TERTIARY FOSSIL PLANTS FROM VENEZUELA.

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The collection which forms the basis for the present contribution was made by C. F. Bowen during 1919, and was presented by him to the United States National Museum (accession No. 63946). The bulk of the material was collected from a light-colored clay interbedded with sandstone and exposed on a small hill in the northeastern outskirts of the town of Betijoque, District of Betijoque, State of Trujillo, Venezuela. The second lot of material was collected from a yellowish sandy micaceous clay exposed along the trail 2½ miles northwest of La Salvadora and between 25 and 30 miles south of Betijoque on the same side of Lake Maracaibo. The third lot comprises the single specimen of Entada, already described.[1] The last was collected from the base of a great thickness of dark shales underlying the plant-bearing series and overlying a sandstone which has an estimated thickness of from 700 to 1,000 feet, and is in turn underlain by black shales and limestones of Cretaceous (?) age, at Mesa Pablo, about 5 miles southwest of Escuque, on the south side of the Rio Caus.

The beds containing these fossil plants are part of a thick series of sandstones, conglomerates, and some interbedded shales which Mr. Bowen informs me are similar in lithologic characters to the Lance and Fort Union beds of the western United States, except that they are somewhat coarser. This series is reported to be of enormous thickness (10,000 to 12,000 feet), and is exposed in a narrow belt bordering the Cordillera de Merida around the entire basin of Lake Maracaibo.

The beds are highly tilted in places, and were evidently deposited before the last great orogenic disturbance of the region. About 2,000 feet below the plant horizon Mr. Bowen observed a thick bed of lignite, which is perhaps of interest in comparison with the Tertiary section on the Island of Trinidad. I understand that the lower third of the series in Venezuela is reported to contain numerous lignite

[1] Berry, E. W., Amer. Journ. Sci., vol. 50, pp. 310–313, fig. 1, 1920.

beds in this general region. I was interested in the possible presence of tuffs in the series as an item for comparison with the fossil plant locality in the Cordillera de Bogota of Colombia, but none were observed. Naturally during a reconnaissance in a region of this sort many beds of lignite or tuffs might be entirely overlooked even if they were exposed.

The plant-bearing series is underlain by several thousand feet of black shale, from which a few marine fossils were collected, and which is hence presumably of marine origin. From the facies of the plant fossils I am inclined to think that the plant-bearing series represents a complex of littoral, estuarine, and continental deposits, some of the latter of palustrine origin and others detrital.

In his account of the Cordillera de Merida, Sievers [2] described a series of interbedded shales and sandstones with lignite and petroleum at least 800 meters thick, overlying the Cretaceous limestones that have been referred to the Albian stage. These he called the Cerro de Oro beds. He had no paleontological data regarding their age. The Cerro de Oro beds, probably a complex, have been compared with the Trinidad beds named the Caroni series by Wall and Sawkins.

The exact age of the Caroni series [3] has never been satisfactorily settled, but probably will be when the collections from the Island of Trinidad, which are accumulating in the United States National Museum, are studied. W. P. Woodring, who monographed the Bowden molluscan fauna (Burdigalian), informs me that a cursory examination of the Trinidad Mollusca suggests a Miocene age for the Caroni fauna.

To the westward the Cerro de Oro series of Sievers is apparently represented in the Cordillera de Bogota, Colombia by the Guaduas formation of Hettner [4] consisting of bright-colored clays, ferruginous sandstones, and conglomerates. Underlying the Guaduas are Cretaceous coal-bearing beds referred to the Guadalupe formation. Karsten considers the former Tertiary and separated by an unconformity from the Cretaceous, but Hettner is inclined to consider both formations Cretaceous.

Subsequent scattered references to this general region show the presence of marine beds of probably middle Miocene (Helvetian) age at several localities in Colombia, and others at Cumana, Venezuela, which Douvillé correlates with the Burdigalian stage of Europe. The recent studies of Vaughan and his associates in Central America and the Antilles demonstrate that the upper Miocene was a period of uplift around the perimeters of the Caribbean and that there was profound deformation during Pliocene times.

[2] Sievers, W., Die Cordillere von Merida, Geog. Abh., vol. 3, no. 1, 1889.
[3] Guppy, R. J. L., Agr. Soc. Trinidad and Tobago, Proc., vol. 12, pt. 10, pp. 330–334, Oct., 1912.
[4] Hettner, A., Die Kordillere von Bogota, Petermanns Mitt. Ergänz., vol. 22, no. 104, 1892.

The only fossil plant that I find recorded from Venezuela is a *Weichselia* described by Schlagintweit[5] from Santa Maria and of Lower Cretaceous age, although Karsten[6] mentions ferns, reeds and dicotyledonous leaves from Santa Maria and Nariqual in association with the coal. No specimens appear to be in the Berlin or Rostock collections to verify this statement except the aforementioned fern, which is a Lower Cretaceous form, widely distributed throughout the Peruvian Andes and Coastal region, and also known from the European Wealden.

The present report enumerates but 16 species, all but two of which are new to science. The following nine forms are from Betijoque:

Blechnum betijoquensis Berry.
Sabalites, species.
Heliconia elegans (Engelhardt) Berry.
Coussapoa villosoides Berry.
Ficus betijoquensis Berry.
Anona guppyi Berry.
Trigonia varians Engelhardt.
Simaruba miocenica Berry.
Rhizophora boweni Berry.

The locality near La Salvadora furnished the following seven species:

Leguminosites venezuelensis Berry.
Leguminosites entadaformis Berry.
Sophora salvadorana Berry.
Antholithus venezuelensis Berry.
Apocynophyllum salvadorensis Berry.
Burserites venezuelana Berry.
Trigonia varians Engelhardt.

The locality at Mesa Pablo yielded the single species, *Entada boweni* Berry, which is stratigraphically below the two preceding main plant horizons.

As will be observed there is only a single form common to the two principal localities—namely, *Trigonia varians* Engelhardt, but this, it seems to be, is sufficient to indicate the practical synchroneity of these two localities, which is also borne out by Mr. Bowen's field observations. Hence it will be expedient to consider the flora as a whole in discussing the ecology and age which it indicates.

The 16 identified species represent 15 genera, 13 families, and 10 orders. They comprise a fern, 2 monocotyledons, and 13 dicotyledons. They include the abundant remains of a species of *Blechnum*, a genus of ferns with a large number of existing tropical species, well represented in northern South America. The monocotyledons

[5] Schlagintweit, O., Centralblatt Min. Geol. u Paläont., Nos. 19 and 20, pp. 315–319. 1919.
[6] Karsten, H., Zeits. Deutsch. Geol. Gesell., vol. 2, p. 354, 1850.

comprise a fragment of a generically undeterminable fan palm and a fragment of a large leaf of the American wild banana, *Heliconia*, which forms thickets in the rain forests of the present day in central and northern South America.

Among the Dicotyledons there are two species of Moraceae—a fig belonging to the immense cosmopolitan genus *Ficus*, and a species of *Coussapoa* representing an exclusively American tropical type of Central and South America. No other dicotyledonous family except the Leguminosae is represented by more than a single species. The order Ranales is represented by a species of *Anona*, a genus which, except for two or three forms of tropical Africa and Asia, is exclusively American with three score or more existing species.

The representation of the order Rosales is most interesting. It may be noted that none of the forms recorded came from the Betijoque locality, which has an assemblage that suggests a partially inundated tidal estuary border. The forms referred to the Rosales all belong to the leguminous alliance and include the striking specimen of a sea bean, two species referred to Leguminosites, one of which suggests the leaflets of *Entada*, and a species of *Sophora*—a tropical and often coastal type in modern floras.

The order Geraniales contains representatives of the three families Simarubaceae, Burseraceae, and Trigoniaceae of the genera *Simaruba*, *Burserites*, and *Trigonia*, respectively. The first is to-day confined to the American Tropics; *Burserites* is a form genus named from its resemblance to the existing genus *Bursera* which is confined to the American Tropics. The third is likewise exclusively American and tropical in the existing flora.

The Myrtales is represented by the form from Betijoque, which I consider as a species of mangrove of that familiar tropical plant association of tidal estuary mud flats. The Ebenales are doubtfully represented by the floral remains referred to *Antholithus* and tentatively considered as belonging to the family Symplocaceae. The order Gentianales is represented by a species referred to the form genus *Apocynophyllum*.

All of the foregoing are types which in existing floras are tropical in their distribution; all belong to types which are exclusively American or largely represented in America, and several genera have their modern representatives confined to the South American Tropics. The flora is not only tropical but lowland in character. This is indicated by the predominantly coastal types present, such as *Sophora*, *Rhizophora*, *Simaruba*, *Burserites*, *Entada*, etc., and is not negatived by any of the described species, since none would be out of place in such an association. Moreover it may be noted that all of the dicotyledons are coriaceous or subcoriaceous types with

entire margins—features that distinguish existing lowland tropical forests.

It may therefore be concluded that this flora indicates a rain forest climate, and that at the time it lived the ancient margin of the Caribbean in this region belonged to the "tierra caliente," as so much of it still does.

The question of the geologic age of the flora is not nearly so simple a problem nor one that can be as satisfactorily answered. All but two of the species are new and hence without any known distribution in other regions. None are represented in the Tertiary floras that I have described from Costa Rica, Panama, or Dominica. I had hoped to have collections from the Caroni series of Trinidad for comparison, but these have not yet been received. None are present in the undescribed Pliocene flora that I collected in Bolivia.

The two species previously known—*Heliconia elegans* and *Trigonia varians*—were both described by Engelhardt from near Santa Ana, in the Cordillera de Bogota, from a tuff occurring in the mountains along the Rio Magdalena at 970 meters (State of Honda). Unfortunately the age of the Santa Ana flora is unknown. Its describer, Engelhardt, did not venture to suggest its age more precisely than Tertiary.

It comprises 35 species, and its chief contrast to the Venezuelan flora is the presence of 10 different species of Lauraceae—a family that, strangely enough, is not represented in the Venezuelan collections. I have previously suggested [7] that the Santa Ana flora was lower Miocene and the same age as the flora from near Tumbez in the Peruvian coastal region, that from the so-called Navidad beds of Chile, and that from the Loja basin in southern Ecuador. My reasons for this suggestion were the presence of the Santa Ana species *Persea macrophylloides* and *Moschoxylon tenuinerve* in the Chilean lower Miocene; the presence of *Phyllites strychnoides* at Loja, in Ecuador; and the presence of *Condaminea grandifolia* near Tumbez, Peru, thus making 4 of its 35 species present in beds of known lower Miocene age.

In addition, I tentatively identified [8] fragments of six additional species from Peru as questionably identical with Santa Ana forms.[9] These latter, however, I do not regard as of much weight in precise correlation, since all were fragmentary and all of the identifications were queried.

Pointing toward a younger age are the facts that two of the Santa Ana species—*Nectandra areolata* and *Buettneria cinnamomifolia*—are undoubtedly present in Costa Rica in beds that are about the same age or younger than the Gatun formation of the Canal Zone, the

[7] Berry, E. W., Bull. Geol. Soc. Amer., vol. 29, pp. 637–648, 1919.
[8] Idem.
[9] Berry, E. W., Proc. U. S. Nat. Mus., vol. 55, pp. 279–294, pl. 14–17, 1919.

datum plane in the case of the Costa Rican beds being an unconformably underlying marine shale with invertebrates. Furthermore, the Santa Ana plants are contained in a tuff, and all of the tuffs known to me from the Caribbean to Patagonia are late Tertiary to Recent, and correspond to the great period of vulcanism that started in the late Tertiary.

This is slender evidence, to be sure, but a considerable body of facts is accumulating to prove the recency of the last and greatest period of orogenesis in the Andes.

I think that the Venezuelan fossil plants are of approximately the same age as those in the tuffs near Santa Ana, Colombia. Both are undoubtedly Miocene. Those from Venezuela are said to antedate the last great orogenesis of the Cordillera de Merida, which is really nothing but a northeasterly continuation of the Andean Cordillera de Bogota. Moreover, the latest considerable transgression of the Caribbean Sea, represented by the deposits that presumably underlie the whole Maracaibo basin, but are now largely masked by Pleistocene and Recent deposits, except where they are uplifted along the flanks of the mountains, occurred, according to the present conceptions as elaborated by Vaughan [10] during the lower and middle Miocene, or, in terms of European geology, during Burdigalian and Helvetian times.

Summarizing these statements, the Venezuelan plant-bearing beds represent a series that may be compared with the Gatun formation of the Canal Zone, which has been satisfactorily shown to be of Burdigalian and Helvetian age, although Toula [11] considered the contained and mixed (in the collecting) fauna as Pliocene. The underlying marine shales are probably Burdigalian or Helvetian, and the fossil plants could therefore be Burdigalian, Helvetian, or younger. From the fact that they antedate the latest extensive orogenesis of the region, which I regard as Pliocene, since conclusive evidence of Pliocene orogenesis is available in the Antilles and elsewhere in this general region, and because the upper Miocene has been demonstrated to have been a time of general uplift, I am inclined to regard the fossil plants as representing the middle Miocene, although they may be upper Miocene. They seem to me to be distinctly pre-Pliocene, although it must be admitted that the present collection is far too small to warrant an uncompromising conclusion. It is also realized that our knowledge of this vast region is very limited, so that the present suggestion of age is made with all due reservation. By implication, the same age would be indicated for the plant-bearing tuffs near Santa Ana, Colombia.

[10] Vaughan, T. W., Bull. 103, U. S. Nat. Mus., 1919.

[11] Toula, F., Jahrb. k. k. Geol. Reichanstalt, vol. 58, pp. 673–760, 1908; vol. 61, pp. 487–530, 1911.

Phylum PTERIDOPHYTA.

Class LEPTOSPORANGIATAE.

Order POLYPODIALES.

Family POLYPODIACEAE.

Genus BLECHNUM Linnaeus.

BLECHNUM BETIJOQUENSIS, new species.

Plate 107, fig. 1.

Fronds of medium size, pinnate. Pinnae ovate-lanceolate, with an acuminate apex and a rounded base. Midvein stout, prominent. Lateral veins numerous, closely spaced, parallel, simple or once forked, craspedodrome, diverging from the midvein at wide angles and curving gently upward. Margins, except in the basal region, with small crenate-serrate teeth. No traces of sori or fertile pinnae.

This species, which is clearly new, is represented by a considerable amount of broken material, which is sufficient, however, to show the pinnate character of the frond and all of the details of the sterile pinnae. In the absence of fruiting characters its generic reference is beset with difficulties, since it resembles a number of existing tropical American forms which have been variously assigned to the genera *Blechnum*, *Lomariopsis*, *Stenochlaena*, etc., by students of living ferns.

The genus *Gymnogramme* has a Neuropteroid instead of a Taeniopteroid venation, which eliminates it from consideration. On the whole it has seemed best to refer the present species to the genus *Blechnum*, although the generic limits of this and other tropical fern genera are variously interpreted by different authorities and are evidently not clearly understood. The genus has a large number of mostly tropical species, and is well represented at the present time in northern South America. The present species may be compared with *Blechnum serrulatum* Richards, *Blechnum brasiliense* Desveaux, and other members of the genus to be found in the rain forest country from Central America to Brazil and Bolivia, all of which show a general similarity to the fossil species.

Collected from light colored clay interbedded with sandstone, exposed on a small hill on the northeastern outskirts of the town of Betijoque.

Holotype.—Cat. No. 36423, U.S.N.M.

Phylum ANGIOSPERMOPHYTA.

Class MONOCOTYLEDONAE.

Order SCITAMINALES.

Family MUSACEAE.

Genus HELICONIA Linnaeus.

HELICONIA ELEGANS (Engelhardt.)

Musophyllum elegans ENGELHARDT, Abh. Senck. Naturf. Gesell., vol. 19, p. 25, pl. 2, figs. 1–3; pl. 5, fig. 1, 1895.

Oblong leaves, evidently of large size, but only preserved as fragments. These indicate a leaf up to 20 cm. in maximum width and with an estimated length of at least 70 cm. Margins entire except where the lamina was mechanically split. Midrib stout, prominent, and cylindrical, about .5 cm. in diameter in the preserved material. Leaf substance of considerable consistency. Lateral veins closely spaced, parallel, diverging from the midrib at wide angles that vary from 70 to 90 degrees in different specimens. The laterals are relatively straight but curve slightly upward, particularly in the marginal region. At regular intervals of about one centimeter there is a slightly stouter lateral. All terminate in the margins.

This species was described by Engelhardt from a tuff near Santa Ana in the valley of the Rio Magdalena in Colombia. The single fragment, shown in the accompanying figure, and 10.5 cm. in length by 12 cm. in width, was collected in Venezuela. It is obviously identical with the Colombian material. Both are here transferred to the genus *Heliconia*. Two additional fossil species are known from tropical America, namely, a fragment from the Tertiary of Costa Rica and a well marked species from the Pliocene of the montaña country of eastern Bolivia. The latter was a much smaller form than the present species and lacked any differential development of the lateral veins.

The genus *Heliconia* has between 30 and 40 existing species. These are confined to the American tropics, where they range from the Antilles to Brazil and Bolivia. They are exceedingly common in Central America and the lower montaña region of Peru and Bolivia, where I have observed species at elevations up to around 6,000 feet, associated with many representatives of the tropical lowland flora.

The genus *Musophyllum* was established by Goeppert [12] in 1854 for fossil banana leaves from the island of Java. Subsequently about a dozen different species have been referred to this genus. The bulk

[12] Gœppert, H. R., Tertiarflora Insel Java, p. 39, 1854.

of these are European and range in age from Oligocene through the Mediterranean Miocene. They appear to have reached southern Europe during the Oligocene, coming from eastern and central Africa, since several are remarkably close to the existing *Musa ensete* of Abyssinia, and consequently appear to have been ancestral to the Old World genus Musa.

The North American records include a form, *Musophyllum complicatum* Lesquereux, which has a considerable distribution in the

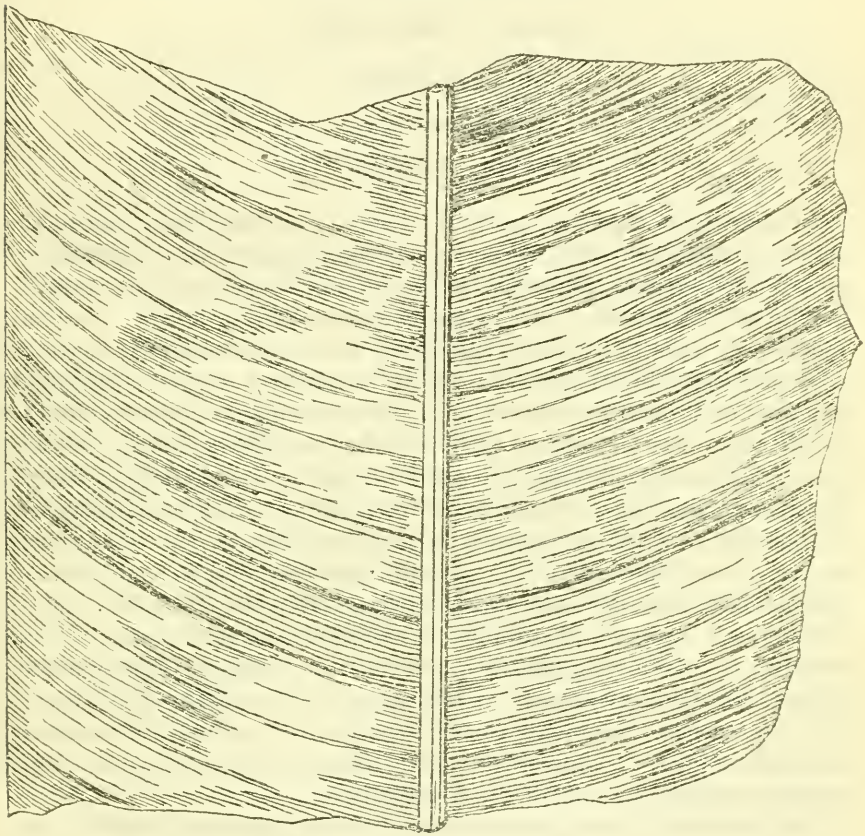


FIG. 1.—HELICONIA ELEGANS (ENGLEHARDT) BERRY. BETIJOQUE.

earlier Eocene of the present Rocky Mountain region, and a second from the basal Eocene of Wyoming. The genus has not yet been discovered in the Tertiary floras of the Atlantic or Gulf Costal Plain.

Aside from the actual resemblance between these fossil American forms and the existing *Heliconias*, it seems to me that general considerations point to the conclusion that the genus *Musa* was never present in the Western Hemisphere, despite the fact that it flourishes

so greatly under cultivation in the American Tropics at the present time.

The fossil described above is from a clay shale interbedded with sandstone, exposed on a small hill on the northeastern outskirts of the town of Betijoque.

Plesiotype.—Cat. No. 36424, U.S.N.M.

Order ARECALES.

Family ARECACEAE.

Genus SABALITES.

SABALITES, species.

Plate 109, fig. 3.

Fragments of the basal part of a leaf of some species of fan palm, showing neither the size of the leaf or the character of the petiole or rays. The present material is worthless beyond the fact that it indicates the presence of fan palms in this fossil flora. The leaf appears to have been small, but there are no features that serve to suggest its botanical affinity, and it is referred to the form-genus *Sabalites* as a matter of convenience and without the slightest implication that it may be related to the existing species of *Sabal.* In this connection attention should be called to similar material described as *Palmacites,* species, by Engelhardt[13] and coming from the Cauca valley in Colombia. This is identical in appearance with the Venezuelan material, but this similarity is without significance in the case of such fragmentary material as has been collected from both of these regions.

Although a number of palm leaves from Tertiary horizons have been referred to the form-genus *Palmacites,* this usage is objectionable, despite the appropriateness of the name for fragments whose exact relations are undeterminable, since Brongniart[14] proposed *Palmacites* for palm trunks, the type of the genus being his *Endogenites echinatus* from the middle Eocene of the Paris Basin.

The present material comes from the clay outcrop at Betijoque. The modern genus *Mauritia,* with about 10 American species of fan palms, often congregate in modern Venezuelan swamps, and it is possible that the fossil fragment may represent a Tertiary member of this genus.

Type.—Cat. No. 36425, U.S.N.M.

[13] Engelhardt, H., Abh. Senck. Natur. Gesell., vol. 19, p. 40, pl. 4, fig. 8, 1895.

[14] Brongniart, A., Prodrome, p. 120, 1828.

Class DICOTYLEDONAE.

Order URTICALES.

Family MORACEAE.

Genus COUSSAPOA Aublet.

COUSSAPOA VILLOSOIDES, new species.

Plate 108, figs. 1–4.

Leaves of large size, but not large for this genus, broadly ovate in general outline, widest at or below the middle, narrowing distad to the bluntly pointed tip. Base wide and full, slightly cordate. Margins entire, but slightly undulate. Texture coriaceous, the upper surface polished, the lower surface villous. Length about 15 cm. Maximum width about 12.5 cm. Petiole very stout, thin, and flush on the upper surface of the leaf, but very prominent on the lower surface. Secondaries 8 to 10 opposite to alternate pairs, which, except for the basal and opposite pair, diverge from the midrib at regular intervals, at angles of about 45°, and pursue nearly straight subparallel courses, curving somewhat toward their tips and abruptly comptodrome close to the margins. The basal pair, which may be considered as representing the first stage in the development of lateral primaries, although they are no stouter than the strictly pinnate secondaries above them, diverge from the midrib at the top of the petiole and immediately below the normal second pair of secondaries; their angle of divergence from the midrib approaches 90° and they curve rather regularly upward subparallel with the lower lateral margins, each giving off on the outside about four camptodrome tertiaries or pseudo-secondaries, all but the lowest pair of which follow the basal margins of the leaf, pursuing rather straight courses. The tertiaries are relatively stout, well marked on the lower surface of the leaf but faint on the upper surface; they are very closely spaced, are for the most part simple, but slightly curved, and percurrent at right angles to the secondaries. The nervilles are prevailingly at right angles to the tertiaries, and where the latter fork, as they frequently do, the cross nerville joins one limb with the other, so that the tertiaries appear more nearly parallel and more generally simple than they really are.

The present species is exceedingly well marked, and so similar to certain existing species of *Coussapoa* as to amount almost to identity. Although I have not seen all of the existing species of *Coussapoa*, since several are not represented in American Herbaria, the fossil is exceedingly like *Coussapoa ruizii* Klotsch and *Coussapoa villosa* Poeppig and Endlicher, of which I have had numerous specimens

from Central America. The latter is, I think, the form figured by Ettingshausen in his Blattskelet. Dikotyledonen as *Artocarpus*, species, to which I refer in a subsequent paragraph. The modern leaves vary considerably in size, as would probably prove true in the

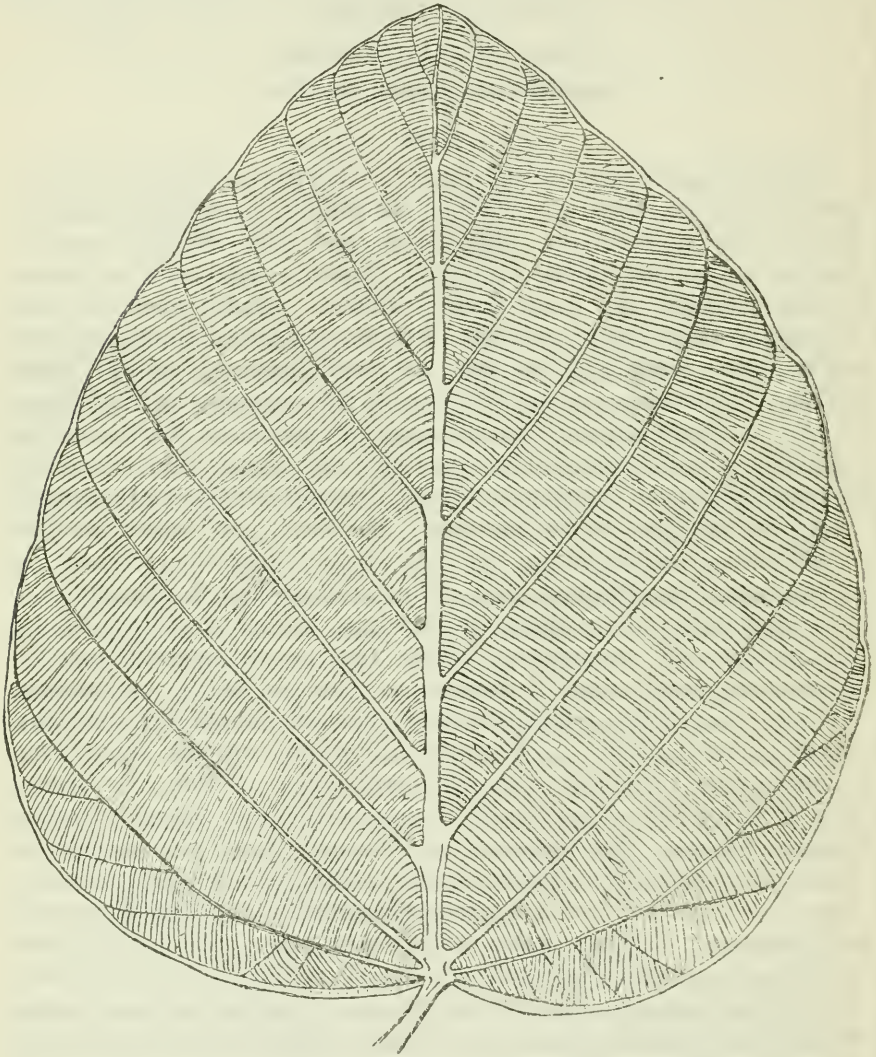


FIG. 2.—RESTORATION OF COUSSAPOA VILLOSIODES, NEW SPECIES, NATURAL SIZE.

case of the fossil were more material available for study; this is certainly true of an undescribed fossil species which I collected from the Pliocene of Bolivia.

The only observable differences between the Tertiary *Coussapoa villosoides* and the existing *Coussapoa villosa* are that occasionally a distal tertiary in the latter becomes somewhat stouter and diverges at

a slightly different angle; and in the fossil between the lowest branch from the basal secondary that follows the basal leaf margin and the next normal branch above, there are three or four straight cross veins cutting diagonally across the normally oriented percurrent tertiaries.

This striking new species, which comes from Betijoque, is represented solely by fragments, which fortunately, however, include the central basal portion and several other parts of the lamina. The leaf was recognized as a member of the Moraceae by its venation, but no attempt was made to identify it until after the restoration shown in text figure 2 had been reconstructed. I mention this in order to show that its almost exact agreement with the leaves of modern species of *Coussapoa* did not have even a subjective influence in the restoration, which was based entirely upon the material studied.

Subsequently the very great similarity of the fossil to a recent leaf from the American tropics figured by Ettingshausen as an unnamed species of *Artocarpus* was noted.[15] This led to an examination of the *Artocarpus* material in the United States National Herbarium. Some of the Old World species of *Artocarpus*, as, for example, *Artocarpus ovatifolia* of the Philippines or *Artocarpus chaplasha* of the Indian region have somewhat similar entire leaves, but the resemblance is not especially close. Material of all of the existing genera of the Artocarpoideae was next examined, and although certain general similarities were naturally to be noted, especially in the case of *Inophloeum* (*Olmedia*) *armatum* (Miquel) Pittier, it was seen that the fossil did not belong to this subfamily.

Subsequently the search was continued to the remaining genera of the Moraceae, and this resulted in the conclusive determination of the fossil as a species of *Coussapoa*. The genus has not heretofore been certainly found fossil. In the existing flora it includes about 15 species of shrubs and trees with the characteristic areolation shown in text figure 2, but varying in the degree of divergence of the secondaries, and, in some forms, this results in a basal primary on either side of the midrib instead of a strictly pinnate arrangement of the secondaries.

A species of the tripalmate venation type, as yet undescribed, is exceedingly abundant in the Pliocene of eastern Bolivia. Engelhardt[16] in 1891 referred a form from the lower Miocene of Coronel, Chile, to the genus *Coussapoa*, but his material was very inconclusive, and scarcely warrants the conclusion that this genus was a member of the south Chilean Miocene flora, at least not unless more

[15] Ettingshausen, C., Blattskelet. Dikot., p. 33, pl. 6, fig. 6, 1861.
[16] Engelhardt, H., Abh. Senck. Naturf. Gesell., vol. 16, p. 649. pl, 3, fig. 2, 1891.

convincing material from that region is subsequently discovered, which would not be at all surprising.

All of the existing species, which are not especially well represented in the larger American Herbaria, are confined to the tropics of Central and South America. The presence of this type with such unusually clearly marked characteristics in the Tertiary flora of Venezuela is of the greatest interest.

Cotypes.—Cat. Nos. 36426, 36432, 36433, 36444, U.S.N.M.

Genus FICUS Linnaeus.

FICUS BETIJOQUENSIS, new species.

Plate 108, fig. 5.

Leaves broadly ovate, presumably nonlobate and entire in outline, of medium size, palmately veined. Apex pointed. Base truncate, slightly decurrent. Length about 12 cm. (estimated). Maximum width, at or below the middle, about 10 cm. Texture subcoriaceous. Petiole stout, its total length unknown. Midrib stout, prominent, stouter than the lateral primaries. Lateral primaries one on each side, stout, relatively straight, diverging from the base of the midrib at angles of about 45 degrees, giving off about six camptodrome secondaries on the outside. A wide interval separates the primaries from the lowest secondaries that diverge from the midrib. The secondaries are less stout than the primaries, diverging at more open angles, and camptodrome. Tertiaries well marked, percurrent or alternating in the median region, connected by well marked nervilles at nearly right angles to the tertiaries. Venation typical of the short and wide forms of *Ficus*.

The present species is represented in the clays at Betijoque by the single specimen figured, which is unfortunately incomplete. Since it shows sufficient characters to enable it to be recognized if future collections are made, it has seemed best to figure it and describe it as completely as is possible from the nature of the material.

It belongs to a genus which shows considerable diversity of features among its very many species. They are present in all tropical countries at the present time and some extend for considerable distances into the Temperate zones. A large number of fossil species have been described from the Upper Cretaceous and Tertiary rocks of different parts of the world. Little is to be gained, however, from detailed comparisons with fossil species from other regions, or with the more or less unknown existing species of the Venezuelan region.

Holotype.—Cat. No. 36427, U.S.N.M.

Order RANALES.

Family ANONACEAE.

Genus ANONA Linnaeus.

ANONA GUPPYI, new species.

Leaves of variable but mediumly large size, ovate in general outline, widest at or below the middle, narrowing slowly upward to the obtuse tip, and more rapidly downward to the broadly cuneate base. Length averaging between 12 cm. and 13 cm. Maximum width ranging from 5.3 cm. to 6.2 cm., averaging about 6 cm. A single specimen is somewhat inequilateral. Margins entire, very faintly undulate in some specimens. Texture subcoriaceous. Petiole missing. Midrib stout, prominent on the lower surface of the leaf. Secondaries remote, 10 to 12 pairs, diverging from the midrib at wide angles of 60 to 70°, generally but slightly curved upward until they approach the marginal region where they are camptodrome. These leaves have all been mined by the aquatic larvae of insects, so that the tertiary venation is much obscured. A few percurrent nervilles are distinguishable.

I have ventured to name this obviously new species in honor of H. B. Guppy, whose enlightened researches have added so much to our knowledge of the distribution of plants.

The existing species of *Anona*, many of which are economically valuable, number about 60, all of which are American except two or three forms of Africa and tropical Asia. Several are widely cultivated in all tropical countries, and their original home has been a matter of dispute, since the cultivation of some of the species probably antedates the discovery of America. A. De Candolle, after his extended systematic studies of the Anonaceae, reached the conclusion that *Anona* was of American origin and that the ancestors of the cosmopolitan cultivated forms probably came from the West Indies or from the neighboring part of the American mainland. This is unquestionably true, not only of the cultivated forms, but of the genus as a whole, since fossil species are recorded from the late Cretaceous and early Eocene of North America.

The total number of known fossil forms is between 20 and 30. Around the perimeters of the Gulf of Mexico and the Caribbean there are four well-marked species in the lower Eocene of the Mississippi embayment region; an upper Eocene species in Texas; and a Miocene species in Costa Rica. A species is known from the Miocene of northern coastal Peru, two have been described from the lower Miocene of southern Chile, and there is a species in the Pliocene of Bolivia.

The present species may be compared with a number of the numerous existing species of the Caribbean hinterland of Central

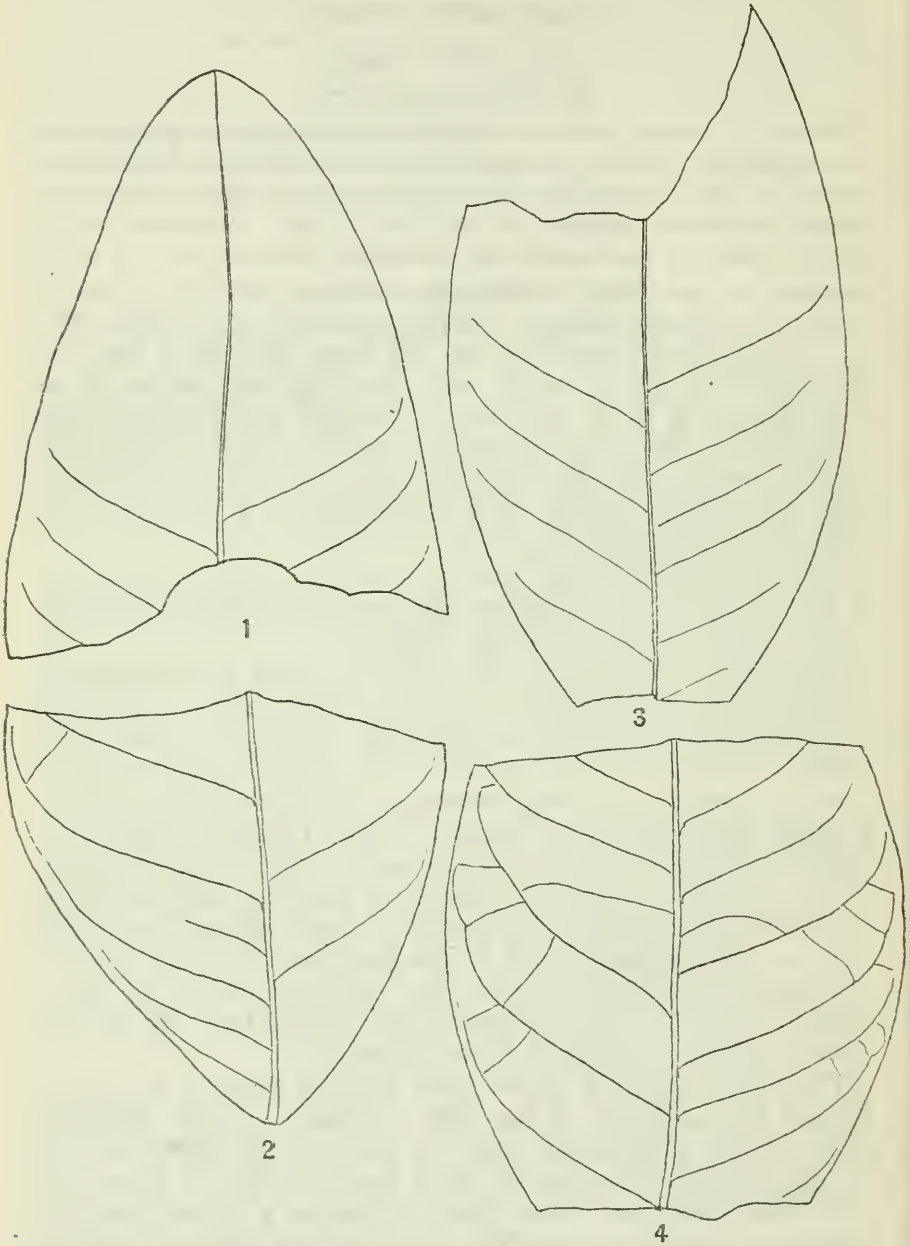


FIG. 3.—ANONA GUPPYI, NEW SPECIES. BETIJOQUE.

and northern South America. Specimens are abundant, but broken, in the clays at Betijoque.

Cotypes.—Cat. Nos. 36428, 36429, 36430, 36431, U.S.N.M.

Order ROSALES.

Family MIMOSACEAE.

Genus ENTADA Adanson.[17]

ENTADA BOWENI Berry.

Plate 109, fig. 1.

Entada boweni Berry, Amer. Journ. Sci., vol. 50, pp. 310–313, fig. 1, 1920.

Seed of large size, about 5.25 cm. in diameter, lenticular in form, reniform in surface view, and depressed elliptical in cross section. The surface view would be almost perfectly circular except for the pronounced sinus at the hilum. The sclerotest or hard lignified seed coat is gone from the face of the specimen, exposing the thick reniform upper cotyledon. The inner face of the lower cotyledon is shown in the upper left-hand corner of the specimen, where a portion of the upper cotyledon is broken away. Where the two cotyledons join, the hypocotyl or plumule is conspicuous, indicating the incipient germination of the seed before it was finally buried by sediment. The outer surface of the cotyledon is slightly furrowed as in the existing sea bean. The central area is somewhat collapsed exactly as would be the case in the modern bean if the cotyledons were somewhat softened and the central air cavity upon which its buoyancy depends had been collapsed by pressure. Around the greater part of the edge of the seed the sclerotesta is preserved, being replaced by what is presumably marcasite. This test is thick and about 3 mm. in diameter around the edges of the seed.

The single specimen was collected from dark shales overlying a sandstone at Mesa Pablo, about 5 miles south, 84 degrees west, of Escuque, on the south side of the Caus River, inland from Lake Maracaibo. The age is Tertiary, but has not as yet been more definitely determined.

Holotype.—Cat. No. 36435 U.S.N.M.

The counterpart of the specimen if present in the shale was not collected, and I assume that it carried the face of the test and the small fragment of the upper cotyledon which is missing. I have dissected a number of seeds of the existing *Entada scandens*, and their correspondence with the fossil is most remarkable, the only observable difference being the partially developed plumule or hypocotyl in the fossil which, as I have suggested above, was probably due to germination. The cotyledons appear to have been infiltered with ferruginous salts before they had time to decay, becoming flattened by the escape of gas from the central intercotyledonary cavity.

[17] This is often made a synonym of *Pusaetha* Linnaeus, as for example by Taubert in Engler and Prantl

Entada scandens is probably the best known tropical plant distributed by ocean currents, since its large, lenticular, dark kidney colored seeds have been for ages cast up by the waves on the eastern shores of the Atlantic from the Azores northward to Nova Zembla. These seafaring qualities and vitality are remarkable, as is the distribution of the parent plant, since it is found in all of the Tropics and yet presents certain apparent anomalies. It is normally a climber of immense proportions with truly gigantic pods, and belongs to a genus with some 15 existing species, about half of which are African. There are three or four in the American Tropics, one or two in the southeastern Asiatic region, and one in Madagascar. Most of these are not strand plants, and although *Entada scandens* also grows in inland situations, it is as a strand plant that it is principally known, since it frequents mangrove associations and the jungle immediately behind tropical beaches.

The fossil is so much like the existing sea bean that one is justified in assuming that it, like the descedant, was distributed by ocean

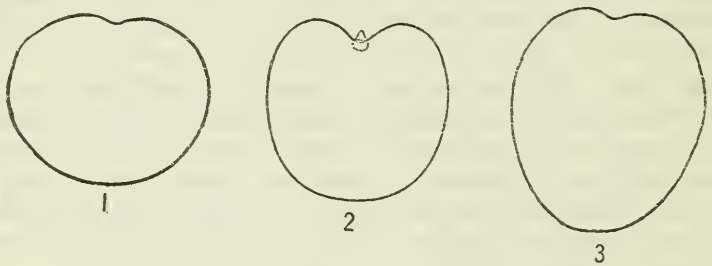


FIG. 4.—1. ENTADA SCANDENS (LINNAEUS) KUNTZE. OUTLINE OF A SEED FROM JAMAICA. 2. E. BOWENI BERRY, MESA PABLO. 3. E. SCANDENS. OUTLINE OF A SEED FROM CUBA. ONE-HALF NATURAL SIZE.

currents, and its occurrence in a clay lens in what appears to have been a rather widespread marine series of deposits, adds some probability to this conjecture; and as its horizon antedates the last seaway across the Isthmus of Panama, it is not difficult to account for the presence of the modern species on both the Atlantic and Pacific sides of South America.

Entada has not certainly been found fossil heretofore except in the case of the subfossil seeds of the existing sea bean buried in the coastal deposits of Scandinavia, where they had been carried from the Antilles by the Gulf Stream. Unger long ago described two different species of fossil pods which he referred to the genus *Entada*. These were *Entada primogenita* [18] from the Miocene of Radoboj in Croatia and *Entada polyphemi* [19] from the Oligocene of Sotzka in Styria. They are both large pods, although not so large as the Venezuelan fossil or the existing sea bean. The second is rather suggestive of *Entada*,

[18] Unger, F., Sylloge, vol. 2, p. 36, pl. 11, fig. 22, 1862.
[19] Idem., fig. 23.

but as Schenk points out at some length [20] both resemble other leguminous pods and are hence inconclusive, although not entirely improbable.

There can not be the slightest doubt regarding the botanical affinity of the present fossil, since it agrees in every detail with the existing species. It adds another to the considerable list of plants of the sea drift that have been discovered in recent years in the tropical and subtropical floras of the American Tertiary.

Family PAPILIONACEAE.

Genus SOPHORA Linnaeus.

SOPHORA SALVADORANA, new species.

Plate 107, fig. 4.

Leaflets sessile, elliptical, and slightly inequilateral in outline, with a rounded apex and base, the latter somewhat narrower than the former. Margins entire. Leaf substance thin but of a firm consistency, perhaps meriting the term subcoriaceous. Length about 4.75 cm. Maximum width about 2 cm. Midrib stout, prominent and curved. Secondaries stout and prominent; about eight opposite to alternate, regularly spaced, subparallel pairs diverge from the midrib at angles of about 45° and are camptodrome in the marginal region. Tertiary areolation obsolete by reason of the coarseness of the matrix.

The present species may be compared with numerous existing and fossil species of *Sophora*. There are about 25 existing species of shrubs and small trees referred to the genus. These are scattered over the warmer parts of both hemispheres and some are found upon all tropical seashores. Two arborescent forms occur along our western Gulf coast, where they show a preference for moist calcareous soils along streams. One of these Texan species, *Sophora secundiflora* DeCandolle, the coral bean, has leaflets very similar to those of *Sophora salvadorana*. Other existing species are likewise very similar to the latter, as, for example, *Sophora tomentosa* Linnaeus, a cosmopolitan tropical strand plant. The dry pods of the latter float for a week or two and then decay, liberating the buoyant seeds, which float uninjured for several months, according to the experiments of both Schimper and Guppy.[21]

The genus is well represented in European Tertiary floras from the Eocene to the Pliocene and is common in the earlier Tertiary floras of the Mississippi embayment region of the United States.

[20] Schenk, A., Palaeophytology, p. 702, 1890.
[21] Guppy, H. B., Plant Dispersal, pp. 147, 579, 1906.

Among the described fossil forms *Sophora salvadorana* greatly resembles *Sophora europaea*,[22] which was compared by Unger, its original describer, with the existing *Sophora tomentosa*. *Sophora europaea* has been identified by numerous students at a large number of European localities, extending from the Oligocene through the Miocene.

The present species is based upon two specimens from the yellowish sandy micaceous clay found along the trail, 2½ miles northwest of La Salvadora.

Holotype.—Cat. No. 36436, U.S.N.M.

POSITION UNCERTAIN.

Genus LEGUMINOSITES Bowerbank.

LEGUMINOSITES VENEZUELENSIS, new species.

Plate 107, fig. 2.

Leaflets small, apparently sessile, very inequilateral, with an acute apex and a very inequilateral base. Margins entire. Texture subcoriaceous. Length about 1 cm. Maximum width about 5 mm. Midrib thin, somewhat curved. Secondaries immersed, a few camptodrome pairs, more ascending in the narrower side of the lamina, the basal one in the wider side of the lamina more prominent than the others.

This small leaflet has a characteristic form; the acute tip is not obviously inequilateral, but the lamina on one side is twice as wide as on the other; the base on the narrow side curves to form an acute angle with the midrib; that on the broad side continues downward to form a prominent auricle.

This species is based upon a single specimen and its counterpart from the sandy clays near La Salvadora. Consequently it seems desirable to refer it to the form-genus Leguminosites rather than to attempt comparisons with recent species of Leguminosae, which are so numerous in this region at present, and so extremely difficult to differentiate by means of the leaflets alone. The following genera contain forms in this region which show similarities with the fossil—namely *Enterolobium*, *Zygia*, and *Lysiloma* among the Mimosaceae, and *Cassia*, *Caesalpinia*, and *Swartzia* among the Caesalpiniaceae.

Holotype.—Cat. No. 36437, U.S.N.M.

LEGUMINOSITES ENTADAFORMIS, new species.

Plate 107, fig. 3.

Leaflets elliptical in form, nearly equilateral in outline, widest in the middle and about equally rounded at the apex and base, the latter slightly broader than the former. Margins entire, regular. Texture

[22] Unger, F., Die fossile flora von Sotzka, p. 57, pl. 42, figs. 1–5, 1850.

subcoriaceous. Length about 4 cm. Maximum width about 3.2 cm. Midrib thin, but prominent. Secondaries immersed; 9 or 10 camptodrome pairs diverge from the midrib at regular intervals, at angles of about 55 to 60°, pursue a curved ascending subparallel course, and are camptodrome in the marginal region. Tertiaries obsolete.

This species is based upon the single specimen figured, and because of this paucity of material it is referred to the form-genus Leguminosites. It has been compared with the somewhat similar forms in genera likely to occur in this region, such as *Mimusops*, *Laguncularia*, *Sophora*, *Cassia*, *Chrysobalanus*, etc. In size, texture, and venation, as well as in its intangible facies, it suggests the Leguminosae, among which there are a considerable number of analogous or homologous forms. Without being able to decide upon its generic affinity, I have suggested, in the specific name proposed, its possible relationship with *Entada*, which is represented by a fossil seed at Mesa Pablo in this region and at a not very different horizon.

The specimen comes from the sandy clays, 2½ miles northwest of La Salvadora.

Holotype.—Cat. No. 36438, U.S.N.M.

Order GERANIALES

Family SIMARUBACEAE.

Genus SIMARUBA Aublet.

SIMARUBA MIOCENICA, new species.

Plate 109, fig. 2.

Leaves pinnate. Leaflets sessile or subsessile, small, elliptical in general outline, with a bluntly pointed apex and base. Margins entire, slightly revolute. Texture subcoriaceous. Length about 4 cm. or less. Maximum width, midway between the apex and the base, 2 cm. or less. These leaflets are slightly inequilateral, one side (the proximal) of the lamina being 1 to 2 millimeters narrower than the other. The midrib is stout, somewhat curved, and prominent on the under side of the leaflet. The secondaries are fairly stout, numerous, approximately equally spaced, and prominent; they diverge from the midrib at angles between 60 and 70°, pursue subparallel and almost straight courses. and are abruptly camptodrome close to the margins. The tertiaries are relatively stout and mostly percurrent, although there are some nervilles from the midrib that run subparallel with the secondaries part way toward the margins.

The single specimen upon which this species is based came from the clay outcrop at Betijoque, and shows parts of five leaflets, and from their disposition it appears that their arrangement was alternate. Of these the central one in the accompanying figure is much the

largest, and the distal one is considerably smaller. On the whole the material is more satisfactory than is usually the case.

Holotype.—Cat. No. 36439, U.S.N.M.

The Simarubaceae is a mostly tropical family of shrubs and trees, with persistent alternate exstipulate leaves made up of small coriaceous leaflets, and with drupaceous fruits. The genus *Simaruba* has about a half dozen existing species, all trees, which are confined to the American tropics, where they range from the coasts of southern peninsular Florida to the middle Amazon basin. The present fossil species is practically identical with the existing *Simaruba officinalis* Macfarlane of the Antilles and Caribbean coastal regions. If the present fossil were not indicative of a pinnate compound leaf, I would be disposed to consider it as representing a small leaf of the sapotaceous genus *Chrysophyllum*, which a single leaflet greatly resembles.

The only other fossil species known to me is *Simaruba eocenica* Berry,[23] from the lower Eocene of the Mississippi embayment deposits in western Tennessee, which resembles the existing *Simaruba glauca* De Candolle.

Family BURSERACEAE.

Genus BURSERITES Berry.

BURSERITES VENEZUELANA, new species.

Plate 107, fig. 7.

Leaves pinnate. Leaflets small, petiolulate, inequilateral-ovate in form; with acuminate tips and broadly cuneate bases. Length about 4.7 cm. Maximum width, midway between the apex and the base, about 2.25 cm., of which about two-thirds is on one side of the midrib. Margins entire, somewhat undulate. Texture subcoriaceous. Petiolule enlarged, about 4 mm. in length. Midrib stout, prominent, curved. Secondaries stout, regularly spaced, subparallel; about eight pairs diverge from the midrib at angles of from 40 to 65 degrees, curve regularly, and are camptodrome in the marginal region. Tertiaries thin, mostly obsolete; a few percurrent nervilles can be made out.

The present species may be compared with various existing species of the genus *Bursera* Jacquin and *Protium* Burmeister. Except that the leaflets are about twice as large they are very similar to those of the existing West Indian Birch or Gumbo Limbo. Among the 16 genera of the family, *Bursera* is the only one that reaches the United States, and *Bursera simaruba* Sargent is a large tree ranging from southern Florida throughout the West Indies and Central America to Colombia and Venezuela. The genus contains about 40 existing

[23] Berry, E. W., U. S. Geological Survey Prof. Paper 91, p. 252, pl. 54, fig. 7, 1916.

species, confined to the American Tropics in the Antillean, Central American, and northern South American regions.

The genus *Protium*, with which the fossil also shows resemblances, has only about four-fifths of its 50 existing species in the American Tropics, the others being scattered in India, Java, Madagascar, and Mauritius. The family Burseraceae comprises 10 oriental, 4 occidental, and 2 genera common to both hemispheres. Of the 300 or more existing species over two-thirds are oriental. So far as I know the only previously described fossil member of the family is *Burserites fayettensis* Berry [24] of the Fayette sandstone (upper Eocene) in Louisiana and Texas.

The present species is unfortunately represented by the single folded specimen figured, which comes from the yellowish sandy micaceous clays along the trail, 2½ miles northwest of La Salvadora.

Family TRIGONIACEAE.

Genus TRIGONIA Aublet.

TRIGONAI VARIANS Engelhardt.

Plate 107, fig. 8.

Trigonia varians Engelhardt, Abh. Senck. Naturf. Gesell., vol. 19, p. 35, pl. 7, figs. 4–6; pl. 9, fig. 9, 1895.—?Berry, Proc. U. S. Nat. Mus., vol. 55, p. 290, 1919.

This species was described by Engelhardt from several different sized specimens collected from tuffs near Santa Ana in the Magdalena Valley, Colombia. Rather poor material from the lower Miocene of northern Peru was tentatively identified as this species by the writer in 1919. This last record remains of doubtful value, but in the Bowen collection from Venezuela there are seven specimens from the two principal plant localities that are unquestionably identical with Engelhardt's type material from Colombia. The species may be more fully described as follows:

Leaves of variable size, ovate to obovate in general outline. Apex and base about equally pointed. Margins entire, slightly undulate. Texture subcoriaceous. Length ranging from 6 cm. to 13 cm. Maximum width, at or slightly above the middle, ranging from 3 cm. to 5.25 cm. A maximum sized specimen from Betijoque is figured on the accompanying plate. Petiole stout, its length unknown. Midrib stout, prominent on the undersurface of the leaf, usually curved. Secondaries stout, prominent on the under surface; 9 to 12 opposite to alternate pairs diverge from the midrib at fairly regular intervals and at angles of 55 degrees or less, ascending subparallely, becoming camptodrome in the marginal region.

[24] Berry, E. W., U. S. Geol. Surv. Prof. Paper (in press).

Tertiaries thin but well marked on the underside of the leaf, consisting of rather closely spaced percurrent nervilles, which may be all that can be made out if the preservation is not good; these are connected by anastomosis, so that their course is usually not straight, the whole forming a relatively open, isodiametric areolation.

The genus *Trigonia*, not otherwise known in the fossil state, comprises about 30 existing species of reclined or climbing shrubs, which are confined to the region between Central America and southern Brazil.

The Bowen collection contains four specimens from Betijoque and two from near La Salvadora.

Plesiotype.—Cat. No. 36441, U.S.N.M.

Order MYRTALES.

Family RHIZOPHORACEAE.

Genus RHIZOPHORA Linnaeus.

RHIZOPHORA BOWENI, new species.

Plate 109, fig. 4.

Stout leaves, elliptical in general outline, abruptly acuminate distad and rounded at the base. The two specimens collected (counterparts) are conspicuously inequilateral, but this is considered as probably an abnormality. The margins are entire and the texture is coriaceous. Length between seven and eight centimeters. Maximum width about 4.5 cm. Petiole stout, about 7 mm. or 8 mm. in length. Midrib stout, prominent on the under and channeled on the upper side. Secondaries camptodrome, diverging at wide angles, immersed in the leaf substance. The leaf has been galleried by insect larvae and also shows suberized patches such as are commonly seen on the leaves of the existing species.

The present species agrees with the leaves of the existing *Rhizophora mangle* Linnaeus in general size, form, and texture; in the thin, open, wide angled, immersed secondaries; in the stout petiole; in the stout midrib, prominent on the lower and channeled on the upper surface; in the decurrent base. It differs in its inequilateral form and acuminate tip.

There are three existing species of *Rhizophora*. *Rhizophora mangle* of the American Tropics is found as far north as Mosquito Inlet and Cedar Key in peninsular Florida. It occurs throughout the Bahamas and Antilles and very generally throughout Central America and northern South America, having in comparatively recent times

extended its range northward from the Bahamas to Bermuda. On the west coast of America it is found from southern California to the Galapagos Islands. *Rhizophora mucronata* Lamarck ranges from southern Japan to northern Australia and westward to eastern Africa; *Rhizophora conjugata* Linnaeus is confined to tropical Asia. Doubtless modern systematists will differentiate additional specific forms, but judging by the rather uniform habits of these plants, such differentiation will be based upon minor features. The mangroves possess the singular ability of thriving in sea water, and their manner of life and development have become well adapted both structurally and physiologically to their mode of life, so that they have become widely disseminated and individually abundant. In fact they are the most remarkably specialized plants for their habitat that are known and their specialization appears to have been in a measure reached during the Tertiary period.

It is possible that leaves of this genus may not have been recognized although present in paleobotanical collections. However, since the genus is almost exclusively tropical and most known Tertiary floras are not strictly tropical, the geological record of *Rhizophora* may be as meager as it seems. Only three fossil species have heretofore been referred to *Rhizophora* and only one of these has any claim to such an affinity. A single specimen was described by Massalongo [25] from the later Tertiary (Messinian) of the east coast of Italy, and a second form was referred to this genus by Ettingshausen. The latter came from the Ligurian-Aquitanian of Austria and was compared with the existing *Rhizophora parvifolia* Roxburg of the East Indies.[26] The similarity of this form to various members of the Myrtaceae and Leguminosae, however, led Schenk to express doubts as to its identity.[27] The third and in my judgment only authentic fossil species, *Rhizophora eocenica* Berry [28] was described from the upper Eocene (Jackson) deposits of Georgia. The presence of a fossil species in the later Tertiary of Venezuela serves to explain, if explanation were needed, the presence of the modern mangrove on both the Atlantic and Pacific shores of America.

The present species is named for the collector C. F. Bowen, and comes from Betijoque.

Holotype.—Cat. No. 36442, U.S.N.M.

[25] Massalongo, A., Studii sulla flora fossile e geologia stratigraphica del Senigalliese, p. 407, 1859.
[26] Ettingshausen, C., Die Tertiare Flora von Haering in Tirol, p. 82, pl. 27, figs. 28, 29, 1853.
[27] Schenk, A., Zittel's Handbuch, Ab. 2, p. 632, 1890.
[28] Berry, E. W., U. S. Geol. Surv. Prof. Paper 84, p. 144, pl. 29, figs. 1, 2, 1914.

Order EBENALES (?).

Family SYMPLOCACEAE (?).

Genus ANTHOLITHUS Brongniart.

ANTHOLITHUS VENEZUELENSIS, new species.

Plate 107, fig. 5.

Calyx or coralla five parted, gamopetalous or gamosepalous, divided more than halfway to the base into five, broadly ovate, very faintly mucronate, divisions. Diameter, 5 mm. The matrix is coarse, so that the preservation is not of the best. The calyx or coralla is tiny and seems to have been of considerable consistency.

The botanical position of floral remains unless they are unusually well preserved, which they usually are not, is beset with almost unsurmountable difficulties. In the present case the small size precludes their reference to such genera as *Getonia*. After considerable comparison the choice of relationship appears to me to narrow to the order Ebenales, and more especially to the families Styracaceae and Symplocaceae. Both are still plentiful in the American Tropics; the latter, to which I tentatively refer the present specimen, having about one-third of the existing 150 to 200 species confined to the American, and chiefly the South American Tropics. The balance of the existing species are oriental and chiefly southeastern Asiatic.

A considerable number of fossil forms, both of *Symplocos* and *Styrax*, have been described. Thus there are about 15 forms of *Symplocos* recorded from the Oligocene and Miocene of Europe; and about 20 forms of *Styrax*, mostly from the European Tertiary, but including two forms from the early Eocene of the western United States, and two from the lower Miocene of Chile. In addition to the latter, Englehardt has described foliage of *Styrax* from near Santa Ana in the Magdalena Valley in Colombia,[29] and I have tentatively identified the same form from the Miocene of northern coastal Peru.[30]

The present specimen, of which the original and the counterpart are preserved, comes from 2½ miles northwest of La Salvadora.

Holotype.—Cat. No. 36443, U.S.N.M.

[29] Engelhardt, H., Abh. Senck. Naturf. Gesell., vol. 19, p. 32, pl. 5, fig. 9, 1895.
[30] Berry, E. W., Proc. U. S. Nat. Mus., vol. 55, p. 293, pl. 15, fig. 2, 1919.

Order GENTIANALES.

Family APOCYNACEAE.

Genus APOCYNOPHYLLUM Unger.

APOCYNOPHYLLUM SALVADORENSIS, new species.

Plate 107, fig. 6.

Leaves linear-lanceolate in outline, about 13 cm. in length and 2.4 cm. in maximum width, with a somewhat narrowed rounded base. Apex missing, so that the total length as given may be slightly overestimated. Margins entire, even. Petiole missing. Midrib thin on the upper surface of the leaf, stout and prominent on the lower surface. Secondaries numerous, thin, regularly spaced, subparallel and camptodrome.

This species is of a somewhat uncertain botanical affinity since it exhibits no conclusive diagnostic characters. It approaches most nearly to the various fossil species that have been referred to the form-genus *Apocynophyllum*, and which suggest various existing tropical genera of the family *Apocynaceae*, such as *Plumiera, Prestonia, Thevetia*, etc.

Three specimens are represented from the sandy clays 2½ miles northwest of La Salvadora.

Holotype.—Cat. No. 36444. U.S.N.M.

EXPLANATION OF PLATES.

PLATE 107.

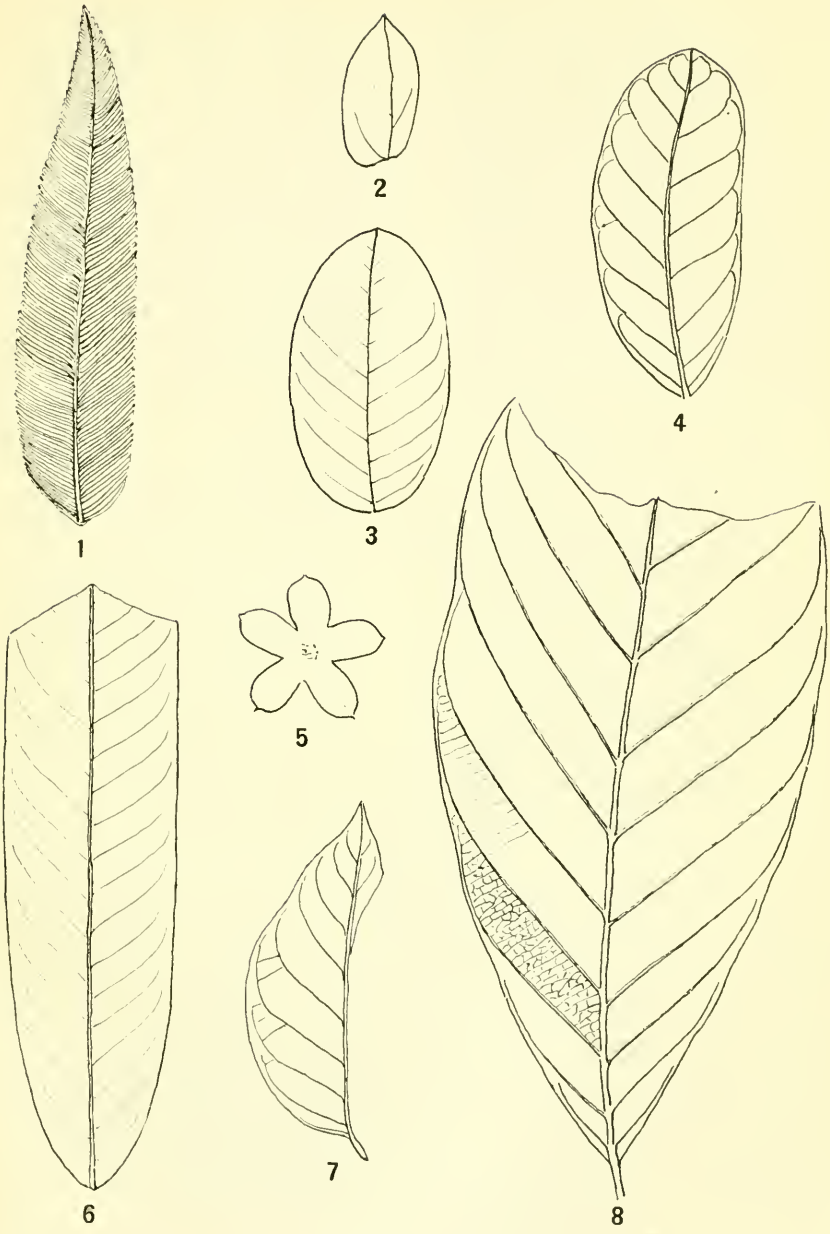
Fig. 1. *Blechnum betijoquensis*, new species. Betijoque.
2. *Leguminosites venezuelensis*, new species × 2. La Salvadora.
3. *Leguminosites entadaformis*, new species. La Salvadora.
4. *Sophira salvadorana*, new species. La Salvadora.
5. *Antholithus venezuelensis*, new species × 4. La Salvadora.
6. *Apocynophyllum salvadorensis*, new species. La Salvadora.
7. *Burserites venezuelana*, new species. La Salvadora.
8. *Trigonia varians* Engelhardt. Betijoque.

PLATE 108.

Figs. 1–4. *Coussapoa villosoides*, new species. Betijoque.
5. *Ficus betijoquensis*, new species. Betijoque.

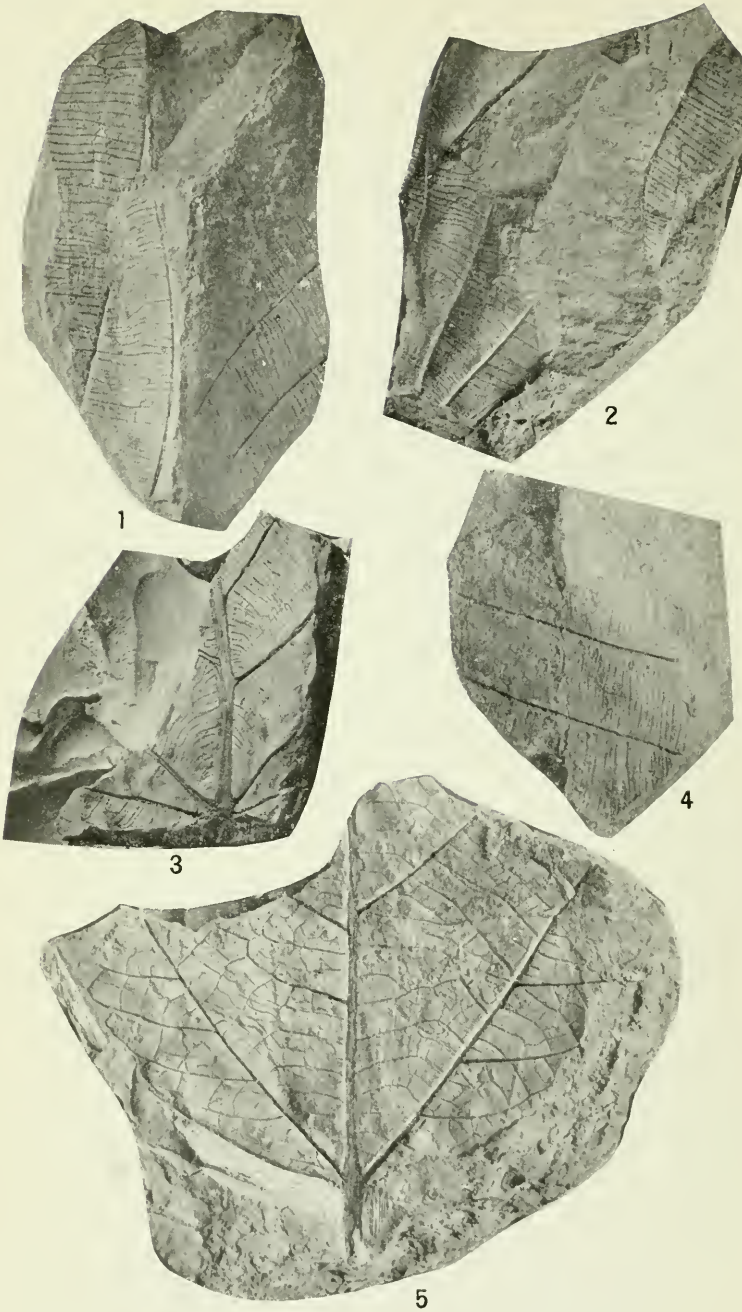
PLATE 109.

Fig. 1. *Entada boweni* Berry. Mesa Pablo.
2. *Simaruba miocenica*, new species. Betijoque.
3. *Sabalites*, species. Betijoque.
4. *Rhizophora boweni*, new species. Betijoque.



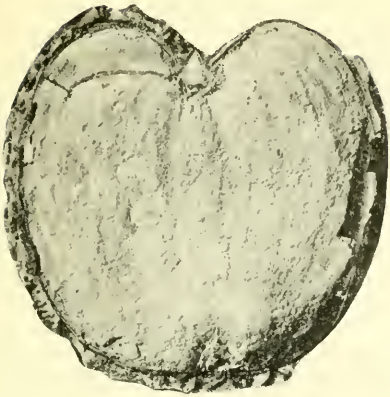
TERTIARY FOSSIL PLANTS FROM VENEZUELA.

FOR EXPLANATION OF PLATE SEE PAGE 579.



TERTIARY FOSSIL PLANTS FROM VENEZUELA.

FOR EXPLANATION OF PLATE SEE PAGE 579.



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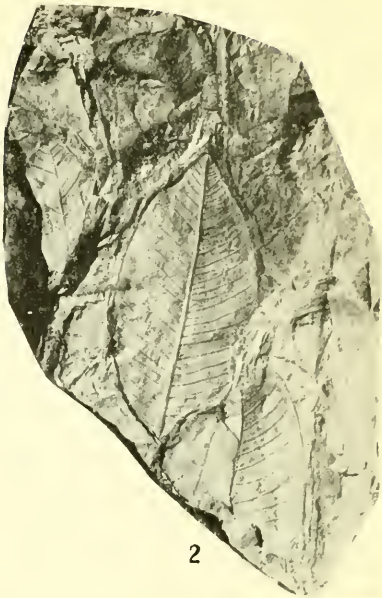

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TERTIARY FOSSIL PLANTS FROM VENEZUELA.

FOR EXPLANATION OF PLATE SEE PAGE 579.