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ON SOME DISTRIBUTION FACTORS IN THE SIERRA MAESTRA, CUBA

By Norman Taylor

Botanical collecting in the tropics constantly reminds one of the difficulty of forming any real idea of the factors that govern the distribution of plants.

In a survey of the mountains west of Santiago, Cuba, many plants of very curious distribution were met with. To travel for four weeks over a somewhat restricted but heterogeneous country and find only a single individual of *Amyris elemifera*, and also single specimens of *Calophyllum Calaba*, of a certain *Oncidium*, and of an unnamed *Euphorbia*, makes one wonder what are the factors that govern such sporadic occurrences. And these are not the only species that have apparently only individual representation, for here and there throughout the various habitats visited we came across trees, shrubs and even some herbaceous plants that were never seen again. This remarkable feature of tropical forests has often been noted before,* but no reasonable explanation is forthcoming.

Besides this occurrence of lone individuals, we find also what might be called "species centers." † That is, some species would be found in a very restricted area, and then either not be seen again, or else found in some distant but ecologically related habitat. Only a very few plants were observed in this state, which after all may be more a matter of coincidence or accidental dispersion than any well-defined system of distribution. The most noticeable of the species having these apparent distri-

* Warming, E. On the Vegetation of Tropical America. Bot. Gaz. 27 : 2. 1899.

† Kurz, S. Report on the Vegetation of the Andaman Islands, 16. 1870.

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bution centers is *Peperomia maculosa*. It was first seen growing under the shade of *Pinus occidentalis*, on a mountain slope that except for this *Peperomia* might be considered edaphically xerophytic. Not until our descent from the ridge of the Maestra did we find it again, when a fair representation was seen in an almost identical situation and at approximately the same altitude. Its absence on a number of such mountains that we visited, and its occurrence on these particular two, would seem to conform to no well-known law of distribution.

The method employed by the forestry expert in getting an idea of the timber value of an area is perhaps the best possible way to gather data on the tree distribution. From a study of these notes and figures,* we came to know the frequency of occurrence and characteristic habitat of the commercially more important trees. But the number of exceptions, and the lawlessness of the occurrence of the monotypic species, together with the equally inexplicable "species centers" make it dangerous to draw any conclusions. Indeed it is practically impossible to form any law that can reasonably account for the distribution of even a small number of the species in this region.

Although it is very difficult, perhaps impracticable, to get any real idea of the distribution of the species, it is quite possible to get some notion of the factors that govern the occurrence of the various plant associations. From topographic and climatic conditions that have been elsewhere more fully described,† we have in these mountains two well-defined ecological areas: the country lying on the southern slope, which is mostly dry, and the country on the northern slope and ridge. The latter is the windward side of the range and the strong Northeast Trade deposits most of its moisture here, leaving very little for the leeward and drier southern exposure. This has, of course, an obvious effect on the vegetation, and by this is meant not so much the diversity in the species, although this is great, as the marked difference existing in the general vegetative or floristic character of these contrasted situations.

* Fernow, B. E. The High Maestra. Forestry Quarterly 4 : 250. 1906.

† Fernow, B. E. *Loc. cit.* 239; Taylor, N. Collecting in the Mountains west of Santiago, Cuba. Jour. N. Y. Bot. Garden 7 : 256. N 1906.

Taking first the region within the lee of the Maestra, we have two main factors that must be taken into account in any attempt to understand the regional distribution of the plant groups; and these are the practical stability of the temperature and rainfall, and the great instability and inequality of available surface- or drainage-water. With these in mind we may enumerate several variations in the plant associations that are directly traceable to one or both of these factors. Other factors, such as soil, which throughout the region is a decomposition of the native granite, and light, which does not vary enough to make much difference, may for the time be ignored. There seems little doubt that both of these agencies are equally potent in all situations, and are not therefore violent causes of variation. On this southern exposure the three following characteristic areas may be enumerated:

Slopes and Ridges

These are covered with a dense growth of trees. The actual number of species is not very great but the number of individuals is enormous. In the expedition some hundred and fifty species were noted, and, allowing for others that were overlooked, this vast tract is covered almost exclusively with this arboreal vegetation. The number of individuals of the lower shrubs and herbaceous plants is not accurately determinable, but it is very small, so small that it can be almost truly said that these slopes and ridges are without undergrowth. An appended list of the collections from one such slope will give some idea of these conditions:

Litobrochia denticulata
Oplismenus hirtellus
Arthrostylidium capillifolium
Pharus latifolius
Tillandsia fasciculata
Renealmia occidentalis
Vanilla phaeantha
Cecropia sp.
Pisonia aculeata
Oxandra virgata
Pithecolobium arboreum
Lysiloma Sabicu
Lonchocarpus sericeus
Bursera Simaruba
Swietenia Mahagoni
Cedrela odorata
Drypetes lateriflora
Spondias lutea
Carpodiptera cubensis
Calyptranthes sp.

The list is necessarily incomplete, but it will serve to show the preponderance of tree species. The greatest number of individuals is found in *Calyptranthes* and *Oxandra*, with certainly other arboreal species coming very close to them. The lack of undergrowth is very marked, and throughout the forest one finds an unbroken succession of ridges and slopes carpeted with little but a covering of dried leaves. The grasses *Arthrostylidium capillifolium*, *Oplismenus hirtellus* and *Pharus latifolius* are the most common herbaceous species, and these with *Renealmia occidentalis* are about the only ones that are frequent enough to be noticed.

The lack of undergrowth is due almost solely to the want of available surface- or drainage-water. There is practically no humus, for the reason that the conditions that will produce it are wanting. We have therefore a dry, almost arid, but well-wooded formation that is devoid of under-vegetation.

Cañons

The gorges are as profusely covered as the adjoining forest-floor is bare and naked. A list prepared from the collections in a typical cañon will give some idea of the species likely to occur in such places:

Helicophyllum sp.
Campyloneurum angustifolium
" *Phyllitidis*
" *latum*
Ceropteris calomelaena
Asplenium pumilum
Doryopteris pedata
Dryopteris sp.
Polypodium Plumula
" *polypodioides*
Anthurium sp.
Philodendron lacerum
Renealmia occidentalis
Epidendrum cochleatum
Pleurothallis Wilsoni
Oncidium sp.
Peperomia rotundifolia
" *acuminata*
" *scandens*
Peperomia obtusifolia
Boehmeria littoralis
Pilea nudicaulis
" *microphylla*
" sp.
Rajania hastata
Drymaria sp.
Picramnia pentandra
Pavonia Typhalaea
Marcgravia sp.
Gilibertia arborea

Wallenia laurifolia
Asclepias nivea
Solanum triste
Hamelia lutea
Psychotria lasiophthalma
Psychotria sp.
Chiococca parvifolia
Diapedium assurgens
Lobelia sp.
Adenostemma Berterii

But no mere list can give one the least idea of the vegetal wealth and beauty of one of these gorges, and they are all the more striking in contrast with the arid slopes through which they have cut their way. With vines festooned among the trees and shrubs and almost all the trees covered with epiphytes the scene is most beautiful.

These gorges are a fine example of the action of an edaphic factor as a determinant in the plant-covering of a restricted area. The climatic and primary soil conditions are practically identical in the cañons and the slopes. But the water that is at the bottom of all these gorges is almost the sole factor in producing such profusion on the one hand, and the lack of water is certainly the chief cause of such scarcity on the other. The moisture and consequent decomposition of successive generations of herbaceous plants make a rich, damp compost, and we therefore find here a profusion of plants in striking contrast to the poverty of the ridges and slopes.

River Bottoms and Deltas

The sterility of most of the river bottoms, particularly where they spread out to form the delta, is a very marked feature of this region.* With the exception of species of *Plumiera* and a few other tree species, these areas are without arboreal vegetation. A rather rank growth of somewhat xerophytic shrubs and weeds gives the whole river bottom a characteristic appearance not unlike a typical "scrub" of the Bahamas. The line of demarcation between these sterile areas and the well-wooded hills that rise abruptly on both sides is very sharp; and it is quite as much the sudden change as the sterility that will strike the collector. This sterility is caused by the floods that annually wash

* Taylor, N. Botanical Notes on the Vegetation of the High Maestra. Forestry Quarterly 4: 270. 1906.

out the available soil, so that little is left to support a heavier vegetation.

Practically the whole southern slope may be roughly divided into these three areas, the first, of course, being much the largest. And all these are in a great measure controlled by the presence or absence of available surface water. It is, in short, to this edaphic factor that we must turn for an explanation of the barrenness of the slopes, the profusion of the cañons, and the sterility of the river bottoms. With soil, light, and climatic conditions so even throughout this great southern exposure, there is only this instability and inequality of terrestrial water sources that can account for the marked diversities existing among these three types.

It is unnecessary to discuss the strand and littoral, as they are much the same throughout the West Indies and have little to do with the problem of the general or regional distribution of the plants of this area.

Turning now to the windward or northern slope and the ridge of the Maestra, we have entirely different conditions prevailing. Here the northeastern trade-wind keeps the country continually bathed in great quantities of moisture, and the precipitation is heavy. From this constant equality of moisture supply and an almost similar equality of temperature this ridge is an ideal environment for moisture-loving plants of all kinds.

The vegetation forcibly reminds one of the lowland cañons, but it is much more dense; so much more so that without cutting a path it is impossible to scramble through. Many plants occur here that we had never seen at the lower elevations, but the number of species is so great and the time spent here so short, that any list based on the present collections would give no adequate idea of the richness and variety of the flora. Filmy-ferns, tree-ferns, epiphytic orchids and bromeliads, hepatics and mosses, together with many Peperomias, seem to predominate, but the whole effect is one of bewildering complexity and density. The vegetation is evenly distributed at all the points that we visited on the ridge and windward slope, but the line of demarcation in this belt is clearly seen when one begins the descent to the sea, thus leaving the region that comes under the influence of the trade-wind.

It would seem, then, from the foregoing, that in the distribution of the plant groups in this great mountain range, we have not, primarily, a problem of altitude. For the altitude *per se* can scarcely be of much importance as a determinant, for by it no greatly changed conditions of atmospheric pressure are reached, our greatest elevation being nowhere more than three thousand six hundred feet. It is cooler, however, at the ridge than at the coast and this may have some effect on the precipitation, and, secondarily, of course, on the plants.

But the Maestra rises more or less abruptly from the level part of Cuba, and furnishes a great barrier of from three to eight thousand feet in height and about sixty miles long. Its altitude thus at once becomes the all-important factor in regulating the amount of rainfall that gets over to the leeward side of the range. This action of the ridge in monopolizing the better part of the moisture from the trade-wind is responsible for the comparative dryness of the whole southern exposure. The division of the area into regions coming under the influence of this wind and those lacking it, is, therefore, not such an arbitrary proceeding as one might suppose who had not seen this marked example of the importance of the rainfall in determining the general characteristics of any given area. In the variation of the plant associations cited under the discussion of the southern slope other factors must be taken into consideration. But these are almost wholly local in their effect and are not therefore comparable to a factor of the scope and importance of this trade-wind.

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A NEW BLACKBERRY FROM THE VICINITY OF PHILADELPHIA AND WASHINGTON

By William H. Blanchard

The blackberries in the vicinity of Philadelphia and Washington were studied by the writer in July, 1906. The species found are not numerous. *Rubus hispidus* L. and *R. cuneifolius* Pursh occur, but are not common generally, though *R. cuneifolius* is