

TERTIARY FOSSIL PLANTS FROM COLOMBIA, SOUTH AMERICA

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In a paper published in 1913 Father Miguel Gutiérrez¹ mentions trunks and impressions of dicotyledonous leaves associated with the coal seams at Guadalupe, but his conjectures regarding their probable identity are unreliable and his illustrations are unrecognizable. Aside from this paper I know of no publications on the Tertiary flora of Colombia other than those of Engelhardt and the present writer.

In 1895 Engelhardt² described 35 species of plants from the tuffs of Santa Ana in the upper Magdalena Valley, and 5 species from Buga in the Cauca Valley which he referred to the Tertiary. Several of these have been found in deposits of known Miocene age in Venezuela, Peru, southern Mexico, and Costa Rica, which would seem to indicate a Miocene age for these Colombian plants described by Engelhardt.

My contributions to Colombian paleobotany comprise the following descriptions of fruits and seeds: A *Simaruba* stone from Guasca; *Saccoglottis* stones from Cipacon and drupes of *Cordia* from Guasca, described in 1924;³ *Anacardium* fruits from Santo Ecce Homo, Boyacá;⁴ *Celtis* stones from Pijiaquay;⁵ *Vantanea* stones from Cipacon and a second species of *Anacardium* from Ovejas;⁶ and seeds of *Musa* from Guadalupe and Montserrat.⁷

A miscellaneous amount of leaf impressions and unrecognized carpalogical material has been awaiting study for several years, and it is the purpose of the present paper to place this material on record. For this material I am indebted to Maurice A. Rollot of Bogota, W. P. Woodring, and Robert Anderson. In a region so little known geologically it is impossible to be certain of the precise horizon of much of the material. This is especially true of the continental deposits, and too little is known of the fossil floras of tropical America for the plants themselves to afford accurate chronological

¹ Gutiérrez, M., *Geología de Bogotá y sus alrededores*, *Anales de Ingeniería*, vol. 20, pp. 313-331, 1913.

² Engelhardt, H., *Abh. Senck. naturf. Gesell.*, vol. 19, pp. 24-41, 1895.

³ *Bull. Torrey Bot. Club*, vol. 51, pp. 61-67, figs. 1-22, 1924.

⁴ *Amer. Journ. Sci.*, vol. 8, pp. 123-126, 1924.

⁵ *Torrey*, vol. 24, pp. 44-46, 1924.

⁶ *Pan Amer. Geol.*, vol. 42, pp. 259-262, 1924.

⁷ *Amer. Journ. Sci.*, vol. 10, pp. 530-537, 1925.

information. Large collections remain to be made, and eventually we may expect that the present lack of information will be remedied.

The present communication enumerates 16 species, of which 11 are new. Six are of carpological material and 10 are based upon leaves. Fifteen genera, 14 families, and 12 orders are represented. Especially interesting is a fragment of a *Zamia* pinnule, a fruit of a *Lepidocaryum*-like palm, a representative of the South American bamboos, and the fruit of *Theobroma* (cacao). Some of the material is precisely located both geographically and geologically and some is not, so that no ecological or chronological comments are warranted.

Order CYCADALES

Family CYCADACEAE

Genus *ZAMIA* Linnaeus

ZAMIA species

Plate 1, Figure 6

The single fragment upon which this identification is based is worthless from a specific standpoint, but of considerable interest as it appears to represent a pinnule of a *Zamia*. It indicates a fairly large, linear-lanceolate coriaceous pinnule, contracted toward the base, and with 12 or 13 stout parallel veins. The specimen comes from sandstone associated with the coal at Montserrat near Bogota.

Zamia with about 35 existing species is the dominant cycad genus of the Western Hemisphere, ranging from peninsular Florida and Mexico through the Antilles and Central America to eastern Bolivia and northern Argentina. Tertiary species have been found from latitude 36° 30' north to 41° 30' south and include 3 from the lower Eocene of southeastern North America, 2 from the Tertiary of Porto Rico, 1 from the Miocene of Chile, and 1 from the Oligocene (?) of Patagonia.

Order POALES

Family POACEAE

Tribe BAMBUSEAE

Genus *CHUSQUEA*

CHUSQUEA ROLLOTTI, new species

Plate 2

Large grass with relatively slender stems, large linear-lanceolate leaves, and expanded rhizomal internodes. The material is abundant but fragmentary and can be but incompletely described.

The leaves are of a considerable degree of consistency, narrowed to the sessile and slightly inequilateral base, with stout midveins and slender parallel lateral veins; they vary in maximum width from

less than 1 to over 2.5 centimeters; lengths of as much as 16 centimeters are preserved with the margins practically parallel, but in no cases are the tips preserved and these were presumably acuminate. The stems are longitudinally striated. There are several crushed internodes of rhizomes in the collection. In no case are these complete. All are flattened but are of considerable consistency; these internodes are about 6 to 7 centimeters in length, and 2.5 to 3.5 centimeters in diameter in their present condition; they show no details except the somewhat distorted thin vascular strands of the cortex. Named for the collector Dr. Maurice A. Rollot.

So far as I know this is the first published record of the occurrence of *Chusquea* as a fossil, although I have observed similar remains, probably of this genus, at a number of localities in Peru and Bolivia, and they are comparatively common in the tufaceous deposits of late Tertiary to Recent Age which are so widespread in the Andean region.

The present species occurs in a well-lithified gray shale associated with the coals of Usme and I am informed is the horizon known locally as the Piso Barzalosa. It is overlain by gypsiferous varicolored shales and underlain by black shales, and is said to be older than the coal-bearing beds of the Sabana of Bogota. The locality is La Virginia on the railroad about 15 kilometers from Girardot, Dept. of Cundinamarca.

The genus *Chusquea* has about 50 existing species, ranging from Mexico to southern Chile, and it is especially characteristic of the east Andean Ceja region, denoting an abundant water supply. Its present-day altitudinal limit under the equator is around 11,500 feet.

Order ARECALES

Family PALMAE

Subfamily LEPIDOCARYINAE

LEPIDOCARYOPSIS, new genus

LEPIDOCARYOPSIS ROLLOTI, new species

Plate 1, Figure 7

The single incomplete specimen upon which this species is based was sent to me by Dr. Maurice Rollot of Bogota along with other carpological material collected from the so-called Guaduas formation of that region, but I do not know the exact locality where the specimen was obtained. It is a cast in a fine-grained sandstone matrix and indicates a fruit prolate spheroidal in form, more narrowed toward the base than toward the apex, about 5 centimeters in diameter, covered with what were in life coriaceous scales, arranged in a low spiral. These scales are rhomboidal in shape, about a centimeter in width, bluntly pointed and overlapping (imbricated) in the direction of the base.

The species is named for the collector. There can be no doubt but that the fossil represents a nut of some Tertiary palm belonging to the subfamily Lepidocaryinae, but since the genus can not be ascertained I have coined the generic term *Lepidocaryopsis* for its reception. The reasons for uncertainty regarding the precise generic affinity of the fossil are the incomplete character of the type, the lack of generic differences in the fruits of the existing genera and the lack of sufficient recent comparative material. It may well be that the fossil belongs to one or the other of the three American tropical genera *Mauritia*, *Lepidocaryum*, and *Raphia*; in fact I regard this as very probable.

The genus *Mauritia* is confined to tropical South America with about 10 existing species; the genus *Lepidocaryum* has 5 or 6 Amazonian species and the genus *Raphia* has about 6 existing species ranging from Central America to Brazil and also represented in Africa. From the point of view of the existing distribution *Raphia* should be the oldest of the three and the fossil may well represent that genus, with which it agrees in so far as its features can be made out.

Order URTICALES

Family MORACEAE

Genus COUSSAPOA Aublet

COUSSAPOA AMPLA, new species

Plate 3

Leaves of large size, widest below the middle, with a bluntly pointed tip and a broadly truncated and slightly decurrent base. Margins entire. Texture coriaceous. Length about 19 centimeters. Maximum width about 15.5 centimeters. Petiole short and stout; in the single specimen in which this part is preserved it is only about 1 centimeter in length. Midvein exceedingly stout and prominent. Secondaries numerous, stout, and prominent; they diverge from the midvein at angles around 45° , pursue rather straight subparallel courses, and are abruptly camptodrome close to the margins. The secondaries are rather evenly spaced, except at the base, where two or three pairs are convergent near the top of the petiole. The imperfection of the material in the marginal region renders it impossible to state whether the secondaries send off lateral branches or not. Tertiaries faint, numerous, and percurrent. Areolation obsolete.

This fine species is unfortunately represented by an inadequate amount of broken material. It was collected by Maurice A. Rollot from the outcrop of coal-bearing Tertiary at the Falls of Tequendama, west of Bogota, and is probably Oligocene in age. If this is the correct age it is the oldest as well as one of the largest fossil species of *Coussapoa* known. It differs sufficiently from the known species to be readily recognizable, and hence obviates the necessity of contrasting the differences in the present connection. Several fossil

species of *Coussapoa* have been described in recent years from tropical America. These comprise forms from the Miocene of southern Mexico,⁸ Venezuela,⁹ Trinidad,¹⁰ Ecuador, and Bolivia.¹¹

The genus contains about 15 existing species of shrubs and trees confined to the rain forest country between southern Mexico and Brazil and the Bolivian Yungas.

COUSSAPOA GIGANTEA, new species

Plate 4

Leaves of large size, broadly ovate in outline, abruptly acute tipped, broadly cuneate or rounded at the base. Margins entire. Texture subcoriaceous. Length at least 25 centimeters. Maximum width, at or below the middle, 19 to 20 centimeters. Midvein extraordinarily stout and prominent. Secondaries stout and prominent, seven or eight pairs; they diverge from the midvein at wide angles proximad, becoming more ascending in the upper half of the leaf, curving regularly and camptodrome close to the margins. Tertiaries relatively very thin, closely spaced, parallel, and percurrent. Areolation obscure.

This species is based upon the single incomplete specimen figured. It is preserved in a sandstone and the finer features are consequently obscure. It unquestionably belongs to some member of the family Moraceae, and among these is more like the leaves of the genus *Coussapoa* than any other known to me, although it does not agree exactly with all the features of any existing species.

I am indebted to Robert Anderson for the specimen, which was found as float in the northwestern outskirts of Cali a few hundred feet north of Rio Cali at the edge of the Cauca Valley. It obviously had fallen from one of the thick, hard sandstone beds which are here interbedded with carbonaceous clays and sands. It is possibly of the same age as the Tertiary plants described by Engelhardt from Buga in the Cauca Valley.

Order ROSALES

Family MIMOSACEAE

Genus INGA Willdenow

INGA REISSI Engelhardt

Plate 5, Figure 1

Inga reissi ENGELHARDT, Abh. Senck. Naturf. Gesell., vol. 19, p. 36, pl. 8, figs. 1, 2; pl. 9, fig. 8, 1895.

This species, described by Engelhardt from rather abundant material from Santa Ana, Colombia, appears to be present in the older travertine near Leiva, Department of Bayaca.

⁸ Berry, E. W., Proc. U. S. Nat. Mus., vol. 62, art. 19, p. 6, pl. 2, 1923.

⁹ Berry, E. W., Idem, vol. 59, p. 563, fig. 2, pl. 108, figs. 1-4, 1921.

¹⁰ Hollick, A., Bull. New York Bot. Gard., vol. 12, p. 296, pl. 6, fig. 1, 1924.

¹¹ Berry, E. W., Johns Hopkins University Studies in Geology, No. 4, p. 168, pls. 4, 5, 1922.

Family CAESALPINIACEAE

Genus CYNOMETRA Linnaeus

CYNOMETRA MCGILLI, new species

Plate 1, Figures 8, 9

Pod rather small, inflated, tardily dehiscent. About half as wide and thick as long, uniformly rounded at both ends. Peduncle scar excentric toward the placental side, which is somewhat flattened and nearly straight; opposite side full and broadly curved in both lateral and terminal profiles. Valves very thick and leathery. Surface prominently corrugated by irregularly impressed grooves bounding rounded more or less warty ridges. Length, 2.7 centimeters; width, 1.3 centimeters; thickness, 1.4 centimeters. Named for the collector A. K. McGill.

This species is based upon the single valve figured. The only recent form which approaches it closely is the genus *Cynometra*, which comprises about 30 species of shrubs and trees found in all tropical lands. The recent specimens I have seen are drift material from San Miguel Bay in which the pods are about the same size but are considerably wider and the surface rugosities follow a somewhat different pattern from that of the fossil. All of the modern species have small leathery pods with thick, papilloso-ridged walls.

The fossil species is lower Miocene in age, and comes from Quebrada Pajuil west of Rio Sinu, Department of Bolivar, Colombia.

Order GERANIALES

Family HUMIRIACEAE

Genus SACCOGLOTTIS Martius

SACCOGLOTTIS CIPACONENSIS Berry

Plate 1, Figures 1-5

Saccoglottis cipaconensis BERRY, Bull. Torrey Bot. Club, vol. 51, p. 64, figs 20-22, 1924.

This species was based upon four specimens from the Guaduas formation at Cipacon, Department of Cundinamarca, and I have since received a large amount of material from the type locality.

The silicified fruits of *Saccoglottis* from Belen, Peru, which I referred to this species, I would now separate as they are prevailing 5-seeded whereas in the Cipacon material of 46 specimens 4 are 5-seeded, 33 are 6-seeded, 6 are 7-seeded, and 3 are 8-seeded.

There is no need to repeat the description of this form but several illustrations from photographs are given to show the range in size and form.

Order SAPINDALES

Family SAPINDACEAE

Genus SAPINDOIDES Perkins

SAPINDOIDES PERUVIANUS Berry

Plate 1, Figure 10

Sapindoides peruvianus BERRY, Pan Amer. Geol., vol. 47, p. 126, pl. 19, fig. 9, 1927.

This determination is based upon the single specimen figured, which appears to be identical with the type. It is especially interesting in having been collected from middle Eocene marine beds in Colombia. It was described originally from Belen in northwestern Peru and has also been recorded from the Ancon Point sandstone of western Ecuador. If I have been correct in identifying this species at these three widely scattered early Tertiary localities, these occurrences have a considerable value for purposes of correlation and also in their bearing upon environmental conditions.

Occurrence.—Middle Eocene. Arroyo 1½ miles east of Tolu Viejo on trail to Colodo, Department of Bolivar. Collected by A. Iddings and F. A. Sutton.

Order RHAMNALES

Family RHAMNACEAE

Genus GOUIANA Linnaeus

GOUIANA LEIVANA, new species

Plate 5, Figure 2

Leaves ovate-cordate, small, with a sharply but shortly pointed tip and an equilateral cordate base. Margins entire below, above with large and somewhat variable crenate teeth. Textures subcoriaceous. Length about 5.5 centimeters. Maximum width, about midway between the apex and the base, about 4 centimeters. Petiole not preserved. Midvein stout, prominent. A pair of stout lateral primaries diverge from the base of the midvein at angles of about 45° and sweep upward in broad even curves about two-thirds of the distance to the tip, where they join the lower secondaries. Secondaries relatively thin; about four camptodrome pairs in the upper half of the leaf; also as regularly spaced camptodrome outer branches from the lateral primaries. Tertiaries thin. Areolation indistinct.

This species bears considerable resemblance to part of the material from the tuffs of Santa Ana which Engelhardt included in his *Gouiana firma*.¹² The material has been compared especially with recent

¹² Engelhardt, H., Abh. Senck. Naturf. Gesell., vol. 19, p. 34, pl. 4, figs. 6, 7, 1895.

tropical American forms of various Sterculiaceae, *Triumfetta* (Tiliaceae) and Ulmaceae. There is considerable resemblance to certain species of *Momisia* in the last family, but the equilateral cordate base favors its reference to *Gouiana* in which a number of species, both in the new and old worlds, are very similar.

The fossil material comes from the older travertine at Leiva, Department of Boyaca.

The genus contains about two score species of herbs and climbing shrubs found in all the Tropics and occasionally in the sub-Tropics. Over half of the existing species are confined to northern South America. Several Tertiary species have also been described from the latter region.

Order MALVALES

Family STERCULIACEAE

Genus THEOBROMA Linnaeus

THEOBROMA FOSSILIUM, new species

Plate 1, Figures 13, 14

This is based upon a single specimen, which shows in natural section a nearly complete transverse and part of a tangential section of the fruit. The axis and thick walls as well as the seed coats have been replaced by calcium carbonate and the matrix and interstices between the seeds consist of a dark calcareous mudstone. The whole fruit is about 5 centimeters in diameter and oval instead of circular in cross section because of the abortion of the ovules in three of the cavities. The wall is lignous and about 6 millimeters in thickness, with a rough surface, but not appreciably ribbed or tuberculated. There are five cells, but seeds are matured in but two of these. The matured seeds are large and are oriented either horizontally or obliquely, and more or less radially to the axis. They are rounded at both ends and elliptical in cross section, the maximum equatorial diameter being about 10 millimeters and the minimum about 8 millimeters. The length is about 2 centimeters. The outer seed coat appears to have been smooth and is about 1 millimeter in thickness. The inner seed coat is prominently longitudinally striated.

The specimen is unfortunately incomplete. It was collected by Dr. Maurice A. Rollot at a locality called El Infierno, near Leiva, in the Department of Boyaca.

The geological age of the specimen is very uncertain. The country rock around the Leiva Valley is Cretaceous limestone (Hettner's *Villeta* beds) overlain by his Guaduas beds, here supposed to be of lacustrine origin. There are thermal springs near Leiva and travertine deposits, both ancient and modern. I have plants from both, but the lithology of the *Theobroma* matrix differs from both of these and

suggests that it may come from the Guaduas beds, but it would take a personal examination to settle the question and the age must therefore be considered conjectural.

The accompanying figures show both the transverse and tangential sections with the plant parts in white and the matrix and filling in black.

The genus *Theobroma* comprises about a dozen existing species of trees confined to the American Tropics, where they range from the warmer parts of Mexico to the upper Amazon. All are humid tropical types and the cultivated forms have been introduced into all tropical lands. This appears to be the first record of a fossil form, and it is particularly unfortunate that more material is not available and that the age can not be settled.

Order LAURALES

Family LAURACEAE

Genus PERSEA Gaertner filis

PERSEA CORIACEA Engelhardt (?)

Plate 5, Figure 3

Persea coriacea ENGELHARDT, Abh. Senck. Naturf. Gesell., vol. 19, p. 26, pl. 6, figs. 3, 4, 1895

Since the present material is very fragmentary certainty of identification is impossible, but the material is certainly lauraceous and appears to represent the species described by Engelhardt from Santa Ana, Colombia, as a *Persea*. There is much difficulty in discriminating fossil leaves of this family and similar leaves have also been referred to *Nectandra*, *Mespilodaphne*, and *Oreodaphne*. Hollick has recently referred similar leaves from the Tertiary of Porto Rico to the related genus *Aniba*.

Because of the incompleteness of the present material close comparisons are impossible and for the same reason there is no advantage in changing the genus to some other equally uncertain one, and the species is therefore retained as it was designated by Engelhardt. It comes from the older travertine at Leiva, Department of Boyaca.

Genus NECTANDRA Roland

NECTANDRA AREOLATA Engelhardt

Nectandra areolata ENGELHARDT, Abh. Senck. Naturf. Gesell., vol. 19, p. 29, pl. 6, figs. 1, 2, 1895.—BERRY, Proc. U. S. Nat. Mus., vol. 59, p. 177, pl. 27, 1921; vol. 62, art. 19, p. 19, pl. 4, fig. 3, 1923.

This species was described by Engelhardt from Santa Ana, Colombia, and recorded by me from the Miocene of Costa Rica and southern Mexico (Oaxaca).

Matted leaves that appear to represent the same species are present in the roofing shales of the coal near the Falls of Tequendama.

Order EBENALES

Family SAPOTACEAE

Genus **CHRYSOPHYLLUM** Linnaeus

CHRYSOPHYLLUM ROLLOTI, new species

Plate 5, Figure 5

Leaf elongate, ovate-lanceolate in outline, with a gradually narrowed acuminate tip. Texture somewhat coriaceous. The entire margins are somewhat irregular or undulate. Midvein stout, prominent. Secondaries thin, closely spaced, subparallel, and camptodrome; they diverge from the midvein at wide angles and curve sharply upward near the margins. Tertiaries obscure. Length (estimated) about 14 centimeters. Maximum width about 5.25 centimeters.

Although based upon incomplete material, the character of the venation stamps it as a *Chrysophyllum*. It is very similar to *Chrysophyllum ficifolia* Berry¹³ of the lower Eocene (Wilcox) of southeastern North America, and there are several recent species in northern South America and the Antilles with very similar leaves.

The genus is tropical and subtropical with about 60 existing species, which are largely American, although the genus is sparingly represented in all the other tropics. Several fossil species have been described.

The present species comes from the older travertine at Leiva, Department of Boyaca.

Order RUBIALES

Family RUBIACEAE

Genus **SABICEA** Aublet

SABICEA ASPERIFOLIA LANCEOLATA, new variety

Plate 5, Figure 4

After an extended comparison I have decided to describe this well-marked leaf as a variety of the species of *Sabicea* described by Engelhardt¹⁴ from the Tertiary at Buga in the Cauca Valley of Colombia.

Leaf lanceolate, widest at or slightly below the middle and tapering equally to the acuminate tip and to the acute slightly decurrent

¹³ Berry, Edward W., U. S. Geol. Survey, Prof. Paper 91, p. 335, pl. 100, fig. 7, 1916.

¹⁴ Engelhardt, H., Abh. Senck. Naturf. Gesell., vol. 19, p. 40, pl. 5, fig. 6; pl. 8, fig. 6, 1895.

base. Margins entire, sometimes slightly undulate. Texture subcoriaceous. Length about 10 centimeters. Maximum width 2.25 to 3.5 centimeters. Petiole very short and stout, expanded at the base. Midvein stout and prominent. Secondaries relatively thin, numerous, subparallel, diminishing in repeated flat archings in the marginal region which their distal ends parallel; their angle of divergence from the midvein is acute in the narrower leaves and obtuse in the wider leaves. Distal tertiaries precurrent, proximal occasionally anastomosing or crossed by tertiaries from the midvein and parallel with the secondaries.

I have compared the fossil with a variety of recent leaves, some few of which are worth mentioning. In the genus *Pilocarpus* the lanceolate forms of *Pilocarpus racemosus* Vahl, an Antillean and Central American species are much like the fossil, but there are minor differences in venation and the majority of leaves of *Pilocarpus*, even of the species mentioned, are different in form. I have also found leaves of *Rhabdodendron amazonicum* (Sprengel) Huber (Rutaceae) which were similar, but this species tends to have larger leaves which are frequently obovate or even emarginate, and all of the recent forms have prevalingly larger leaves. I have seen a few recent leaves from Colombia belonging to the genus *Quiina* Aublet somewhat similar to the fossil, but the majority show decided differences, and the same remark applies to the genus *Maytenus* in which the leaves are frequently toothed and the venation different, but in which *Maytenus myrsinoides* Riess approaches the fossil. The same is true of the genus *Casearia* Jacquin (Samydaceae) where the leaves are mostly toothed. Engelhardt compared the Buga fossil with the existing *Sabicea aspera* Aublet—a composite which has since been made the basis of several species, and the type of which is not especially close to the fossil. Most of the existing species of *Sabicea*, which are about 35 in number and include both shrubs and climbers, have relatively slightly shorter and wider leaves which are conspicuously hirsute, pilose, or canescent. They are largely American but occur also in the African tropics. The most similar one seen is *Sabicea glabrescens* Benthham of northern South America in which the variation in form is matched among the several fossil specimens. The latter come from the older travertine at SÁCHICA near Leiva, Department of Boyaca.

INCERTAE SEDIS

CARPOLITHUS BOLIVARENSIS, new specie-

Plate 1, Figures 11, 12

I am unable at present to suggest the botanical affinity of this specimen, although it is sufficiently characteristic to be readily recognized if it should turn up in future collections, or be encountered in existing carpolithological material.

It appears to represent a seed with an indurated outer coat. It is almost perfectly fusiform in shape except for a slight flattening of the sides which give it a trigonal cross section. Ends about equally bluntly pointed. Length, 2.25 centimeters; maximum diameter, in the middle, about 8.5 millimeters. No structural details can be made out.

There is some resemblance to the seeds of the Sapindaceous genus *Talisia* Aublet, but this is not especially marked and probably without significance. I have no doubt but that with more extensive comparative material its relationship could be determined.

It comes from the middle Eocene between Arroyo Mancaniajor and Ovejas, Department of Bolivar, and was collected by R. L. Bechelaymer.

EXPLANATION OF PLATES

PLATE 1

- FIGURES 1-5. Four side views and an apical view of *Saccoglottis cipaconensis* Berry.
 6. *Zamites* species.
 7. *Lepidocaryopsis rolloti* new species.
 8, 9. Front and side views of *Cynometra mcgilli* new species.
 10. *Sapindooides peruvianus* Berry.
 11, 12. Transverse profile and side view of *Carpolithus bolivarensis*, new species.
 13, 14. Transverse and tangential views of *Theobroma fossilium* new species. All natural size.

PLATE 2

- FIGURES 1-4. *Chusquea rolloti*, new species.
 Figure 1. View showing part of a leafy branch. $\frac{1}{2}$ natural size.
 Figures 2-4. Rhizome joints, $\frac{1}{2}$ natural size.

PLATE 3

Coussapoa ample, new species. $\times 1$.

PLATE 4

Coussapoa gigantea Berry, new species. $\frac{1}{2}$ natural size.

PLATE 5

- FIGURE 1. *Inga reissi* Engelhardt.
 2. *Gouiana leivana*, new species.
 3. *Persea coriacea* Engelhardt (?).
 4. *Sabicea asperifolia lanceolata*, new variety.
 5. *Chrysophyllum rolloti*, new species.





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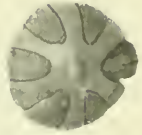
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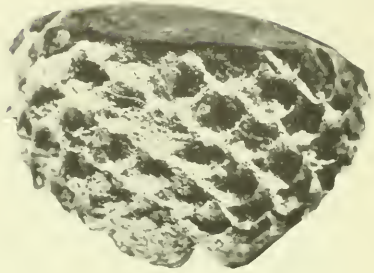
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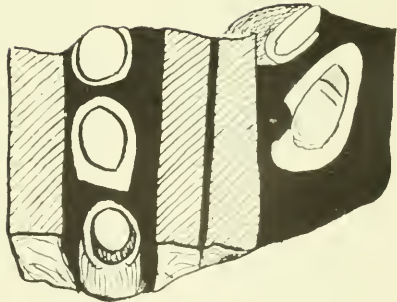
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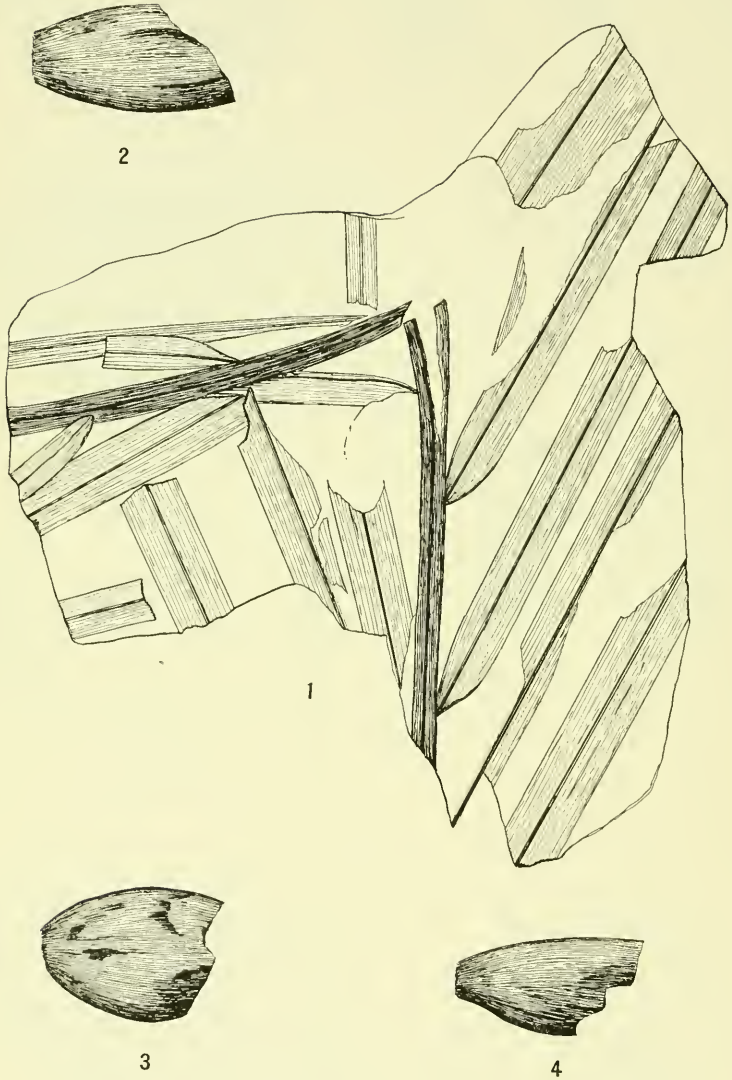
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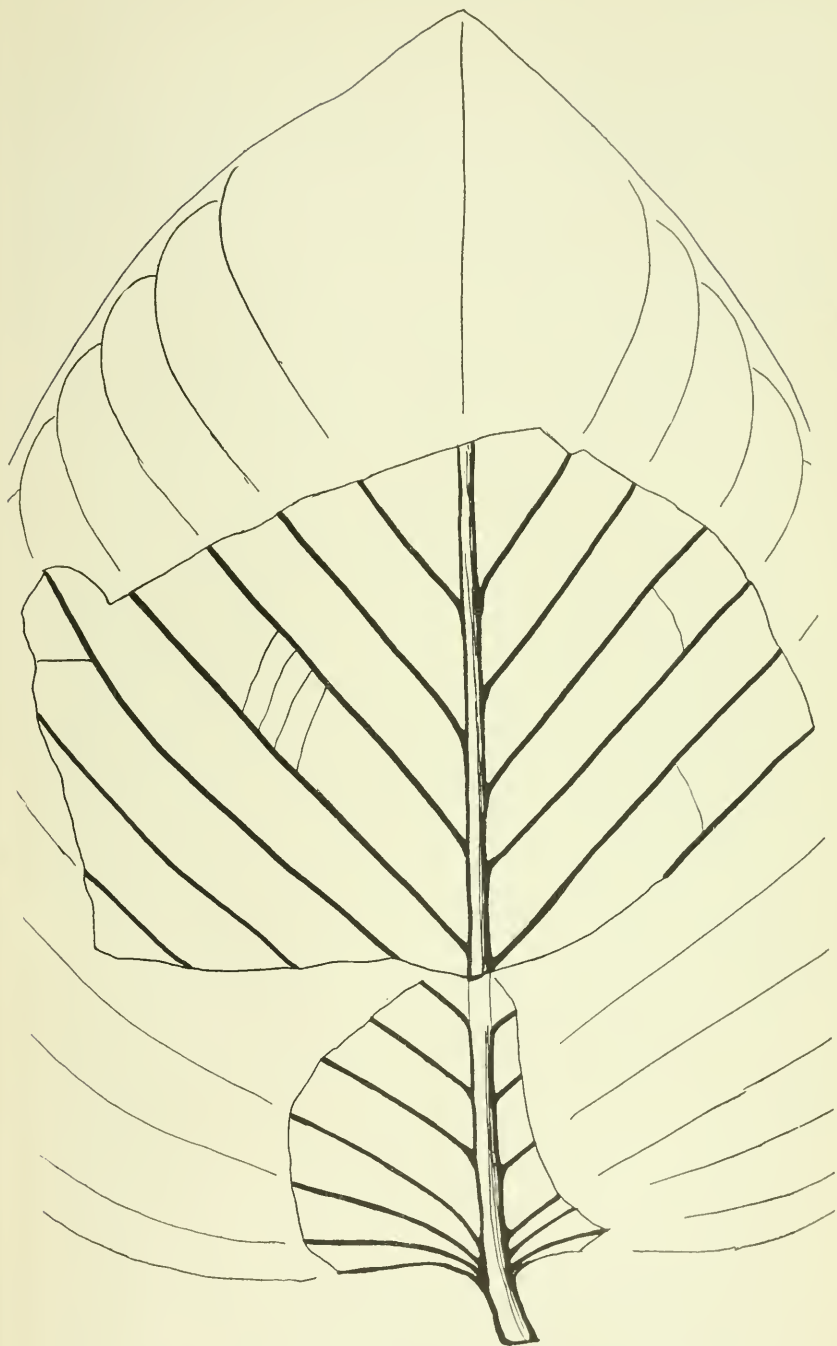
TERTIARY FOSSIL PLANTS FROM COLOMBIA

FOR EXPLANATION OF PLATE SEE PAGE 12



TERTIARY FOSSIL PLANTS FROM COLOMBIA

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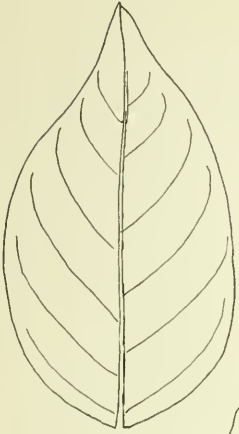
TERTIARY FOSSIL PLANTS FROM COLOMBIA

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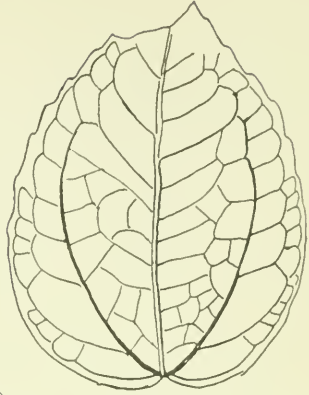


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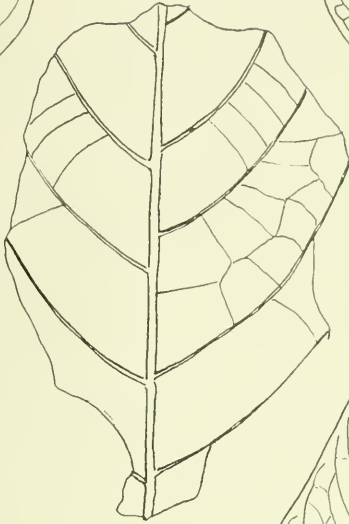
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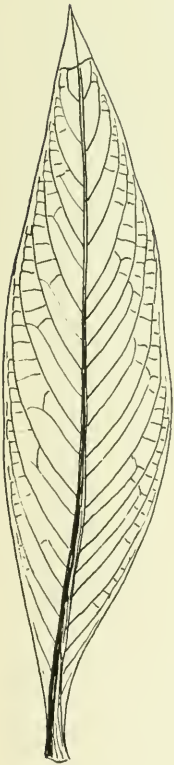
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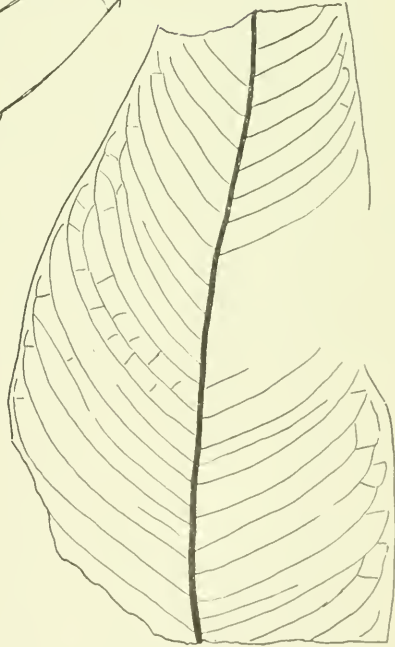
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TERTIARY FOSSIL PLANTS FROM COLOMBIA

FOR EXPLANATION OF PLATE SEE PAGE 12