameivas*.

Tupinambis nigropunctatus Spix.—One specimen from Don Diego (M. A. Carriker). Reported by Mr. Carriker to be not uncommon in the cacao plantation at Don Diego. It does not seem to be recorded that this lizard is a scavenger. The natives on the Demerara River, British Guiana, capture them on fish-hooks baited with flesh.

Ameiva ameiva maculata (Fischer).—Santa Marta to Agua Dulce; Las Pavas (observed); Valencia; Valle de Upar; Fonseca; Loma Larga; Arroyo de Arenas; Riohacha. On San Lorenzo found on the desert and in dry woods to 2,200 feet, above 2,200 feet only in the clearings. In the other localities taken in the flood-plain forests.

This form is close to *Ameiva ameiva*, as stated by Barbour and Noble,³¹ and the large series obtained shows that most of the scale characters given by these writers are not sufficient to distinguish the subspecies. The præ-anals are usually as much enlarged as in the typical form, and, while the shields on the under side of the tibia are usually a little smaller and more numerous in *maculata*, the range of variation in these scales is slight and overlapping in the two forms. The best scale character is the width of the occipital plate, which is quite constantly much less in *ameiva*, being usually less than one-half the greatest width of the adjacent scale in *ameiva* and with few exceptions from two-thirds to the entire width of the adjoining scale in *maculata*. Barbour and Noble state that *ameiva* has two pairs of frontoparietals, but this must be an error, since in a large series two pairs occur only as an abnormality, and this abnormality is also found in *maculata*.

Ameiva bifrontata divisus (Fischer).—Salamanca Coast and Santa Marta to 2,200 feet; Aracatáca and Tucurínca (Rehn and Hebard); Valle de Upar; Fundación. A common ground lizard in the localities mentioned.

The subspecies *A. b. divisus*³² exists in the typical form from the coast at Santa Marta to Fundación. In a large series of specimens not one has the row of granules between the supraoculars and frontals continued anterior to the anterior border of the third supraocular. Of a series of eight specimens taken at Valle de Upar six are like the Santa Marta specimens and two have one granule anterior to the suture of the second and third supraocular. (See p. 62.) No representatives of the species were found between Fundación and Valle de Upar. It is possible that the Valle de Upar form will be found to be closer to typical *bifrontata* than to the subspecies *divisus* or intermediate, but this is not apparent from the material at hand. Also the writer is not certain of the identity of the Don Diego

³¹ *Bul. Mus. Comp. Zool.*, LIV, p. 467.

³² See Ruthven, *Occ. Papers, Mus. of Zool., Univ. of Michigan*, No. 2, 1913.

specimens. Of the two specimens in the collection from that locality, one is like *divisus* and the other is *bifrontata*. Since both types of scalation are found at Riohacha, the specimens are provisionally identified as *bifrontata*. For remarks on the relationship of the two forms see *infra*.

Ameiva bifrontata Cope.—Badillo; Fonseca, Arroyo de Arenas; Riohacha; Don Diego. Very common about Riohacha and the other localities given. A ground form found both in the woods and on the desert. One individual was seen to run on its hind legs.

At Riohacha about one-half the specimens taken (21 out of 50) have the first and second supraoculars entirely separated by granules. In 25 the granules between the frontal and supraoculars extend farther forward than the suture between the second and third supraoculars, and in four the granules end at that suture as in *divisus*. (See p. 62.) These differences are not sexual. Whether these specimens should be referred to *bifrontata*, as is done here, or are to be considered intermediate, can be determined only by the examination of a large amount of Venezuelan material to discover just how variable is *bifrontata*. From a very small series of the typical form from Venezuela the writer believes that it does not constantly have the first and second supraoculars separated. The status of the material from Don Diego, Arroyo de Arenas, Fonseca, and Badillo is not clear, but since one of two specimens from Don Diego and one of three specimens from Fonseca are typical *bifrontata*, while the two taken at Arroyo de Arenas, one from Fonseca and one from Badillo, have the inner row of granules continued farther than the suture of the second and third supraoculars, the logical conclusion is that the lizards in these localities are closer to *bifrontata* than *divisus*.

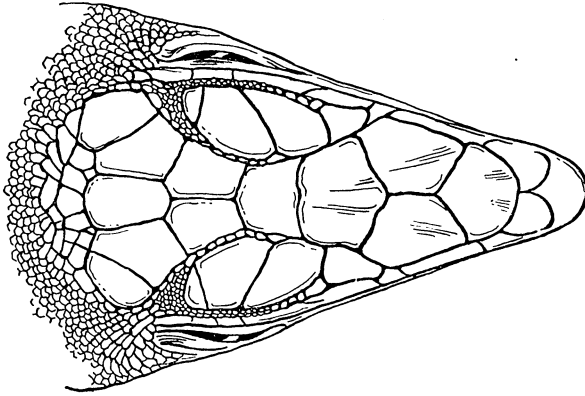
There can be little doubt that the two forms intergrade in the Santa Marta Mountains region, whether the lizards at the east end of the range are typical *bifrontata* or intermediate. The distribution of characters is shown in the following table.

Distribution of the characters of Ameiva bifrontata and Ameiva bifrontata: divisus in the Santa Marta Mountains region.

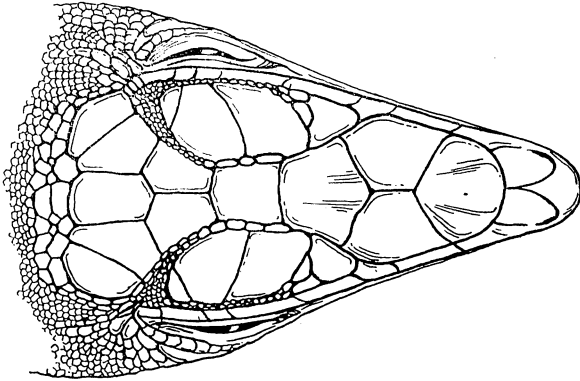
Superior granules, continued anteriorly:	Beyond			Subspecies
	To suture of supraoculars 2 and 3	suture of supraoculars 2 and 3	Entirely around last 3 supraoculars	
Santa Marta	17	<i>Ameiva b. divisus</i>
Fundacion	9	
Valle de Upar	6	2	..	
Badillo	1	1	..	
Fonseca	1	1	1	<i>Ameiva bifrontata</i>
Arroyo de Arenas	2	..	
Riohacha	4	25	21	
Don Diego	1	1	

Cnemidophorus lemniscatus gaigei Ruthven.³³—Salamanca Coast, Gaira (observed), and Santa Marta to 2,200 feet; Tucurinca and Aracatáca (Rehn and Hebard); Fundación; Las Pavas (observed); Valencia; Valle

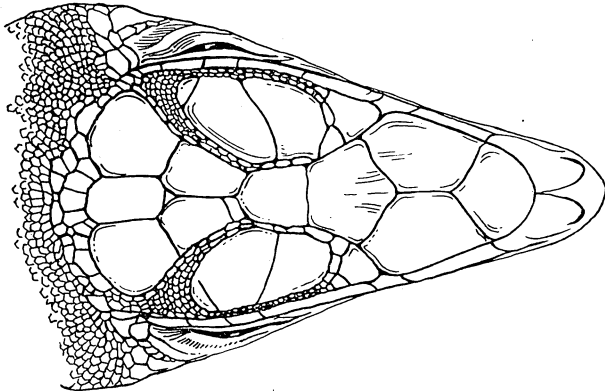
³³ *Occ. Papers, Mus. of Zool., Univ. of Mich., No. 16.*



Santa Marta



Riohacha



Riohacha

Head scalation of Ameiva bifrontata, A. bifrontata divisis and intermediate specimens in the Santa Marta region.

de Upar; Badillo; Fonseca; Loma Larga; Arroyo de Arenas Riohacha; Palomina and La Concepcion (W. W. Brown); Don Diego (M. A. Carriker). Common on the lowlands all about the range, preferring open habitats, but not uncommon in the more open parts of the flood-plain forests at Valencia and Valle de Upar. Although a ground form, it readily climbs about in low bushes in search of food.

Leposoma dispar Peters.—Bolívar to 600 feet; Las Pavas; Tucurínca (Rehn and Hebard). Found among leaves in the dry forest, except that two specimens were in damp leaves in a marshy place on the bank of the Tamocal River.

Loxopholis rugiceps Cope.—Fundación; Las Pavas; Valencia. At Fundación found in some numbers under logs and in the grass about an open marsh and along the river; at Valencia two specimens found among leaves and under detached bark in the valley forest.

The males alone have pores, five on each thigh, and usually four, sometimes 5, in the præanal region. The chin shields are constantly one anterior and four pairs, the members of the first two pairs being in contact. The color of the males is richer (the dorsal parts blackish, the under surfaces more or less red), the females being brownish above and whitish below.

Tretioscincus bifasciatus (Dumeril).—Bolívar to 2,000 feet; Tucurínca (Rehn and Hebard); Fundación; Las Pavas; Valencia; Valle de Upar; Fonseca; Arroyo de Arenas; Don Diego. A common form both in the dry and valley forests. Found among fallen leaves, on and in logs, and on the trees.

In many specimens the color of the tail is a brilliant blue.

Bachia bicolor (Cope).—Bolívar to 600 feet; Tucurínca (Rehn and Hebard); Loma Larga; Palomina (W. W. Brown). Under logs and rocks in the dry forest.

There are two species of *Bachia* in the Santa Marta Mountains region, one of which is the same as *Heterodonium bicolor*. The specimens taken in the localities given above have the scales in 28 (29) annuli, and have from 44 to 46 scales between the occiput and the tail. The hind limbs are undivided and are decidedly larger than in the specimens which have been referred to the following form. There are four digital tubercles on the fore limbs in all specimens. It is possible that this species is synonymous with *B. flavescens*, but if so the definition of the latter must be changed, for the Santa Marta Mountains specimens have fewer scales than given by Boulenger for *flavescens*, and the dorsal scales are distinctly imbricate.

Bachia dorbignyi (Dumeril and Bibron).—Valencia; Valle de Upar; Fonseca. Found under logs in the dry forest at Fonseca and in dry parts of the flood-plain forests at Valle de Upar and Valencia. The species is a very active one.

The specimens referred to this species resemble those identified as *B. bicolor*, but differ in having the scales in 26 annuli, in having 46 to 48 scales from the occiput to the base of the tail, in having the hind limb more reduced, and in having but three digital tubercles on the fore limbs. It will

be noted that the scale counts are those of *B. tridactylus*, but it is clearly not that form, since the dorsal scales are overlapping and there is no interparietal plate.

Gymnophthalmus sumichrasti (Cope).—Bolivar to 600 feet; Tucurínca (Rehn and Hebard); Valencia; Badillo. The specimens, five in number, were taken on the ground under leaves, except that one of two specimens captured at Bolivar was found in the grass in a pasture. They are secretive and very difficult to capture, for they are mostly active only when the sun is shining, or at least are best seen then, and are usually observed slipping about among the leaves.

The scutellation does not conform to the description given by Boulenger³⁴ as shown by the following table:

Locality—Sex	Longitudinal scale rows	Scale between head and tail	Scales at base of tail	Scales on posterior fourth of tail
Bolivar, male	13	34	smooth	keeled
Bolivar, female	15	38	keeled	
Valencia, male	13, 15	34	smooth	
Valencia, male	15	34	smooth	keeled
Badillo, female	13, 15	38	smooth	

It will be seen that the numbers of scales on the median dorsal line are those of *G. quadrilineatus*, and that the number of longitudinal scale rows may be either 13 or 15 or intermediate. In the specimens with both 13 and 15 rows an extra row is added on the sides about half-way between the fore and hind limbs. In four specimens the scales on the base of the tail are smooth as given for *G. quadrilineatus*, but in one specimen they are distinctly keeled. In the two specimens in which the tail is intact the scales of the distal fourth of this appendage are keeled. The coloration is as described by Boulenger, except that the ventral scales may bear round, black spots.

Amphisbaena fuliginosa Linnæus.—A single specimen taken on San Lorenzo at an altitude of 4,000 feet, crawling along the ground in the forest at daybreak. A second individual was seen in the same locality.

Mabuya agilis (Raddi).—Don Diego; Arroyo de Arenas; Valencia; Las Pavas. Only found in regions of dense forest, but there taken in open as well as shaded places.

SERPENTES

Helminthophis petersii Boulenger.—Fundación; Valencia. Taken under logs in dry forest at Fundación and in the flood-plain forest at Valencia.

The two specimens secured have 22 rows of scales. Dr. Boulenger has advised me that he was in error in ascribing 20 rows of scales to the species, the type specimen having 22 rows.

Leptotyphlops macrolepis (Peters).—A single, slightly mutilated specimen found dead in the dry woods at Bolivar is referred to this species. It differs from the description given by Boulenger³⁵ in that the second labial reaches the eye, but it differs from *L. myopica* in the proportions and in

³⁴ *Catalog of Lizards, British Museum*, II, p. 428.

³⁵ *Catalogue of Snakes, British Museum*, I, p. 69.

having six lower labials. The diameter of the body is contained $41\frac{1}{2}$ times in the length, the length of the tail $13\frac{2}{3}$ times.

Epicrates cenchría (Linnæus).—Fundación. A single specimen taken near Fundación was secured from a native.

Constrictor constrictor (Linnæus).—San Lorenzo, 2,200 feet. Taken in the forest. Reported as frequently seen at an elevation of about 2,200 feet and lower.

The characters given below are those of *C. constrictor*, not *C. imperator*. Dorsal scale rows 81, supraoculars 24, ventrals 247, subcaudals 55, rows of scales across forehead 18, dark cross-bands 20.

Drymobius boddaertii (Santzen).—Two hundred feet above Bolivar (observed) to 5,500 feet, San Lorenzo; Valencia; Palomina and La Concepcion (W. W. Brown). A common ground snake in the wet forest on San Lorenzo; generally distributed above 2,200 feet, below this altitude only seen in ravines in the dry forest. At Valencia found in the flood-plain forest. The only food found in the stomachs examined was frogs. (Pl. VIII, fig. 2.)

Drymobius rhombifer (Günther).—San Lorenzo from 3,000 feet to 5,500 feet; Don Diego (M. A. Carriker); Palomina and La Concepcion (W. W. Brown). A common ground snake in the wet forest. One specimen was taken from an egg in the stomach of a *Lachesis lanceolatus*. The stomachs examined contained frogs, *Prostherapis subpunctatus*, and *Eleutherodactylus* sp. (Pl. X, fig. 2.)

The differences in the number of subcaudals is great, the extremes being 84 and 103.

Phrynonax poecilonotus (Günther).—San Lorenzo, 4,500 feet; Don Diego (M. W. Carriker). The specimen taken on San Lorenzo was in a coffee tree; the one from Don Diego was found on the ground in a dense cacao grove. The San Lorenzo specimen had eaten a partly fledged bird.

Peracca³⁶ has shown that the characters used to distinguish *P. poecilonotus*, *lumulatus*, *fasciatus*, and *guentheri* are not sufficient. The Santa Marta Mountains specimens are like those hitherto referred to *P. fasciatus* in that the dorsal scales are weakly keeled, the preocular is in contact or narrowly separated from the frontal, and the upper labials are eight. The dorsal scale formula is 21-19-17-15-13 and 21-23-21-19-17-15-13-(11). (Pl. IX, fig. 2.)

Drymarchon corias melanurus (Dumeril and Bibron).—San Lorenzo, 600 feet to 4,000 feet; La Concepcion, Palomina, and "Macotama or San Miguel, 6,000-8,000 feet" (W. W. Brown). On San Lorenzo found in the wet forest, and although but few specimens were seen, the number of cast skins would indicate that the species occurs in some numbers.

Chironius carinatus (Linnæus).³⁷—Santa Marta; Palomina and La

³⁶ Bol. Mus. Torino, No. 253, pp. 6-8.

³⁷ Fitzinger Syst. Rept., pp. 29 and 31, specifically designates Linne's *Coluber carinatus* as the type of his genus *Chironius*. Dr. Leonhard Stejneger (*in litt.*) has called my attention to the fact that *C. carinatus* has *Coluber chironius* Donndorf, Zool. Beytr., vol. 3, p. 209, as a synonym and is consequently type by tautonymy.

Concepcion (W. W. Brown); Valle de Upar (observed). Of the two specimens seen one was in a river, the other on the bank of a stream.

Leptophis occidentalis (Günther).—One specimen from Aracatáca (Rehn and Hebard). In the stomach of this specimen was found the lizard referred to *Polychrus spurrelli*.

Leimadophis melanotus (Shaw).—Bolivar to 5,500 feet, San Lorenzo; Fundación; Ariguaú; Valencia; Arroyo de Arenas; San Miguel, 5,000 feet (M. A. Carriker). Taken on the edge of marshes and ditches at Bolivar, in the wet and dry forests in other localities on the lowland, in the forest at 5,500 feet, under the bark of a stump at Fundación (one), and on the savanna at San Miguel. One specimen had eaten a frog.

Leimadophis albiventris Jan.—Pueblo Viejo, 8,000 feet (W. W. Brown). A single specimen is referred to this species.

Lampropeltis micropholis Cope.—The writer has examined the specimen from Cacagualito, Colombia, recorded by Griffen³⁸ and examined and referred to this species by Dr. F. N. Blanchard.

Leptocalamus torquatus Günther.—A single specimen taken in a log in the dry forest at Valencia.

The specimen conforms to the description of the type in having a broad nuchal collar which was yellow in life. The head and the region just behind the collar are dark brown, the rest of the dorsal surface a brownish olive, the ventral surface pearly white. The portion of the rostral visible from above is about one-third of its distance from the frontal.

Atractus iridescens Peracca.—San Lorenzo, 4,000 to 6,500 feet; San Sebastian (W. W. Brown). Apparently not uncommon but a secretive form between 4,000 and 6,500 feet; usually found under logs and stones.

One specimen has 15 dorsal scale rows, and 9 have 17 rows. The upper labials are 7 in every specimen; the lower labials are 7 in 4 specimens, 7 and 8 in four, 8 in one, and 6-7 in one. The ventrals vary from 152 to 169, the subcaudals from 22 to 34. The coloration is very variable. The dorsal coloration in some specimens is brownish black with small transverse pale brown spots, in others dark brown with small, obscure black spots, and others (young) are red with prominent black spots and cross bars. A large specimen from San Sebastian is olive brown with black spots and cross bars. The ventral surface may be immaculate white or dull white irregularly spotted with black or with two broad black bands. The iridescence is strongly marked in the young and medium-sized specimens.

The writer is not sure of the identity of the specimens referred to, particularly of those from San Sebastian, but has given them this name as they conform to the descriptions of Peracca³⁹ and Boulenger.⁴⁰ The variations of the species in this genus have not been determined, and the characters used to distinguish the forms have evidently not been properly evaluated.

³⁸ *Mem. Carnegie Mus.*, VII, p. 176.

³⁹ *Bol. Mus. Torino*, No. 252, 1896.

⁴⁰ *Proc. Zool. Soc. London*, 1913, 1035.

Imantodes cenchoa (Linnæus).—A single specimen from Aracatáca (Rehn and Hebard).

Leptodeira albofusca (Lacépède).—Bolívar; Fundación; Fonseca. Found near irrigation ditch at Bolívar, about a marsh at Fundación, and in the flood-plain forest at Fonseca. A nocturnal species usually found under logs, under the scales of palms, etc., during the day. One specimen had eaten a frog.

In six specimens the dorsal scale formula is 19-21-19-17-15, and in three it is 21-19-17. For remarks on the relations of this form and *L. annulata* see *infra*.

Leptodeira annulata (Linnæus).—Arroyo de Arenas. A single specimen taken at night on a tree trunk in the flood-plain forest.

The dorsal scale row formula is 19-17-15. The ground color is brownish white with numerous broad, black-edged, brownish spots about one and one-half scales apart descending to the first row of scales.

After examining a series of specimens from South America, Griffen⁴¹ has arrived at the conclusion that *L. annulata* is a synonym of *L. albofusca*. The writer does not concur in this opinion. It is true that many of the characters do not, because of overlapping, indicate two forms; but in the number of dorsal scale rows there is an apparent difference at least which is not brought out in Griffen's counts. When two species are as much alike as these two, the maximum number of scale rows means little. It is the average for the entire body that is significant. In *L. albofusca* the scales are usually 19-21-19-17-15 or 21-19-17 in the females and usually 19-17-15-(13) in the males. From the number of specimens of *L. annulata* recorded with 19 rows the usual formula is evidently 19-17-15. The two forms can be considered identical in the dorsal lepidosis only if it is revealed after a study of large series that the scale formulae are the same.

Clelia petola (Linnæus).—Don Diego (M. A. Carriker); La Concepción (W. W. Brown). The specimen taken at Don Diego was on the ground in a cacao plantation.

In all of the specimens the dorsal coloration is principally red, the tip of each scale is tipped with black, and the black cross bars are present only on the anterior one-third of the body and distinct only on the anterior one-fourth.

Orybelis acuminatus (Wied).—Bolívar to 800 feet, San Lorenzo; Fundación; Arroyo de Arenas; "Macotama or San Miguel, 6,000-8,000 feet" (W. W. Brown). Common in trees and bushes at Bolívar, and taken in the same habitat at Fundación and Arroyo de Arenas. Known locally as the bejuca snake. (Pl. X, fig. 1.)

The scale formula is 17-15-13, 15-17-15-13, and 15-17-15-13-11.

Erythrolamprus aesculapii (Linnæus).—San Lorenzo from 4,500 to 6,000 feet; Palomina, La Concepción, Pueblo Viejo at 8,000 feet (W. W. Brown). A common ground form in the wet forest. A specimen taken on San Lorenzo had eaten two small individuals of *Atractus iridescens*.

⁴¹ *Ann. Carnegie Mus.*, XI, pp. 321-326.

Another had eaten two frogs, *Eleutherodactylus cruentus* and *Geobatrachus walkeri*.

All of the specimens have black annuli in pairs, the number on the body varying from 11 to 14. The subcaudals are 44 to 64, the ventrals 186 to 200.

Tantilla longifrontale (Boulenger).—San Lorenzo, 4,000 feet; Palomina (W. W. Brown). The San Lorenzo specimen was taken on a rock in a stream.

Tantilla semicinctum (Dumeril and Bibron).—Valle de Upar; Bonda (a specimen in the Museum of Comparative Zoology, from the H. H. Smith collection). The Valle de Upar specimen was in dry woods.

Tantilla melanocephala (Linnæus).—Fundación; Valencia. Two specimens taken under logs, one in a swamp, and one in low forest.

Stenorhina degenhardtii (Berthold).—Valencia; Arroyo de Arenas. Only two specimens taken, both on the ground in dense woods.

The specimens have the color described as variety A by Boulenger,⁴² and there is a broad, irregular black band on the median ventral line.

Micrurus mipartitus (Dumeril and Bibron).—San Lorenzo, 5,000 feet; San Sebastian (W. W. Brown). The single specimen found on San Lorenzo was among leaves in heavy forest.

The specimens (6) all have more than the maximum number of white rings given by Boulenger,⁴³ the number being from 69 to 75.

Micrurus dumerilii (Jan).—Macotama and La Concepcion (five specimens collected by W. W. Brown); Fundación (1). The Fundación specimen was found under a log on the margin of an open swamp.

The material is puzzling. The specimens correspond in many ways with the descriptions of Jan and Boulenger, and, as these writers had but one specimen each, it is to be expected that a series, such as is at hand from the Santa Marta region, will reveal variations. The only constant differences observed are in the size of the eye, which is three-fourths, not two-thirds, of its distance from the mouth, and in the relative length of the frontal and parietal scales, the former being shorter than the latter. The Fundación specimen is in coloration similar to those of Jan and Boulenger, and the larger one of Werner.⁴⁴ In the others the black bands are about half as wide as in those mentioned, the laterals are poorly defined and are often, and the middle ones occasionally, interrupted ventrally. This coloration is apparently represented by Werner's smaller specimen. In some specimens from La Concepcion the postnasal is broadly in contact with the preocular, in others the suture is short, and in still others these scales are completely separated. The triads on the body vary from 9 to 14, the ventrals are 180-200, and the subcaudals are 31 to 50.

It is the opinion of the writer that all of these specimens must for the

⁴² *Catalogue of Snakes, British Museum*, III, p. 230.

⁴³ *Catalogue of Snakes, British Museum*, III, p. 431.

⁴⁴ *Abh. Konig. Bayerischen Akad.*, Bd. XXII, pp. 382-383.

present be referred to *M. dumerilii* (Jan), of which *M. colombianus* Griffen⁴⁵ is a synonym.

Micrurus hollandi (Griffen).—There is a single specimen in the collection of the Museum of Comparative Zoology, labelled "Santa Marta, Colombia, lowlands, Dr. Sellards," which corresponds closely with the description of *M. hollandi* Griffen (*loc. cit.*, pp. 218-219). The head is entirely black except for two yellow spots on the parietals.

Sibynomorphus mikani (Schlegel).—La Concepcion (W. W. Brown).

Bothrops lanceolatus (Lacépède).—La Tigrera (600 feet) to 5,000 feet, San Lorenzo; Fundación; Palomina (W. W. Brown). A nocturnal form said to be not uncommon up to 4,500 feet. Only one specimen observed as high as 5,000 feet on San Lorenzo. In the stomach of one specimen was found an egg of *Drymobius rhombifer*.

In all of the specimens the keels of the dorsal scales are nearly or quite as long as the scales.

Bothrops lansbergi (Schlegel).—Bolívar; Fonseca. Among leaves in dry forest at Bolívar, and under log in low woods at Fonseca.

The dorsal scale formula is 25-23-21-19, and in one specimen, a male, there are 25 rows only on the neck.

Crotalus terrificus (Laurenti).—San Sebastian (W. W. Brown); Bolívar (reported by M. A. Carriker).

The dorsal scale formula is 27-29-27-25-23-21-19.

CROCODYLINI

Crocodylus acutus Cuvier.—One specimen on the ocean beach at Don Diego (M. A. Carriker); one seen on the bank of the Fundación River at Fundación.

Caiman sclerops (Schneider).—A single specimen taken in a stagnant lagoon in the low forest at Don Diego (M. A. Carriker).

TESTUDINATA

Testudo denticulata (Linnaeus).—Santa Marta (reported) to 600 feet, San Lorenzo; Fundación; Copei. The species is much more widely distributed than indicated by the above list of localities. It apparently prefers dry forests and probably occurs in this habitat everywhere on the west, south, and east sides of the range. Shells were observed between Arroyo de Arenas, Fonseca, San Juan de César, Valle de Upar, Valencia, and Las Pavas.

The species is assiduously hunted for food, and the shells are utilized as basins.

Kinosternon integrum (Le Conte).—A single specimen taken in an open marsh at Fundación.

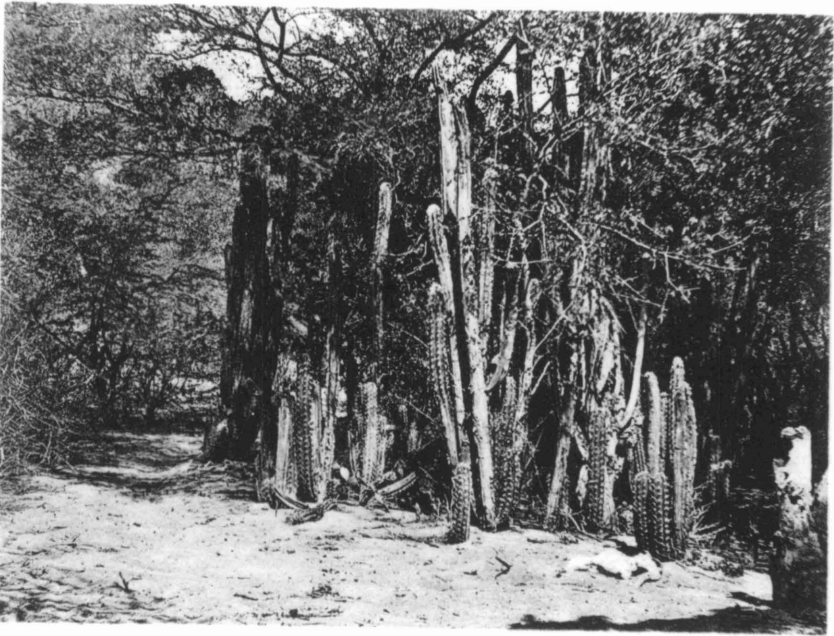
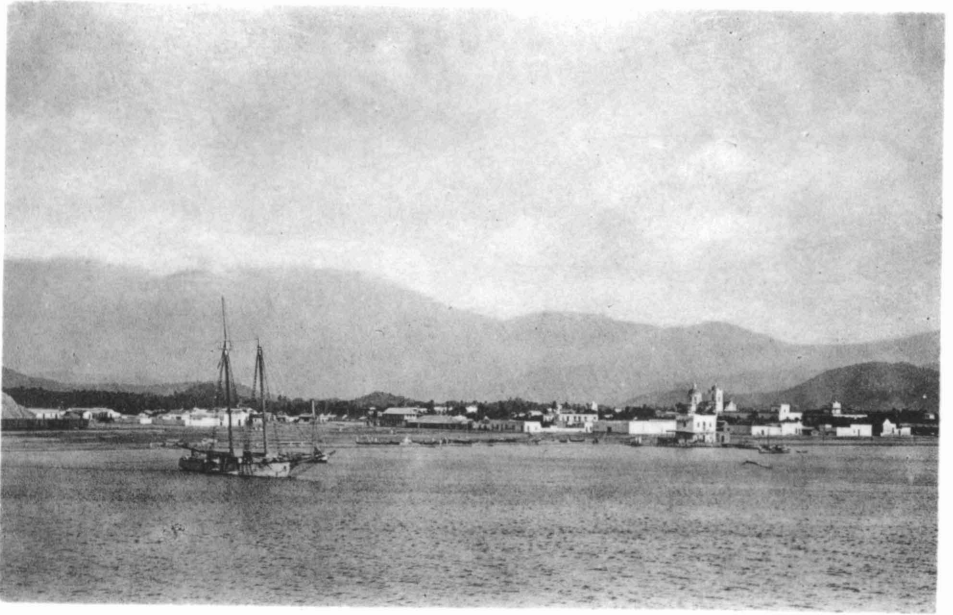
⁴⁵ *Mem. Carnegie Museum*, VII, 216-217.

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PLATE I

Figure 1. Harbor and city of Santa Marta as seen from the entrance to the bay.

Figure 2. Vegetation of the plains near Santa Marta. The vegetation of scraggly trees, cacti and other plants in some places tends to grow in clumps; in others it is more evenly distributed.



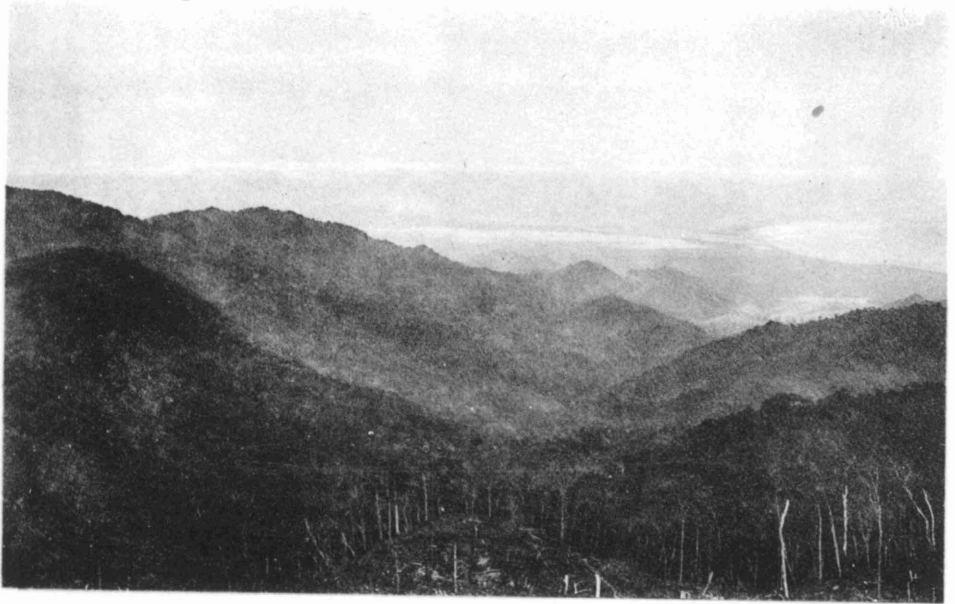
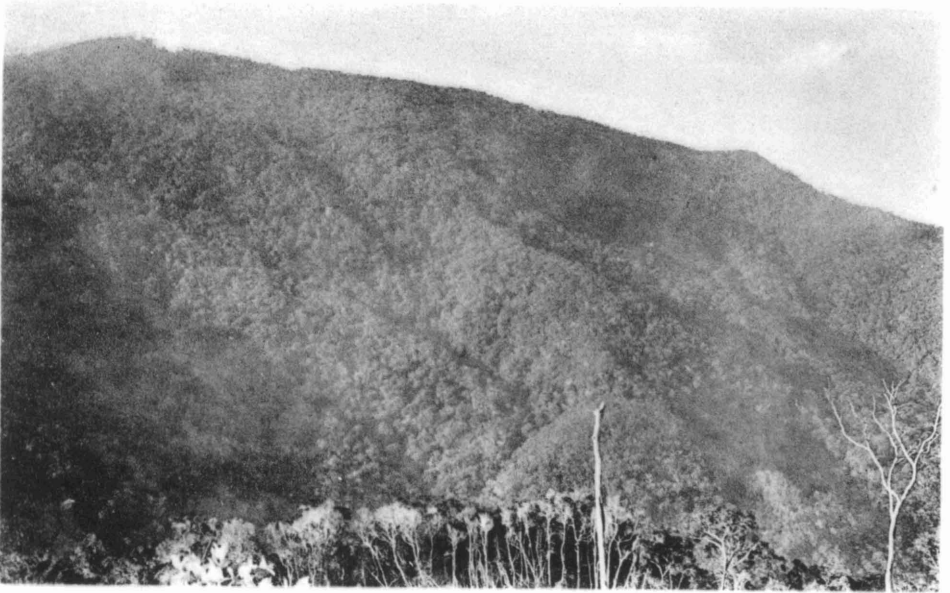


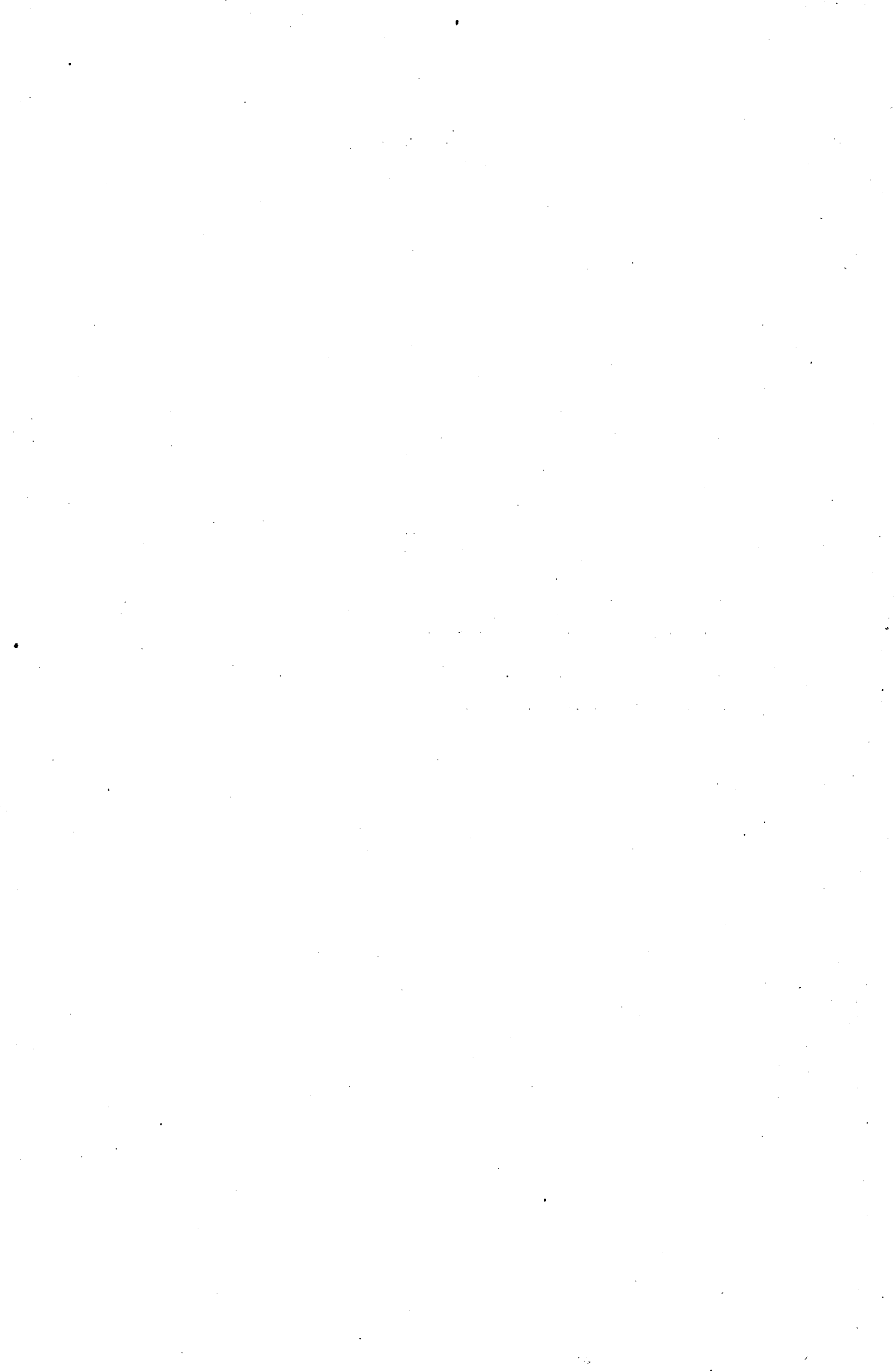
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PLATE II

Figure 1. Wet forest at 4,500 feet on San Lorenzo.

Figure 2. Moderately wet forest below 4,500 feet on San Lorenzo. The abrupt transition to the dry forest at 2,200 feet may be seen at the low peak just to the left of the center of the picture.





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PLATE III

Figure 1. Dry forest, at 1,500 feet, on San Lorenzo. The trees have been largely removed and are replaced by an artificial dry savanna.

Figure 2. Detail of the moderately wet forest, at 4,000 feet, on San Lorenzo, showing the nature of the undergrowth.

SANTA MARTA MOUNTAINS.

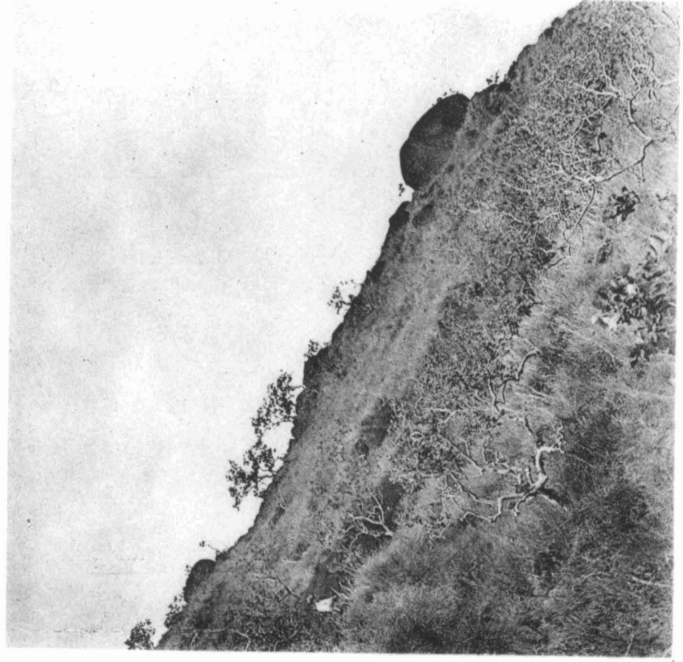
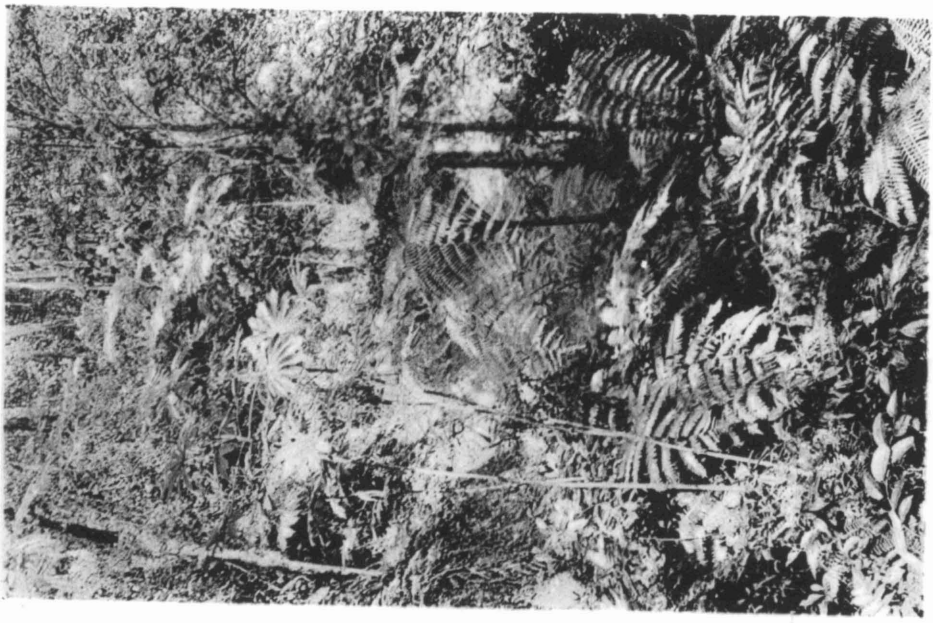


PLATE III



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PLATE IV

The moderately wet forest, at 4,000 feet, on San Lorenzo, illustrating the size and nature of the trees. The wild fig is conspicuous in both pictures.



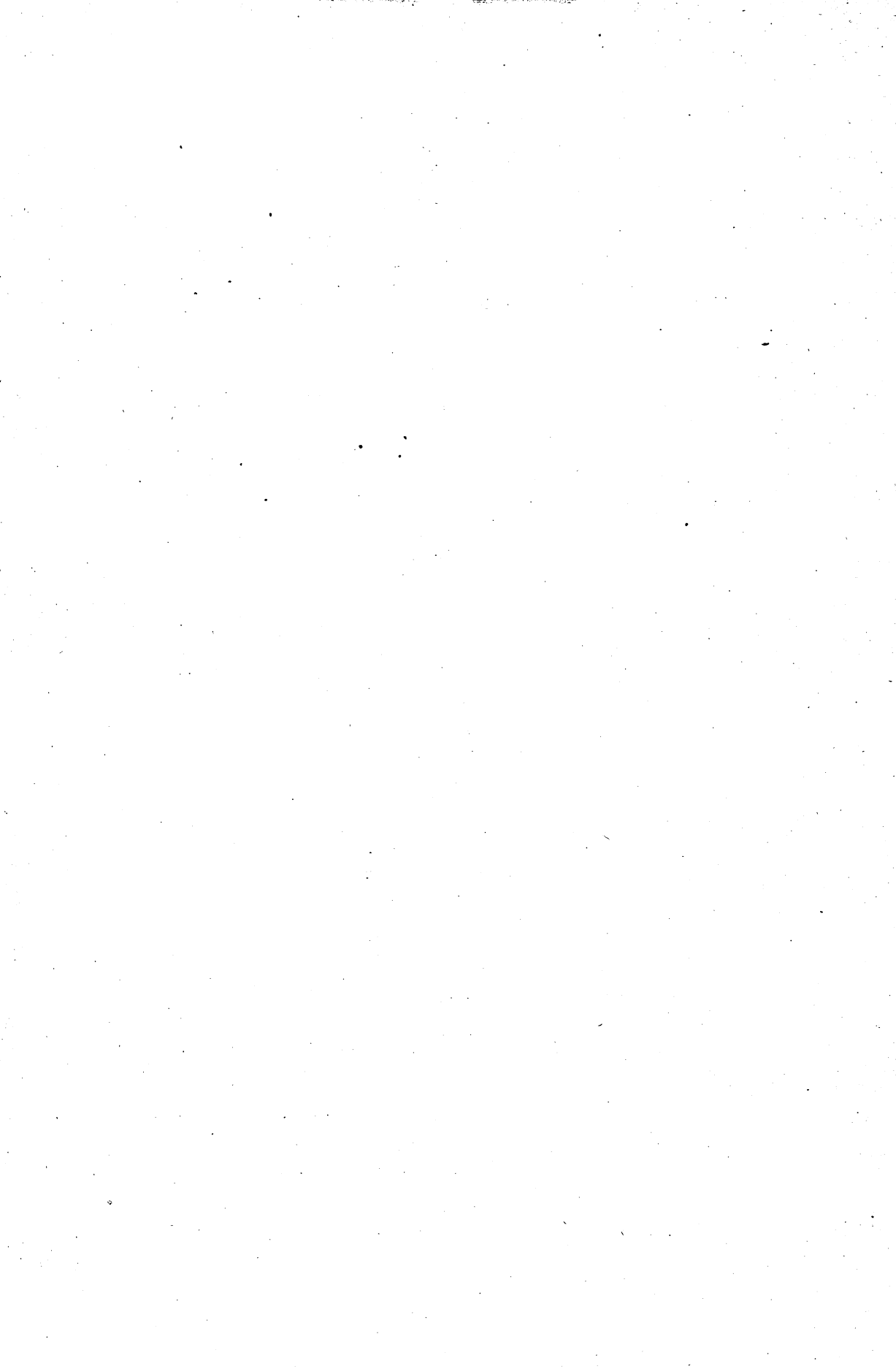
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PLATE V

Figure 1. A stream above 2,200 feet on San Lorenzo. The valleys are V-shaped, and the stream beds are very steep, so that the streams are torrential and characterized by many falls.

Figure 2. View in the lower part of the cloud forest on San Lorenzo, showing the abundance of bromelias on the trees.

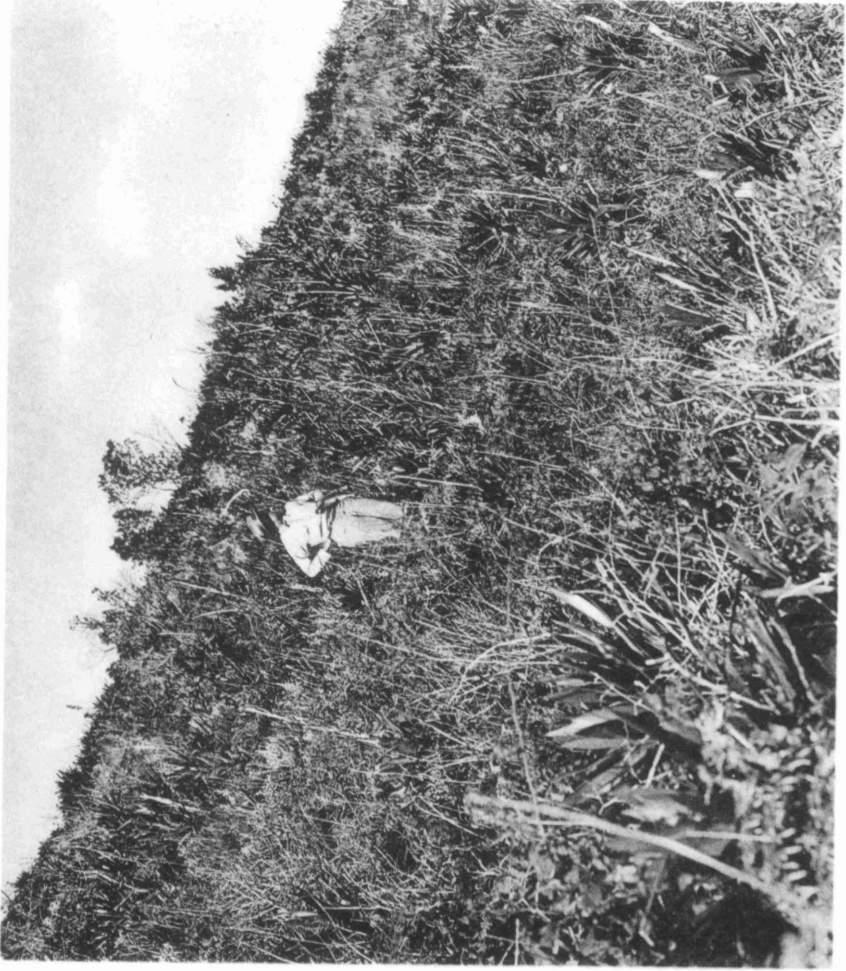


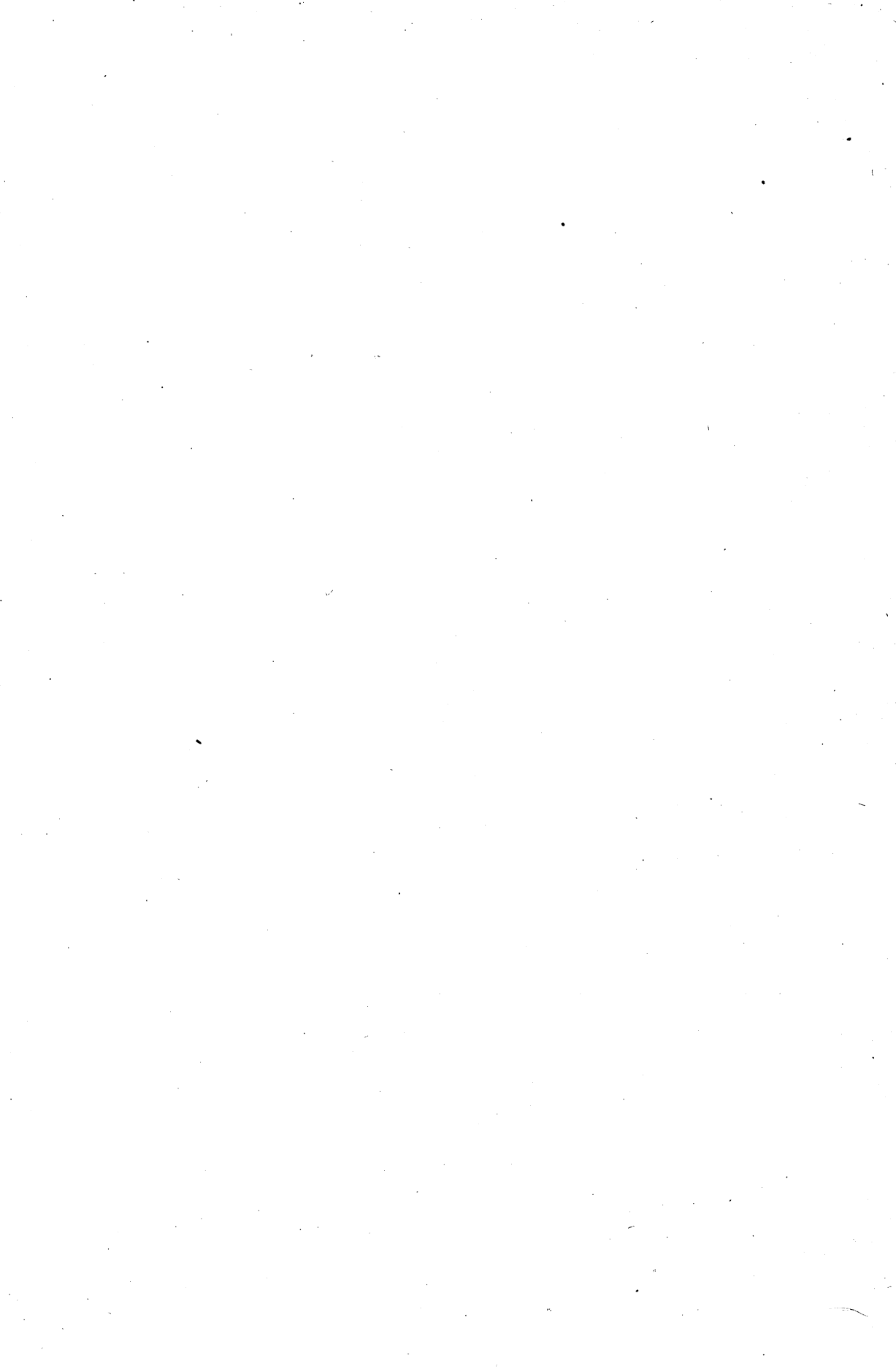


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PLATE VI

A burned area near the summit of San Lorenzo, the "Cerro Quemado." The dominant plant is a gigantic bromelia.

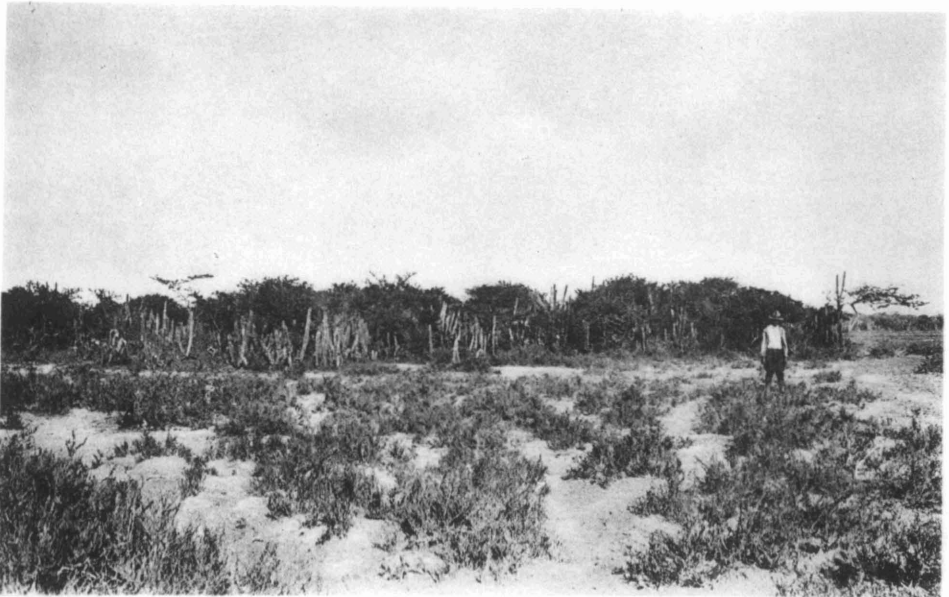
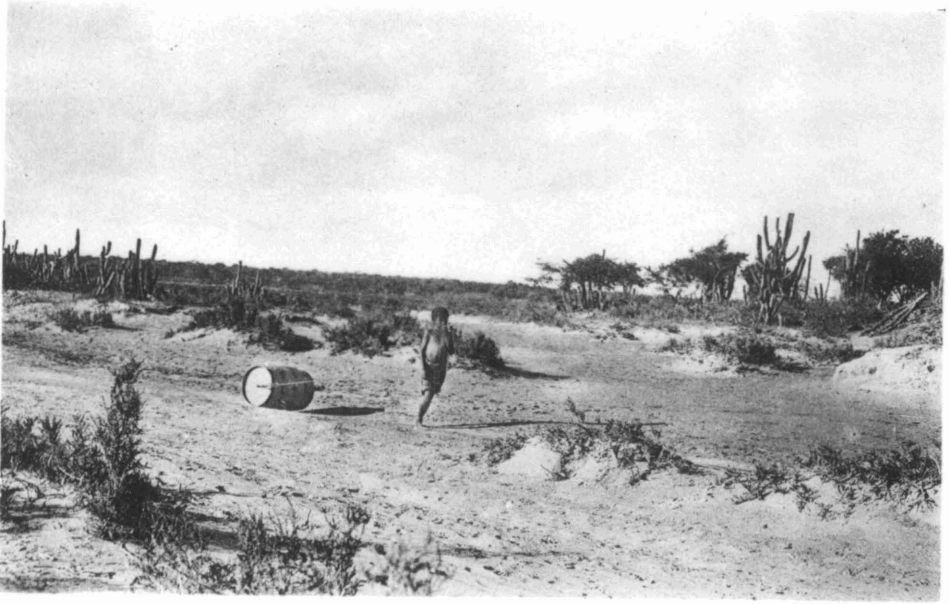




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PLATE VII

Vegetation of the region about Riohacha. Over large areas the giant cacti and scraggly trees are mostly confined to mounds higher than the surrounding flats, but on the ridges and terraces with gravelly or stony soil, the dry forest is more evenly distributed. The river valley has an open forest of large trees.

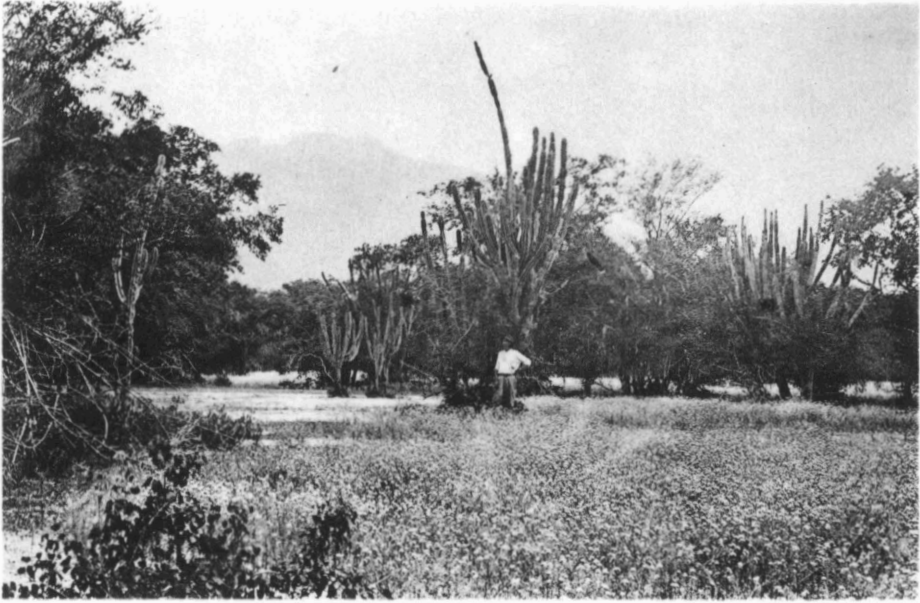


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PLATE VIII

Figure 1. Savanna at Valencia de Jesus. Between the clumps of trees and cacti the vegetation consists principally of grasses.

Figure 2. *Drymobius boddaertii* (Sentzen).





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PLATE IX

Figure 1. *Basiliscus barboursi* Ruthven; photographed in a stream on San Lorenzo.

Figure 2. *Phrynonax poecilonotus* (Günther), taken on San Lorenzo. This heavy-bodied snake climbs about in trees by using the tail as a prehensile organ.

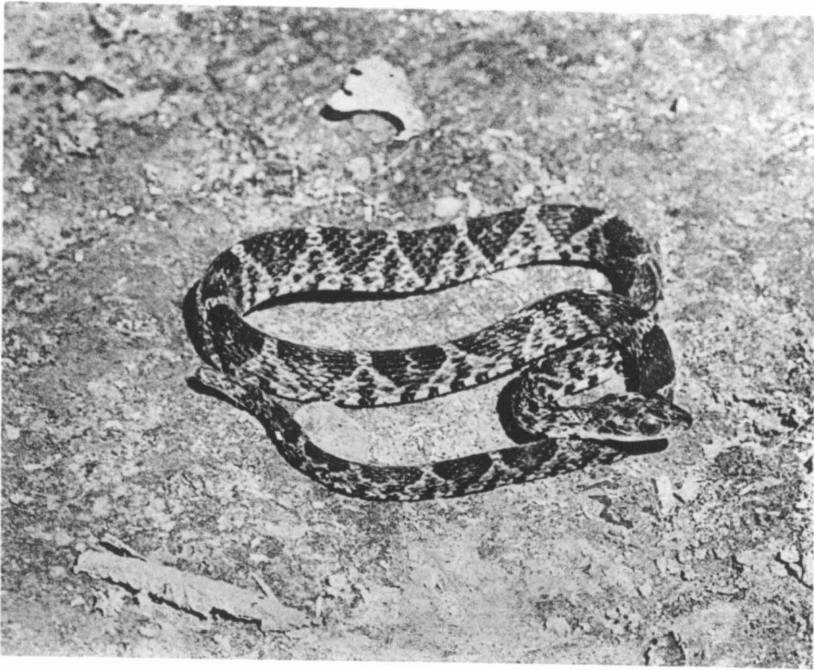


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PLATE X

Figure 1. *Oxybelis acuminata* (Wied), taken near Santa Marta. An arboreal species which has such a slender body that it can move directly through the branches of the trees at an astonishing speed.

Figure 2. *Drymobius rhombifer* (Günther). San Lorenzo.



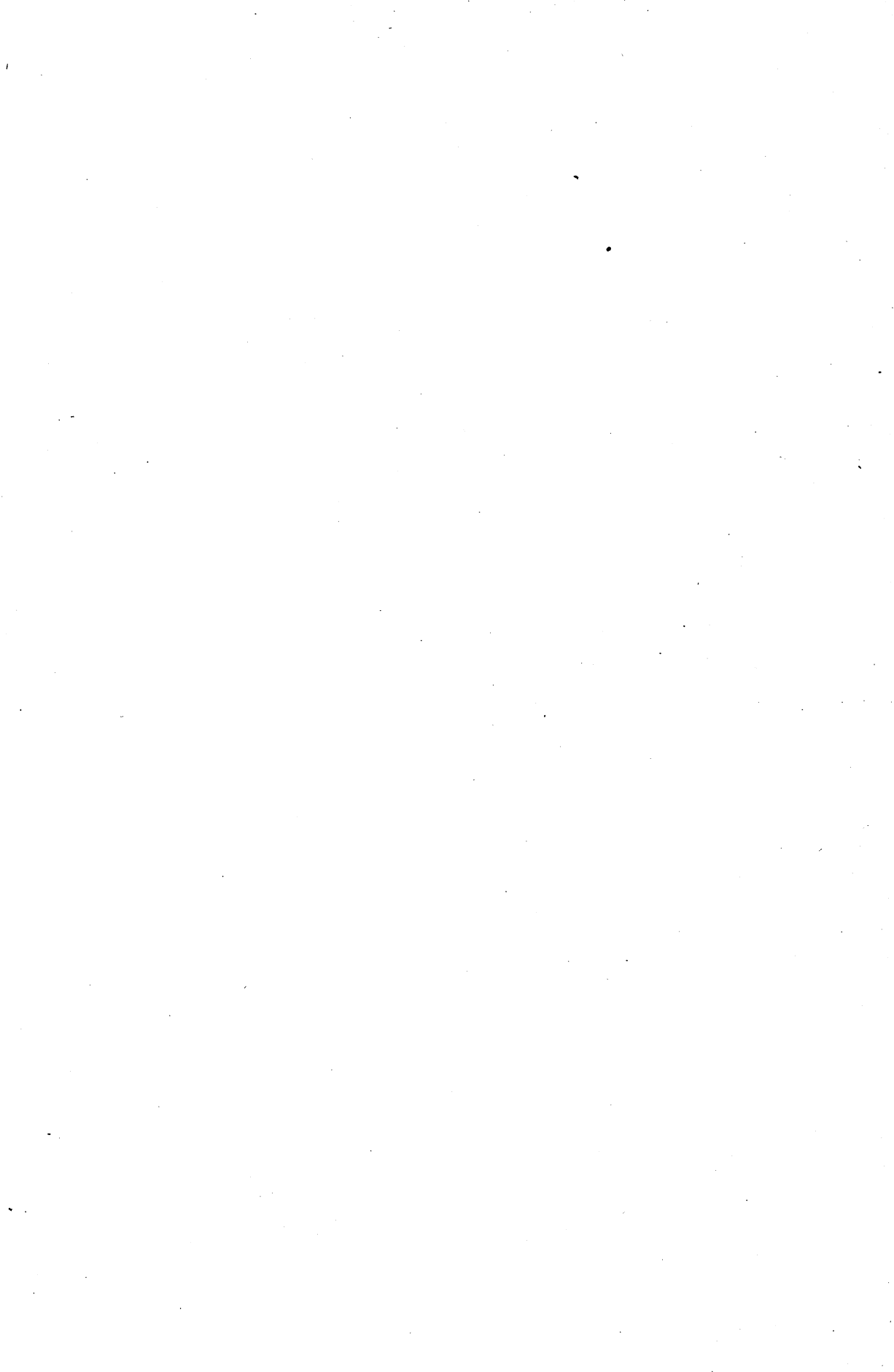


PLATE XI

Figure 1. *Eleutherodactylus carmelitae*, new species, $\times 1\frac{3}{4}$.

Figure 2. *Geobatrachus walkeri* Ruthven. About 2 1-5 times natural size.

Figure 3. *Hypopachus pearsei* Ruthven.



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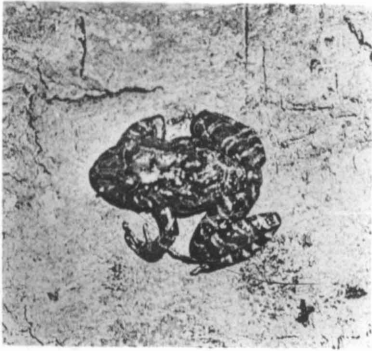
PLATE XII

Figure 1. *Eleutherodactylus carmelitae*, new species.

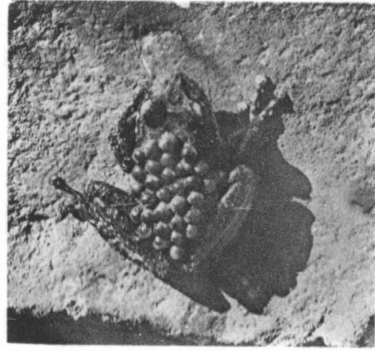
Figure 2. *Cryptobatrachus fuhrmanni* (Peracca). Female with eggs in position.
San Lorenzo.

Figure 3. *Eleutherodactylus megalops* Ruthven. San Lorenzo. The large eyes
are well shown in this picture.

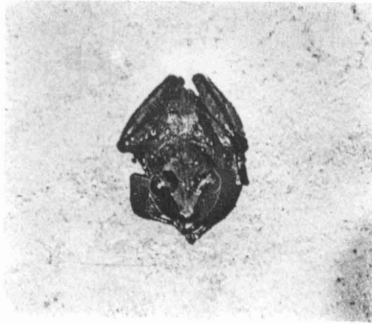
Figures 4, 5. *Eleutherodactylus cruentus* (Peters). Adult and eggs. The eggs
are in position on the leaf of a bromelia.



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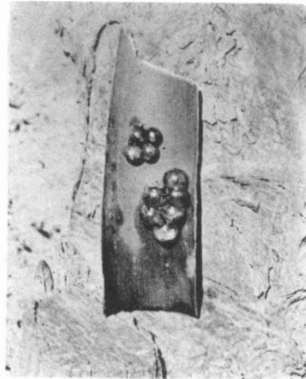
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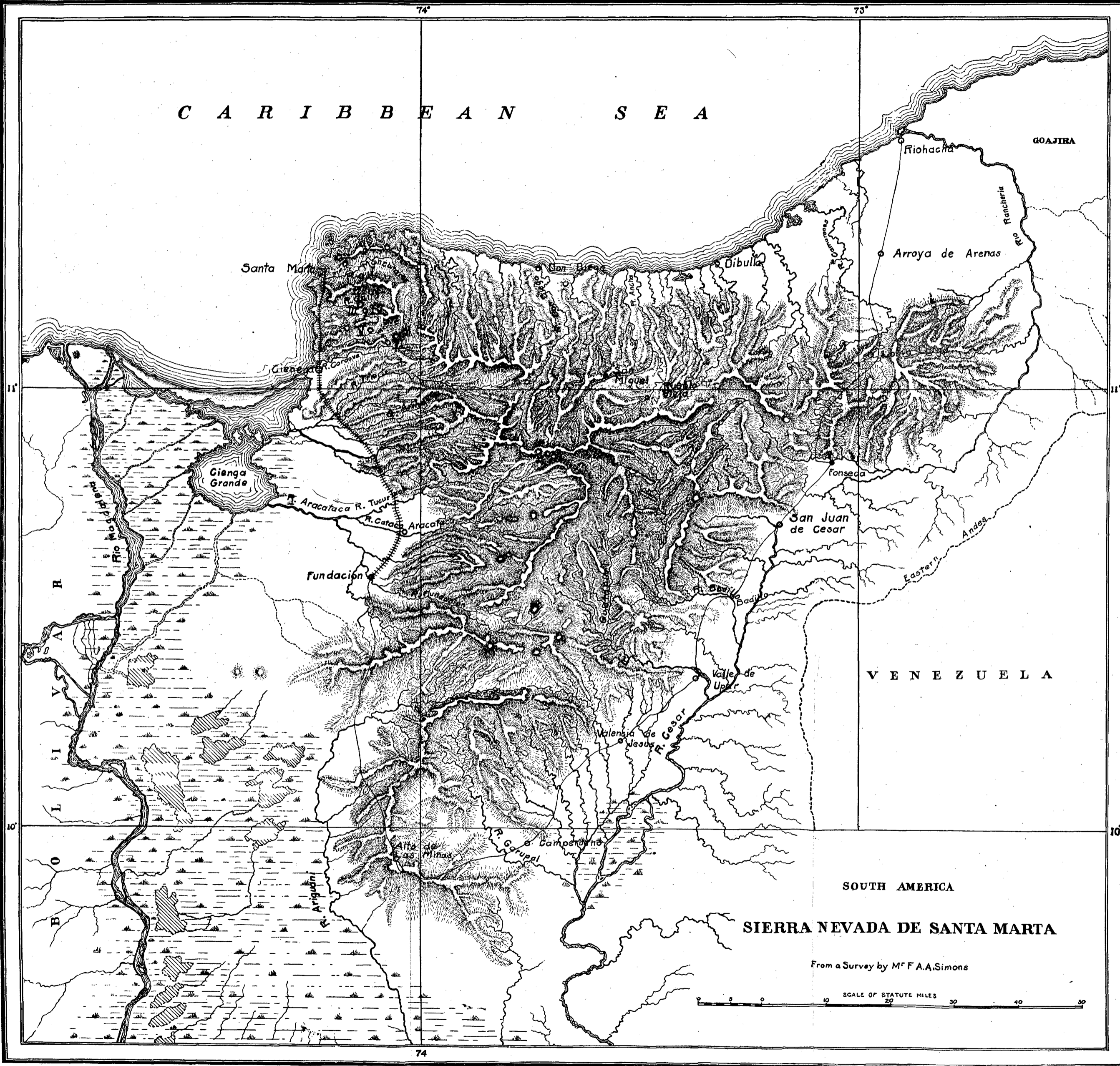
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4



5



C A R I B B E A N S E A

GOAJIRA

Santa Marta

Riohacha

Arroya de Arenas

S. Dibuja

Cienga Grande

Fonseda

San Juan de Cesar

Fundación

VENEZUELA

SOUTH AMERICA

SIERRA NEVADA DE SANTA MARTA

From a Survey by M. F. A. A. Simons

SCALE OF STATUTE MILES



74°

73°

11°

11°

10°

10°

74



