OPPORTUNITIES FOR BOTANICAL RESEARCH IN CENTRAL AMERICA

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It was my good fortune during the winter of 1922 to make a botanical expedition through Central America. I have no intention now of giving an account or travelogue of that expedition, yet, remote as my topic may seem, there are a few matters relative thereto which, I think, are of sufficient general interest to bring before this group of active scientific men and women. I should like furthermore to say at the outset that by opportunities for botanical research in Central America I do not mean opportunities offered by elaborately equipped and well manned laboratories in endowed institutions, nor do I have reference to special grants generously made by scientific organizations in Central America to encourage botanical research. These things, as you all know, do not exist in that country.

I do want to call your attention, however, to the fact that Central America itself offers exceptional opportunities for research in botany—first on the part of the systematist; second, the ecologist; third, the plant geographer; and fourth, the one interested in the development of economic plant products.

It is true that the flora of Mexico, Guatemala, Salvador, Costa Rica and the Canal Zone, through the labors of Gray, Watson, John Donell-Smith, Coulter, Robinson, Rose, Brandegee, Pittier, Maxon, Standley and others, has been studied somewhat intensively during the past 25 or 30 years, but that work has been more or less intermittent, the publications are fragmentary, and there exists today no complete or comprehensive published flora of these countries; and as a matter of fact a vast amount of work must still be done before an exhaustive flora of Mexico or the other countries mentioned is possible.

British Honduras, Honduras, Nicaragua, and the Republic of Panama have been explored but little and the flora as yet is but superficially known. Indeed, only a

few hundred specimens from these countries exist in American or European herbaria. To the taxonomist, therefore, the latter countries mentioned, particularly Nicaragua and Honduras, constitute an almost virgin field for exploration and research.

The natural conditions in Central America, namely, the geographical formations, the varied topography, precipitation, air currents, trade winds, temperature factors, etc., are such that the most pronounced changes in the character of the vegetation are evident in contiguous regions extending over relatively limited areas. Many of these regions present to the ecologist interesting and highly significant problems. This fact is shown conspicuously as one crosses the Republic of Costa Rica from east to west, namely, from Port Limon on the Caribbean Sea to Punta-Arenas on the Pacific.

An adequate description of this country in few words is beyond my ability to present. Briefly, however, the east coast is low, the rain fall is abundant, and the vegetation is tropical. Cartago and San José are located on an elevated plateau about 3000-3500 feet above sea level. At least three rivers have their origin on this plateau. To the north of San José and Cartago is the so-called Cordillera Central, consisting of several volcanic mountains, namely, Turrialba, Irazu, Barba, Poas, and others ranging in elevation from 8000 to almost 12000 feet above sea level. Immediately to the south of this plateau lies the southern Cordillera with enormous mountain masses, such as Buena Vista, Pic de la Vueltas, El Copey, and Cerro de la Muerte (the wall of death), almost as high as those peaks to the north.

The general course of both Cordilleras is northwest and southeast. The prevailing winds, at least during the winter months, come from the east or southeast; there is, therefore, an abundant precipitation on the eastern and southeastern slopes of both Cordilleras. The country to the west of these great mountain masses, namely, west of the continental divide, receives only a limited amount of rain fall, especially during the winter months, and the vegetation there is relatively sparse and presents a marked contrast with that in the eastern part of the

country. The change in the character of the vegetation is quite abrupt, and is noticeable especially between San José and Punta-Arenas. Chemical content in the soil here plays little or no role in the growth of plants; it is mainly a matter of moisture.

Permit me to mention another similar situation in Guatemala. In southeastern Guatemala is a region lying mainly along the Motagua River which is one of the most notable deserts in all Central America. On either side of the river is a range of mountains, off-shoots from the Sierra Madre; their general course is almost northeast and southwest, as is most of the mountain ranges which make up the great Honduras-Nicaragua peninsula. The prevailing winds here also are from the east or southeast, and the precipitation is confined mainly to the mountains east of the Motagua River or to the high slopes of the mountains to the northwest of the river. There is a very limited amount of precipitation in the valley, and the result is a typical cactus desert miles in extent, centering about the region of Zacapa and known locally as the Zacapa desert. Farther northeast and at lower altitudes in this same river valley where there is little to obstruct the moist-laden trade winds, namely, in the vicinity of Puerto Barrios, there is one of the most luxuriant tropical palm-vegetations to be found anywhere in Central America. These may seem to be very simple matters in ecology. They are; but they are significant nevertheless, not only in determining the character of vegetation on local areas but also in determining the distribution of vegetation in the American tropics. A particular opportunity, however, to which I should like to call the attention of the ecologists is that of a study of plant succession in volcanic craters. For example, there are on Mount Poas in Costa Rica several volcanic craters representing eruptions which have taken place at different times, and each crater has, more or less, its distinctive flora in accordance with its relative age.

What now are the specific opportunities in Central America for the plant geographer? No one can say at present with any degree of certainty how far the Andean flora of South America extends into Central America,

or to what extent the reverse migration has taken place. In other words, our knowledge of the flora of these two countries is not yet sufficient to enable any one to say what floral elements are common to the two countries or what the proportion of occurrence of floral elements in one country is to that of the other. Presumably there has been a northward trend of tropical vegetation since the glacial period. In this connection it may be of interest to site a few cases of specific plant distribution.

In Colombia one of the most common types of vegetation is to be found on the paramo or dry ridges. This type of growth consists largely of Compositae of a shrubby or suffruticose habit; and it includes several species of *Eupatorium* and *Senecio*. One of the common plants of the paramo of Colombia is *Senecio vaccinioides* Wedd. Curiously enough either the same thing or a very closely related species, described as *Senecio firmipes* Greenm., occurs on the Vueltas and on the Cerro de la Muerte of the southern Cordillera in Costa Rica at an altitude of 3100 meters or about 10000 feet. Only two stations are known for this plant in Costa Rica, and it has never been reported from Panama. The *Senecio vaccinioides* is very common in Colombia and whether the two things are conspecific or not, it is fair to assume that the Costa Rican form has descended from the South American type, and probably represents a northern migration which has taken place since the glacial times. Certain other natural groups of *Senecio,* consisting of several little known trailing or climbing species, are represented both in South America and Central America. The affinities or relationships of these species are such as to show clearly a South American origin; and the present distribution of these species is such as to indicate a northern migration from the Andean region of Ecuador and Colombia into Central America. In at least one instance this northward migration has extended to that great elevated mountain region of Orizaba in Southern Mexico. In most cases, however, these plants do not occur north of the Southern Cordilleras in Costa Rica.

May I mention one more specific example? I found growing, and apparently indigenous, on the great moun-

tain mass known as Mount Poas in Costa Rica, a species of *Solanum* which is conspecific with the South American *Solanum tuberosum L.* from which our common Irish potato has been derived. It would seem that we have here also a case of northern migration of an Andean species. Further investigations along these lines would unquestionably yield interesting and valuable results in determining the relation of our Central American flora to that of Andean South America; and a most profitable region for investigation in plant distribution is that of these great east and west ranges of Costa Rica, Nicaragua, and Honduras.

It is, of course, well known that Central America for many years, mainly through corporation interests, has been a source of supply for certain staple food and other economic plant products, particularly bananas, coffee, dye woods, fibers, etc. The natural resources, however, have been barely touched; but as a matter of fact the possibilities for development and increase of out-put of these and similar products are more promising today than ever before. There are already limited facilities for botanical research at the laboratory in connection with the hospital at Ancon in the Canal Zone, and certain research work is there under way. There is also a small government station at Frijoles in the Canal Zone where certain experimental work on tropical fruits is being conducted under the direction of Doctor David Fairchild. The various corporations, like the United Fruit Company, employ their own specialists to take care of their special botanical problems. Furthermore, as you doubtless know, a movement is under way to establish somewhere in the American tropics a station where it will be possible to carry on various lines of botanical activity. Transportation facilities between the different Central American countries are being extended by the Ferro Nacional or National Railway. Indeed, one can now travel by rail all the way from any railway point in the United States to Guatemala City, and it will be only a short time before that railway system will be extended through Salvador; and eventually it will be continued to the Canal Zone. Railways and roadways are being built

in Honduras and Salvador which will open up the interior of those countries.

Recently a chemical manufacturer in Chicago said to me, "We import hundreds of tons of plant materials from India, China, Ceylon, etc., from which we make oils, perfumes, soaps, et cetera. Why can't we get these raw products from Central America?" Many of them could be obtained there and in the West Indies also if we only had a better knowledge of the flora and conditions of those countries and could develop their natural resources. The United States must turn to the American tropics not only for an increased supply of fruit products, but also for an increased supply of varied raw plant products. The rapidly expanding commercial relations between the United States, Central America, and South America render the present time most opportune to enter the tropics of Central America for more intensive botanical research.