

SOME INTERESTING MEDICINAL PLANTS OF BOLIVIA.

BY H. H. RUSBY.

The botanical work of the Mulford Biological Exploration of 1921-22 was directed especially toward the investigation of medicinal plants, the results of which will be published from time to time, as the studies are completed. Although most of our information regarding the native uses of these plants will prove of historical interest only, a number of the subjects possess practical importance. Among these are the botanical and geographical sources of the Coto and Coccilana barks and their commercial substitutes, which form the subject of the present contribution.

My acquaintance with coto bark began in the early eighties, when my employers, Messrs. Parke, Davis & Company, listed fluidextracts of both coto and paracoto. Mr. H. A. Wetzel, our superintendent, one day brought me samples of each of these barks with instructions to investigate carefully and decide to which the respective names properly belonged. He informed me at the time that the name "paracoto" had been coined arbitrarily, for the sole purpose of distinguishing a bark that had been found in commerce under the name coto, but which was obviously distinct from, though closely similar to the real article. This statement I verified in the course of my investigations, and it is noted here in criticism of the statement that has found its way into print to the effect that the name "paracoto" was assigned because its bark is produced in the region of Para, in northeastern Brazil, an assumption that is wholly erroneous.

At the time referred to, both coto and paracoto barks were readily obtainable in our market, being imported, always, so far as I know, from Germany. All that was known of their geographical origin was comprised in the general statement that they were collected in Bolivia. On my first journey to South America, in 1885, one of my objects was to determine the exact place of production of these barks.

Nothing whatever was known as to the botanical origin of either, except that their structure, composition and properties rendered it practically certain that they belonged to the family *Lauraceae*. I was, of course, interested in solving this problem, also.

It so chanced that the nearest that I came to the coto region on that expedition was distant a good hard four or five days' journey, and I did not know this until after I had passed by, so I lost even this slim opportunity.

While in La Paz, and before starting overland, I had been presented by a Jesuit priest with a leaf and a fruit which he claimed belonged to the coto tree. This specimen I mailed to Detroit, without, as I now recall, any information concerning it. Mr. Wetzel sent it to a German university for botanical determination. They replied that the species was unknown in Germany, and could not be determined without flowers, but they suspected that it was the source of coto bark. Now that I have specimens of the coto tree, I know this supposition to be incorrect, for the leaf in question was nearly a foot long, lanceolate, and of very thick heavy texture. The fruit was like a very large, elongated acorn, much larger and more slender than those shown here as belonging to the coto tree. I have no doubt that it was a species of *Nectandra*, and I think very likely it came from the paracoto tree.

Upon my return from South America in 1887, I found the market full of spurious coto bark. Both coto and paracoto could still be obtained, but were evidently from old stock, as neither of genuine character appeared to be imported at the time. This scarcity increased until, about the beginning of the present century, it became impossible to obtain any genuine coto, though there was still some paracoto to be had. Both barks, however, must have been going to Germany, as cotoin and paracotoin were always obtainable there. I believe that Gehe & Co. were the sole importers. Between 1900 and 1920, I never saw a pound of genuine coto or paracoto imported into or for sale in the New York market. I was, however, able to obtain samples of both from Messrs. Merck & Company, in Darmstadt. In the meantime, barks purporting to be coto and paracoto, but wholly spurious, were freely sold here, and various manufacturers were offering spurious fluidextracts from them. During my examination of drugs in the Bureau of Chemistry, I rejected many importations of these spurious barks, but never saw any that was genuine, and I collected a variety of substitutes. Most of these appeared to belong to the family *Lauraceae*, but one was quite clearly far removed from this family. In the year 1920, or 1919, I received from Messrs. Denniston & Company, of La Paz and New York, a sample of genuine coto, representing a small shipment that they had for sale. I at once called at their New York office and explained the importance of scientific information regarding this tree, and asked for help in securing it. They communicated with Mr. Denniston, who was in La Paz, and secured his promise of full assistance. The finding of this tree thus became one of the prime objects of my recent travels. I visited and was entertained by Mr. Denniston while in La Paz, and my route of travel was selected partly with a view to securing information regarding coto. He gave me letters to Sr. Mostaja, of Huachi, at the head of the Beni River, whose Indians had been collectors of this drug. On arriving at Huachi, we were given excellent living quarters by Sr. Mostaja, and remained there for some time. Being in poor health, and quite unable to undertake any journeys requiring severe physical exertion, I was most fortunate in having so energetic and faithful a botanical associate as Dr. O. E. White, of the Brooklyn Botanic Garden. To him I assigned this work and explained carefully and impressively the nature of the collections and observations that were required. He made a difficult journey of several days, incurring great labor and considerable hardship, led by Indian guides, to the mountains south of Huachi, where he collected several barks and branchlets of the trees from which barks have been collected for commercial purposes under the name of coto. One of these, there known as "Coto Piquante" or "Coto Fino," appears to be the genuine coto. The others, both there known as "Coto Ordinario," are among the spurious barks that have been offered repeatedly in the United States as coto and paracoto. The real paracoto was not found, although I thought for a time that I had done so. On exhibiting Dr. White's samples to Sr. Mostaja, he expressed the opinion that we had not yet secured the real coto, and at once sent his Indians to procure it. The journey required nearly a week and his men were apparently not very faithful, for they had not returned at the time that we were obliged to leave. Conjecture as to the identity of this fourth species is scarcely profitable, but it is not improbable that it will prove to be paracoto, and I am rather expecting it to be the same that was given me by the priest in 1885.

It must be noted here that there are some indications that Sr. Mostaja is correct in believing that we have not yet received specimens of the original coto tree. Our bark is somewhat softer and more fibrous than the original and it contains two alkaloids never reported previously. On the other hand, Dr. Schneider, who is very familiar with the histology of these barks, reports the structure of this as agreeing with coto, although the cell contents differ somewhat. Moreover, there is an abundance of cotoin and its derivative in our bark. On the whole, I conclude that our bark is a form of the genuine article, and note that it is not impossible that we shall find a group of related species, comparable with that of the cinchonas. It is important to note here that the medicinal repute of coto could not fail to suffer severely as a result of the extensive use of spurious barks, extending over nearly half a century.

The study of these three specimens has been very difficult and the decisions are not free from doubt. None of them possesses flowers. Two possess fruits and very young flower-buds on the leafy twigs, while the third has leaves only. Ordinarily, the taxonomist familiar with a given family is able to refer specimens with some degree of confidence to their respective genera, on their habit and the general characters of foliage and fruit, but such is not the case with the members of the laurel family. There is a close similarity among the genera in both leaves and fruits and such differences as exist are apt to maintain among the species within a genus. Flower-dissection thus becomes a necessity. These facts apply with special force to the two genera *Nectandra* and *Ocotea*, to which the species here discussed appear to pertain. There is no single character by which a species of one genus can be distinguished from the other. This can be done only through a combination of characters, some of which belong to the flowers. Those of *Ocotea* are usually, but not always, unisexual, while those of *Nectandra* are usually, but not always, perfect. It might be assumed that even young buds could furnish clues to this structure, but the unisexual flowers of *Ocotea* retain more or less pronounced vestiges of the effete organs.

The perigone of *Nectandra* is tomentose, while that of *Ocotea* is usually glabrous. By these and other indications, I feel quite sure that the coto plant is a *Nectandra*, while one of the spurious species is an *Ocotea*. The other spurious one, represented by leaves only, I do not attempt to name. Its leaves are so closely similar to those of an undescribed species of *Acrodiclidium* collected on this exploration that for a time I thought they might be identical. Yet it is not at all likely that these leaves belong to that genus, and I am quite sure that the plant is a *Nectandra*.

With an admission of some slight doubt, therefore, I name the coto plant *Nectandra Coto*, and the spurious one with fruit, *Ocotea pseudo-coto*. These names, with descriptions, will appear in the September number of *The Bulletin of the Torrey Botanical Club*.

Dr. White has submitted the following interesting report of his discovery of these trees.

"About noon we reached our camping place, and a short distance down the slopes we found the coto trees—great, tall giants, with cinnamon-colored bark—that towered above the palms and tree ferns. The sky was cloudy, rain was close at hand, and the forest itself gave the impression that showers were a daily occurrence here. At the beginning of a trough-like valley, the ground

carpeted knee-deep in ferns and soft wringing-wet moss, these laurels, that we had come so far to see, the bark of which furnishes such valuable aids to humanity in the far-away civilized countries, produced upon me something of the same effect as though I had come to see one of the brilliant men of the world with whose books I had long been acquainted. The Indians went before us, and as we looked about in the gloomy forest—for the sky was cloudy, and a storm was approaching, and the woods were really deep in gloom—one of the Indians yelled out: "Hay aqui, señor, arto!" (Here they are, sir, in a plenty) and pointed to a group of trees from 60 to 80 feet high, large of trunk, with comparatively few branches at the top, and these mutilated by the winds and storms and other processes of time. We proceeded to cut down one of the trees which the Indians assured me, after tasting and smelling, was *Coto piquante*. While the Indians were chopping down this tree, we searched the forest for other specimens and for types of the spurious cotos. As soon as the tree was felled, we examined its top and collected the leather-like leaves, but found only inflorescences full of buds, which was very disappointing. We searched the ground around the trees for fruits, but found none, upon which we went further down the valley, scattered out, in order to find a tree in fruit or flower. Fortunately, about a quarter of a mile away, upon a steep bank, we came across another such giant, with many fruits upon the ground underneath, and some of these were fresh. I tried to get the Indians to cut this tree down, but since they have, from time immemorial, appreciated the value of coto bark as a remedy for certain of their own disorders, they showed great reluctance to do my bidding, and at last refused, explaining to me that it had taken ages to produce such a tree and that it was very valuable to them, both for its bark in their sicknesses, and for purposes of barter. I finally prevailed upon one of them to climb it, and after much effort he reached a point in its top from which he secured numerous specimens of fruits and leaves. The fruits, as we found them, recalled to mind the acorns, with brownish cups and green acorn-like fruits with whitish speckles. There appeared to be two sizes of fruit, indicating perhaps that more than one season was required for maturing the fruit, the smaller specimens representing fruit of the current season. However, this is only speculation.

"The tree which we cut down was 33 inches in circumference, six feet from the base. The bark was thin and brownish, aromatic, very *piquante*, biting the tongue like cloves after it had been in the mouth for a half-minute or so. The bark adhered closely to the wood and was rather difficult to remove. The wood was yellow and stinky, with an aromatic odor that suggested sandal wood. After the bark was removed, the wood exposed to the air turned a reddish brown. This tree had no branches up to about 50 feet, and then very few. The second tree, marked on our specimens *Coto la*, from which we secured all the fruiting specimens, was 3 feet and 9 inches in circumference at about 5 feet above the ground. This tree was from 50 to 60 feet high.

"One of the peculiar facts about the coto forest was the apparent lack of young trees. Even under the trees or in the vicinity where fruit was plentiful, we were unable to find any young specimens. Perhaps this was because we were unable to recognize them, but the Indians were just as much in the dark in regard to this as we were.

"The cinnamon-colored bark of these two *Coto piquante* trees was indistinguishable as far as gross features were concerned, from *Coto ordinario*. At first the Indians showed us what evidently is a spurious coto for *Coto ordinario*, and this, in our specimens, is labelled *Coto 2*. The bark of this is very thick, brownish as in *Coto 1* and *Coto 1-a*, but peels from the wood surface very easily. The wood of this spurious coto is light yellow or almost white when the bark is removed, and exposure to air did not turn it brown. There is no satiny luster and as it dries it turns reddish white, and as the heart is approached, the wood becomes of a deeper red, while the heart-wood of *C. piquante* is licorice-root yellow. The two species are of about the same height and occur in the same association, often side by side. The leaves of this spurious type are smaller and differ in many small characteristics from those of *Coto 1* or *Coto 1-a*, especially in the coloring of the under side. In *C. piquante*, the leaves are lighter green to almost whitish green on the under side, while those of *Coto 2* or the spurious coto are dark green. The young twigs of *C. piquante* have brownish cinnamon-colored scurf, while on the young twigs of the spurious coto the outer covering is inconspicuously scurfy green. Flower buds of both had reached about the same stage of maturity. The bark of *Coto 2* is not particularly aromatic even when fresh, and not at all so when dry. Specimens of the wood of both the spurious coto and the *C. piquante* were obtained.

"Later, the Indians decided that a tree from which we had obtained leaf specimens, and which are marked *Coto 3*, was the real *Coto ordinario*, and this is the conclusion we ourselves came

to as the barks of *C. piquante* and *C. ordinario* (or *Coto 3*) are very similar, both being aromatic, but that of *Coto 3* is not in the least piquante. The wood of *Coto 3* is yellow, like that *Coto 1* and *Coto 1-a*. We obtained no fruits from *Coto 3*, but the Indians say the fruits are the same, and I found one or two under the tree that indicated this. The height of *Coto 3* is very similar to the others.

"As the specimens stand then, *Coto 1* and *Coto 1-a* are *Coto piquante*, most of the bark being obtained from *Coto 1*, and all the fruiting specimens were obtained from *Coto 1-a*, with a small specimen of bark. *Coto 2* is a spurious coto, while *Coto 3* is *Coto ordinario*, bark being obtained from both these latter, and wood specimens from *Coto 2*. Wood specimens of *C. piquante* were also obtained from another specimen of this tree that had somewhat seasoned, having been chopped down by the Indians on former expeditions. All three types of trees are characteristic of the wet, rain-forest region on the north slope of these hog-back ridges, and even in this region they are not particularly plentiful. They are all near the top of the ridge which runs east and west, the ridge itself being roughly a thousand feet higher than the Mission, possibly 2500 to 3000 feet elevation above the sea. The rain-forest association occurs only on the north side and at the top of the high ridge. It consists of many palm species, trees, ground, and climbing ferns, mosses upon the ground and upon the tree trunks. Orchids and bromeliads are common epiphytes on the trees, and many of the ferns here are epiphytic. The woods are full of fallen leaves."

Cocillana or Guapi Bark and Its Substitutes.

The history of cocillana as a drug is largely a history of my own work in connection with it. Its facts have been published but may be recapitulated here.

Early in the year 1886, while on the upper slopes of the eastern Andes of Bolivia, I received reports of the aboriginal use of a powerful enetico-cathartic drug that was poisonous in overdoses. It was named to me as cocillana, but I have since come to know that this name was quite erroneous and not applied to the drug outside of the locality where I first learned of it. At another place I was told that it was called Upas and that people might be killed by sleeping under its shade. This was obviously a mere ignorant confusion with the oriental upas, and has been entirely ignored. After introducing the drug to use in the United States, and when engaged in securing further supplies, I learned that it was known generally in the region of its use under the name Guapi or Huapi, and on my last journey, I found it generally known farther to the eastward as Trompillo. The latter name has never appeared commercially, nor has the name Cocillana, except through the original error. The drug is commonly known, both in Bolivia and in importations here, only as Guapi, and this name should be substituted for that of cocillana in medical literature, with the latter name as a synonym.

The first specimens of the tree that I actually encountered were found in Guanai, a village on the Mapiri River. It is a matter of great historical and practical importance that the herbarium specimens of the tree, from which the species was named and described, and the bark that was originally used in medicine and on which the medicinal properties of the drug have been established, came from the self-same tree. Since these original specimens, both of bark and herbarium material, are preserved at the New York College of Pharmacy and at the New York Botanical Garden, we have an absolute means of authentication in the case of this drug that is very rare, if not quite unique in materia medica.

The herbarium specimens were originally studied by Dr. N. L. Britton, who regarded them as representing a new genus, which he described under the name *Sycocarpus*, with which he associated my name as discoverer, calling the plant *S. Rusbyi*. In my subsequent studies, I found that the tree belongs to the genus

Guarea and, in conformity with the rules of nomenclature, transferred the specific name, so that the proper name of the plant becomes *G. Rusbyi* (Britton) Rusby. The parenthetical name should not be omitted, since otherwise it would indicate that I had applied my own name to a species, an obviously improper procedure.

For some years, all the cocillana bark used in this country and in Europe was obtained by my own collectors and imported by myself, and all lots were known to me to be of the same kind and quality as the original. I continued the importation of this bark for some years. About the year 1908, the first shipment of spurious bark made its appearance here, and was rejected by myself as pharmacognosist at the New York Laboratory of the Bureau of Chemistry. I at once sought information regarding the botanical source of this article, and received from Mr. Miguel Bang, my Bolivian collector, some fruits and leaf fragments of the tree yielding it. This proved to be another species of *Guarea* and, having satisfied myself that it was undescribed, I proposed for it the name *G. Bangii*, in commemoration of its discoverer. The specimen was so fragmentary that a good description could not be drawn from it, so that publication was withheld. This species is represented in the collections made on my recent trip, so that I have now published the name and described the species. These specimens are here exhibited as "Guapi B." Here, again, the bark and herbarium material have been taken from the self-same tree.

Up to the present time, I have never seen any other bark offered in commerce under the name of Guapi or Cocillana except this one and the genuine, but I have found on my recent journey two other species of *Guarea*, besides a tree belonging to the *Lauraceae*, growing in the Guapi-collecting region, and all there known as Guapi or Trompillo. It is apparent, therefore, that bark from any or all of these is liable to make its appearance in market as guapi and cocillana. I therefore collected barks and herbarium specimens of all of them for purposes of description. Bark specimens of another species of *Guarea* were also collected but were lost in transit. From the herbarium specimens of this species I have determined that it is known to science and it has been described as a new species.

We have thus to consider four bark specimens, accompanied by herbarium material, as follows:

Guapi or Cocillana "A," the original and genuine article, from *G. Rusbyi*.

Guapi or Cocillana "B," the spurious article that has occurred in commerce from *G. Bangii*.

Guapi or Cocillana "C," also spurious, pertaining to a large tree of the laurel family, almost undoubtedly a species of *Nectandra*.

Guapi or Cocillana "D," also spurious, and pertaining to a species of *Guarea* which cannot be determined, as it is without either flowers or fruit.

In addition to these we have a fifth species, represented by good herbarium material, but no bark, which I have described under the name *Guarea alba-rosea*.

In the extreme eastern part of Bolivia, I found an interesting species of *Guarea*, planted as a handsome shade tree along a street. Specimens were secured and are here shown.* It is probably undescribed, but I have not had time to complete my search. Should its bark ever enter commerce, it might prove quite troublesome, since its appearance on the tree is closely similar to that of the genuine Guapi.

* Scientific Section meeting, A. Ph. A., Cleveland, Ohio.

The genus *Guarea* comprises about one hundred species, distributed throughout tropical America. The plants are either shrubs or trees, some of the latter attaining the size of a large apple tree. The leaves are equally pinnate, with a bud at the top of the rachis, between the last pair of leaflets, and are usually large. The number of leaflets is rather constant within the species, rarely varying by more than one or two pairs. In size and form the leaflets are very variable, so that these characters are of little service in determining the species, unless we have a long series of specimens for examination. Neither are the fruit characters very useful for specific distinction, in most cases, as they vary greatly in size with maturity, and the form varies considerably with the stage of development. When young, they are fig-shaped or pear-shaped. Occasionally they retain this form, but usually become nearly spherical as they mature. It is thus in the flower characters that we must look for our constant marks of specific distinction, and dissection is necessary in determining them. The filaments of the stamens are coherent into a cup or tube and the anthers are concealed within this tube and below its margin, which may be either truncate or crenate. It is probably from this stamen tube that the natives have derived their local name "trompillo," meaning "a little trumpet." It is the variation in the shape and size of this cup and the character of its margin and the place of location of the anthers, with their form and size and method of attachment, which gives us our best characters for specific distinction. Good characters are also found in the size and form of the anthers and in their attachment, and in the form of the calyx and its relation as to size and shape with the corolla. Moreover, the calyx and corolla are valvate in some species, imbricate in others. The shape, size and character of the ovary and style are also quite characteristic.

HISTOLOGY OF COCILLANA AND SUBSTITUTE BARKS.

BY C. W. BALLARD.

Commercial supplies of cocillana have been frequently adulterated not only with allied barks from non-official species of *Guarea* but also with various foreign barks. The botanical identity of these substitutes has been more or less in doubt and is one of the problems which has been partially solved by the Mulford Expedition. The four samples described in this monograph were furnished by Dr. H. H. Rusby and were collected by him during his travels in the Amazon region while in charge of the exploration. The material includes specimens of genuine cocillana (*Guarea Rusbyi*) and three substitute barks, namely—*Guarea Bangii*, an unidentified *Guarea* and a species of *Nectandra*. *Guarea Bangii* resembles true cocillana more closely than the other two substitutes but the differences between it and the genuine article are sufficiently great to render its identification a simple matter. The other substitutes differ greatly from cocillana in appearance and physical characters.

GENERAL DESCRIPTIONS.

Cocillana (Guarea Rusbyi).—This bark occurs as flattened and slightly curved fragments more or less mixed with thinner strips of wood. The fragments range in width up to 80 millimeters and in length up to 250 millimeters. The thickness