

## MIOCENE PLANTS FROM SOUTHERN MEXICO.

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I am indebted to the Compañía Transcontinental de Petroleo for the collections described in the present paper. They were made by Dr. Bruce Wade from several localities in the vicinity of Palomares in the State of Oaxaca and near San Jose del Carmen in the south-eastern part of the State of Vera Cruz, on the Isthmus of Tehuantepec. He informs me that fossil plants are present at several additional localities, as for example Ixhuatlan and Tecuanapa, and that detailed collecting would probably yield from 100 to 150 species. It is much to be hoped that additional collections may become available as the country is opened up by the various oil companies.

The fossil plants described in the present paper possess unusual value despite their limited variety from the fact that they are contained in a shallow water marine series carrying an abundant fauna, and thereby afford opportunities for comparisons between the marine fauna so common throughout tropical America and the scattered florules described by the writer from Panama,<sup>1</sup> the Dominican Republic,<sup>2</sup> Costa Rica,<sup>3</sup> Venezuela,<sup>4</sup> and Haiti.<sup>5</sup> The types have been deposited in the United States National Museum.

The Isthmus of Tehuantepec is a low saddle in the backbone of Central America, nowhere over a hundred meters above sea level and in marked contrast in this respect with the broken country lying to the immediate east and west. It is a region of many lagoons and flooded areas both along both coasts and in the interior. The climate is moist tropical with a mean temperature of about 70°. From September to February the winds are prevailing northerly and hence cool, bringing rather continuous light rains. The so-called dry season extends over the months of March, April, and May, with

<sup>1</sup> U. S. Nat. Mus. Bull. 103, pp. 15-44, pls. 12-18, 1918.

<sup>2</sup> U. S. Nat. Mus. Proc., vol. 59, pp. 117-127, pl. 21, 1921.

<sup>3</sup> *Idem*, pp. 159-185, pls. 22-27.

<sup>4</sup> *Idem*, pp. 553-579, pls. 107-109.

<sup>5</sup> *Idem*, vol. 62, art. 14.

southerly winds and tropical showers, and these increase throughout the summer, nearly every day having its afternoon tropical down-pour. Except for the slightly drier belt along the Pacific coast very little of the country is cleared, and then only along the rivers. Most of it, probably about 99 per cent, is tropical rain forest of mixed angiosperms. Some cane, oranges, and cocoa are cultivated and much chicle is gathered, but the population is sparse except along the south coast and in the uplands to the east and west of the low country of the isthmus, and trails are few and poor.

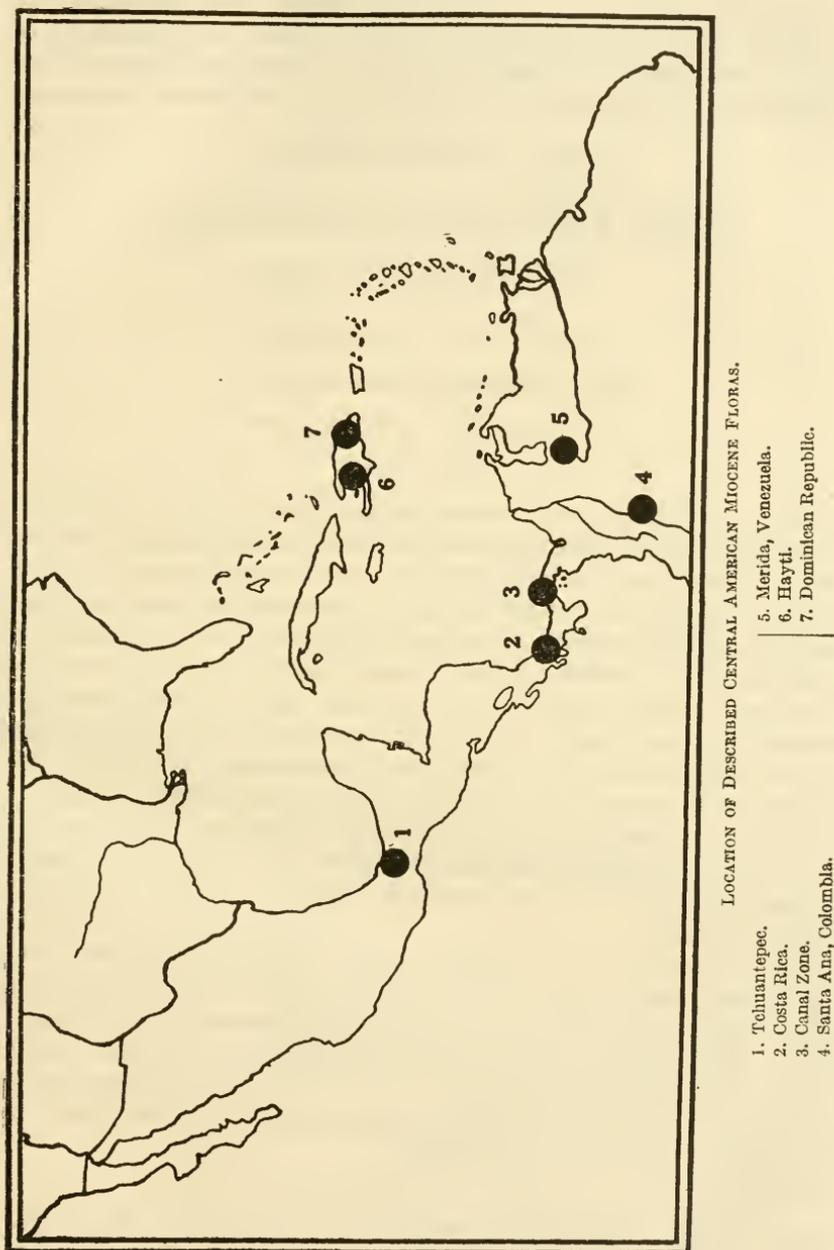
The shores are skirted with thickets of Leguminosae, coco-palms, and Hippomane. Low shores and inlets are covered with mangrove plants (*Rhizophora*, *Avicennia*, *Conocarpus*, etc.) and the less saline marshes abound in *Acrostichum*, *Crescentia*, etc. Prominently represented in the existing flora of the isthmus are various species of the families Lauraceae, Myrtaceae, Anacardiaceae, Anonaceae, Leguminosae, Sapotaceae, Malpighiaceae, and Meliaceae. Species of the following genera are especially characteristic: *Acrostichum*, *Coccolobis*, *Lonchocarpus*, *Haematoxylon*, *Inga*, *Dalbergia*, *Ficus*, *Banara*, *Fagara*, *Cedrela*, *Achras*, *Leucaena*, *Erythrina*, *Crescentia*, and *Exostema*. Six of these genera are represented in the Miocene flora of this region.

The described fossil flora comprises 33 species, all but 4 of which are new. There are 2 ferns, 1 monocotyledon, and 30 dicotyledons. The last represent 11 orders and 20 families. The largest order is the Rosales, with five families and seven species. The orders Geraniales, Thymeleales, and Myrtales follow, with four species each. The largest single family is the Lauraceae, with four species, and the families represented by more than a single species (two each) are the Moraceae, Melastomataceae, Apocynaceae, Bignoniaceae, and Rubiaceae.

The fossil flora, like that of the recent lowland flora of the same region, is essentially South American in its facies. It is strictly tropical except for the presence of Liquidambar fruits, representing a genus still present near by at elevations over 800 meters, and which may have been washed into the basin of sedimentation from Miocene uplands near at hand.

Too little is known about the fossil floras of the Tertiary of tropical America to enable precise age determinations to be made. Intrinsically the flora obviously belongs in the Neogene division of the Tertiary. The only species positively identified which has an outside distribution is *Nectandra areolata* which occurs in Colombia and in the Miocene of Costa Rica. Less certainly determined forms with an outside distribution are *Ficus talamancana* and *Goepertia tertiaria*, which occur in the Miocene of Costa Rica, and *Guettarda cookei*, which occurs in the Miocene of the Dominican Republic. The fossil

floras with which the Tehuantepec flora may be compared are located on the accompanying sketch map.



The associated marine fauna which will settle the age question has received only a preliminary examination. As exemplified by the collection from the marls of Santa Rosa (identified by J. A. Gardner

and W. P. Woodring) it comprises 349 species, and suggests a middle Miocene age (Helvetian). Monographic studies of this fauna which are projected may of course modify this tentative opinion somewhat.

A brief sketch of the geology of the isthmus was published by Böse <sup>6</sup> in 1906 and in this paper the presence of fossil plants at several localities is mentioned although apparently no collections were made.

## Phylum PTERIDOPHYTA.

### Class LEPTOSPORANGIATAE.

#### Order POLYPODIALES.

#### Family POLYPODIACEAE.

#### Genus GYMNOGRAMME (of authors).

#### GYMNOGRAMME WADII, new species.

Plate 1, fig. 2.

The absence of fruiting material makes it impossible to determine the exact position of this characteristic fossil fern and I have therefore referred it to what must be regarded as a composite genus, *Gymnogramme*. This type of sterile pinnule is common to a variety of tropical ferns, as for example, *Lomariopsis*, *Blechnum*, etc. The species, which is new, is named for the collector, and may be characterized as follows: Frond pinnate (?). Pinnules large, oblong-lanceolate, subcoriaceous, acuminate at both ends, about 14 cm. in length and 4 cm. in maximum width. Margins somewhat irregular, entire, inclined to be revolute. Midvein wide, not prominent, channeled. Laterals prevailingly simple, closely spaced, parallel, diverging from the midvein at wide angles, approximately 90°, and nearly straight in passing outward to the margins, in which regions they curve slightly upward.

This is a well marked element in the Tehuantepec Miocene flora. Among previously described fossil forms the only one approaching it is *Gymnogramme woodringi* Berry <sup>7</sup> of the Miocene of the island of Haiti. Many recent American forms match it more or less closely.

*Occurrence*.—Isthmian railroad  $\frac{3}{4}$  km. north of Palomares on Saravia estate, State of Oaxaca;  $1\frac{1}{2}$  km. west of telegraph station San Jose del Carmen, State of Vera Cruz.

*Holotype*.—Cat. No. 36811, U. S. N. M.

<sup>6</sup> Böse, E., Excursion a l'isthme de Tehuantepec, 10th Int. Geol. Congress, Mexico, 1906.

<sup>7</sup> Berry, E. W., Proc. U. S. Nat. Mus., vol. 62, art. 14.

## Genus ACROSTICHUM Linnaeus.

## ACROSTICHUM MEXICANUM, new species.

Plate 1, fig. 3.

Fronde large, of unknown habit, presumably pinnate. Pinnæ thin but coriaceous, lanceolate or oblong-lanceolate in outline. Apex unknown. Base acuminate, sessile. Margins entire, somewhat irregularly undulate. Length unknown, but considerable. Maximum width observed, slightly over 4 cm. Midvein stout and prominent, somewhat flexuous. Venation of the lamina consisting of very thin intricately anastomosing nervilles, the meshes of which in the narrow base of the pinna are elongated parallel with the midvein; higher up they turn outward, forming an angle of about 45° with it.

This obviously new species is represented by the single incomplete specimen figured. It represents a most interesting genus, prominent in coastal floras of the Eocene of the United States, and occurring also during that time in Europe. Several fossil species have been described and these disappear from present day temperate latitudes during the Oligocene. The modern species, as the genus is now understood, are few in number, and comprise in addition to several unimportant Carribean species, the wide ranging tropical *Acrostichum aureum*, a common coastal species of the mangrove and Nipa swamps, and similar situations, more especially of the less saline and less wet soils of the warmer regions of the world. In America it ranges northward to southern peninsular Florida and southward to southern Brazil, and it is especially common on the Atlantic side of southern Mexico and Central America. In Africa it ranges from Guinea to Natal, and in the Mascarene and Seychelles islands. In the Orient it ranges from southern China to northern Australia and Polynesia. It is most natural as well as gratifying to find it represented by a similar fossil species in the Miocene of southern Mexico.

*Occurrence.*—Isthmian railroad  $\frac{3}{4}$  km. north of Palomares on Saravia estate, State of Oaxaca.

*Holotype.*—Cat. No. 36812, U. S. N. M.

## Phylum ANGIOSPERMOPHYTA.

## Class MONOCOTYLEDONAE.

## Order ARECALES.

## Family ARECACEAE.

## PALM RAYS.

Plate 5, fig. 4.

There are numerous broken rays of a palm in the collection from the Saravia estate. They are small and slender, but whether they

are the terminal attenuations of large rays, or belong to a species of feather of fan palm, can not be conclusively determined. Similar broken rays in the muds of estuaries and coastal lagoons are frequent in warm latitudes at the present time.

*Occurrence*.—Isthmian railroad  $\frac{3}{4}$  km. north of Palomares on Saravia estate, State of Oaxaca.

*Holotype*.—Cat. No. 36813, U. S. N. M.

## Class DICOTYLEDONAE.

### Order URTICALES.

#### Family MORACEAE.

#### Genus COUSSAPOA Aublet.

#### COUSSAPOA VERACRUZIANA, new species.

#### Plate 2.

Leaves of large size, broadly ovate in general outline, widest medianly, with a bluntly pointed tip and a wide cordate base. Margins entire, slightly undulate. Texture coriaceous. Length about 15 cm. Maximum width about 13 cm. Petiole stout, prominent on the under surface of the leaf. Secondaries eight or nine subopposite to alternate pairs, diverging from the midrib at irregular intervals and varying angles ranging from  $90^\circ$  at the base to  $20^\circ$  in the tip of the leaf; they are stout and prominent, and relatively straight in their courses; the basals are short and camptodrome; the next pair likewise camptodrome, are short and give off on their outer sides three or four camptodrome tertiaries; the third pair are long and ascending and suggest incipient lateral primaries, giving off two or three stout camptodrome branches from their outer sides; the remaining secondaries give off stout lateral branches two-thirds of the distance above their bases. The internal tertiaries are relatively stout and well marked on the lower surface of the leaf; they are very closely spaced and largely percurrent at right angles to the secondaries; they frequently anastomose, especially toward the periphery of the leaf, in which region they are slightly more openly spaced. The nervilles are prevailingly at right angles to the tertiaries, are rather well marked, and anastomose to form a very fine mesh.

The present species is exceedingly well marked and also exceedingly like the existing Central American species *Coussapoa ruizii* Klotsch and *Coussapoa villosa* Poeppig and Endlicher. It is also very similar to *Coussapoa villosoides* Berry<sup>3</sup> of the Miocene of

<sup>3</sup> Berry, E. W., Proc. U. S. Nat. Mus., vol. 59, p. 563, text fig. 2, pl. 108, figs. 1-4, 1921.

Venezuela, differing from the latter in the usually branched condition of the secondaries, in the less stout midrib, in the character of the basal secondaries, and in the tertiary venation of the basal margins. The secondaries are also less regularly spaced, the maximum width is higher above the base, and the tertiaries anastomose more frequently. The material from Tehuantepec is also much more nearly complete than that from Venezuela.

A third fossil species, with a tripalmate primary venation is exceedingly abundant in the Pliocene of eastern Bolivia and will shortly be published. The genus contains about 15 existing species of shrubs and trees, all of which exhibit the characteristic venation exhibited by these fossil forms, even a small fragment being unmistakable. They are confined to the rain forest country between southern Mexico and Brazil and Bolivia

*Occurrence*.—Small arroya  $1\frac{1}{2}$  km. west of telegraph station, San Jose del Carmen, State of Vera Cruz.

*Holotype*.—Cat. No. 36814, U. S. N. M.

#### Genus *FICUS* Linnaeus.

##### *FICUS TALAMANCANA* Berry (?).

Plate 3, fig. 7.

*Ficus talamancana* BERRY, Proc. U. S. Nat. Mus., vol. 59, p. 172, pl. 23, 1921.

Leaves elliptical to broadly lanceolate in general outline, with an apiculate acuminate tip and a decurrent base; of relatively large size. Margins entire and full. Texture subcoriaceous. Length ranging from 12 to 16 cm. Maximum width, in the median region, ranging from 5 to 7 cm. Petiole stout. Midrib very stout, prominent on the under surface of the leaf, relatively narrow on the upper surface. Secondaries eight or nine subopposite to alternate pairs, diverging from the midrib at wide angles of about  $75^\circ$  to  $80^\circ$ , curving regularly but slightly, and camptodrome in the marginal region. Tertiaries thin, forming an open, prevailing quadrangular, minute areolation, partly consisting of percurrent nervilles.

A single fragment of a leaf unlike anything else in the collection is referred with some hesitation to this species which was founded upon somewhat larger leaves from the Miocene of Costa Rica. In some respects it invites comparisons with the genus *Anona*, and only the collection of more complete material will set the present doubts at rest.

*Occurrence*.—Isthmian railroad  $\frac{3}{4}$  km. north of Palomares on the Saravia estate, State of Oaxaca.

*Plesiotype*.—Cat. No. 36815, U. S. N. M.

## Order RANALES.

## Family ANONACEAE.

## Genus ANONA Linnaeus.

## ANONA SARAVIANA, new species.

Plate 3, fig. 2.

Leaves of medium size, ovate in general outline, with a broadly ultimately decurrent base, and a conspicuously acuminate tip. The complete specimen figured is markedly inequilateral but whether or not this was a constant character is not determinable. Margins entire, somewhat irregularly flexuous. Length about 10 cm. Maximum width, at or below the middle, about 4.8 cm. Petiole missing. Midrib stout, prominent, and curved. Secondaries thin but prominent, about 10 regularly spaced subparallel pairs diverge from the midrib at angles of from  $50^{\circ}$  to  $60^{\circ}$  and are somewhat abruptly camptodrome, particularly toward the apex of the leaf, the lower ones arching more or less along and subparallel with the margins. Tertiaries thin but well marked, forming an open polygonal areolation.

Nearly all of the three score or more existing species of *Anona* are American, ranging from southern peninsular Florida to Brazil, and especially common around the perimeters of the Caribbean. The genus was undoubtedly of American origin and of the score of more of known fossil forms, four well marked species occur in the lower Eocene of the Mississippi embayment region; there is an upper Eocene species in the coastal plain of Texas, and Miocene species are known from Costa Rica and Venezuela. There are also several Miocene and Pliocene species from Peru, Bolivia, and Chile.

This new species is markedly distinct from any of the foregoing, and is rather smaller than most of them. Among recent forms it is surprisingly close to *Anona lutescens* Safford of southern Mexico and Guatemala.

*Occurrence.*—Isthmian railroad  $\frac{3}{4}$  km. north of Palomares on the Saravia estate State of Oaxaca.

*Holotype.*—Cat. No. 36816, U. S. N. M.

## Order ROSALES.

## Family ROSACEAE.

## Genus MOQUILLEA Aublet.

## MOQUILLEA MEXICANA, new species.

Plate 3, fig. 1.

Leaves obovate, with a bluntly pointed or broadly rounded apex, and cuneate base. Margins entire, full and evenly rounded. Leaf

substance thin, but firm and resistant. Petiole missing. Midrib mediumly stout and prominent, somewhat flexuous. Secondaries few in number, thin, four pairs diverge from the midrib at angles of about  $45^\circ$  and sweep upward in broadly ascending curves, sub-parallel with one another and with the lateral margins of the leaf, they are subacrodrome in appearance and are eventually lost in the gradually diminishing arches along the margins. Tertiaries thin, more or less percurrent. Aerolation fine, polygonal. Length about 6 centimeters. Maximum width about 3 centimeters.

This perfectly characteristic leaf has some features suggestive of the genera *Bumelia* or *Bucida*, but after much search among recent material, it appears to me to be most similar to the genus *Moquillea*. The latter comprises about a score of species of shrubs and trees of tropical South America, one of which extends northward an undetermined distance into Central America. The only other known fossil form is *Moquillea stübeli* described by Engelhardt<sup>9</sup> from the Miocene of Santa Ana in the Magdalena Valley, Colombia. The latter although similar to the Mexican species is more distinctly elliptical in form, but is undoubtedly closely related to it, thus emphasizing once more the South American facies of the Miocene Tehuantepec flora.

*Occurrence*.— $6\frac{1}{2}$  to 7 km. northwest of Palomares, State of Oaxaca  
*Holotype*.—Cat. No. 36817, U. S. N. M.

### Family CONNARACEAE.

#### Genus CONNARUS Linnaeus.

#### CONNARUS CARMENENSIS, new species.

Plate 3, fig. 6.

Leaves ovate in general outline, widest below the middle and more narrowed distad. Apex acute. Base broadly cuneate. Margins entire, full but somewhat irregularly rounded. Texture subcoriaceous. Length about 10.5 cm. Maximum width about 5 cm. Petiole missing. Midrib stout and prominent, conspicuously thinning distad. Secondaries few and remote, mostly alternate, about four pairs diverging from the midrib at angles of about  $45^\circ$ , curving upward and ascending parallel with the lower lateral margins, sometime forking in the marginal region, and sometimes regularly camptodrome. Tertiaries mostly percurrent but often anastomosing midway between the secondaries. The fine areolation characteristic of the genus is not preserved.

This obviously new species appears to be most closely related to the leaves of the modern species of *Connarus*, although it resembles

<sup>9</sup> Abh. Senck. Naturf. Gesell., vol. 19, p. 36, pl. 4, fig. 11, 1895.

somewhat the leaves of the Malpighiaceae. The genus *Connarus* has over 50 existing species about equally divided between the Old and New World tropics. In America it is represented from the Antilles to Brazil by trees or high climbing shrubs. I know of no previously described fossil species.

*Occurrence*.—1½ km. west of telegraph station, San Jose del Carmen, State of Vera Cruz; Isthmian railroad ¾ km. north of Palomares on the Saravia estate, State of Oaxaca.

*Holotype*.—Cat. No. 36818, U. S. N. M.

## Order SAPINDALES.

### Family ANACARDIACEAE.

#### Genus ANACARDITES Saporta.

##### ANACARDITES LANCEOLATUS, new species.

Plate 6, figs. 1, 2.

The genus *Anacardites* of Saporta affords a convenient resting place for fossil leaves of the Anacardiaceae of doubtful generic identity. The present species may be described as follows: Leaves or leaflets of variable size; lanceolate in outline; about equally acuminate at the apex and base, the latter slightly inequilateral in all the specimens seen and this feature is probably to be interpreted as meaning that the fossils are the leaflets of a compound leaf. Margins entire. Texture subcoriaceous. Length ranging from 4 to 8 cm. Maximum width ranging from 11 to 18 mm. Petiole or petiolule short and stout, 2 to 3 mm. in length. Midrib relatively very stout and prominent. Secondaries stout, numerous, closely and regularly spaced, subparallel; they diverge from the midrib at wide angles of from 60° to 70°, curve regularly, but slightly upward, thinning in the marginal region, and losing their identity in one or two camptodrome arches. Tertiaries thin but well marked, largely percurrent. Areolation fine, isodiametric.

This well marked form shows clearly the characters of the Anacardiaceae, and in many respects suggests the genus *Spondias*, which is an exceedingly common one in tropical America.

A considerable number of species have been referred to *Anacardites*, there being six of these in the Eocene of southeastern North America.

*Occurrence*.—6½ to 7 km. northwest of Palomares, State of Oaxaca.

*Cotypes*.—Cat. No. 36819, 36844, U. S. N. M.

## Family HAMAMELIDACEAE.

Genus LIQUIDAMBAR Linnaeus.

LIQUIDAMBAR INCERTA, new species.

Plate 3, fig. 5.

From the locality near San Jose del Carmen there are five specimens of fruits that are indistinguishable from fruits that I have described under the above name from the Tertiary of the Mississippi embayment.<sup>10</sup> They appear to represent ferruginous mud casts of the capsular cavities with the beaks worn away, and are similar in appearance to specimens from both the European and North American late Tertiary that have been referred to *Liquidambar europaeum* Alex. Braun and *Liquidambar styraciflua* Linnaeus. Their reference to *Liquidambar* is by no means conclusive, and I have suggested this uncertainty in the specific name *incerta*. It is possible that they may represent some unknown form of Moraceae or Rubiaceae. On the other hand *Liquidambar* is a warm temperate type which is still found in southern Mexico above 800 meters, but not in the tropical altitudinal zone. It may be that these fruits were brought down to sea level by streams from some adjacent Miocene upland, which would explain the absence of leaves.

The geological history of *Liquidambar* has been discussed both by the writer<sup>11</sup> and by Laurent.<sup>12</sup> The existing species are four in number and botanically very similar although geographically remote, being segregated in the southeastern United States, the uplands of Central America, Asia Minor, and southeastern Asia.

*Occurrence*.—1½ km. west of telegraph station San Jose del Carmen, State of Vera Cruz.

*Holotype*.—Cat. No. 36820, U. S. N. M.

## Family MIMOSACEAE.

Genus INGA Willdenow.

INGA MIOCENICA, new species.

Plate 5, fig. 3.

Leaflets relatively small, sessile, broadly lanceolate, slightly falcate, and markedly inequilateral in outline. Apex and base about equally and markedly acuminate. Margins entire. Texture not

<sup>10</sup> Berry, E. W., U. S. Geol. Survey Prof. Paper 92 (in press).

<sup>11</sup> Berry, E. W., *Plant World*, vol. 22, pp. 345-352, 1919.

<sup>12</sup> Laurent, L., *Ann. Mus. d'Hist. Nat. Marseille*, vol. 17, pp. 9-27, 1919.

shown in the limited material collected, although all of the forms collected at this locality are maceration resisting forms. Length about 6 cm. Maximum width, about midway between the apex and the base, about 1.85 cm. One side of the lamina full below and narrowed above, the opposite side narrowed below and full above. Maximum difference in width of the two sides about 2 mm., but this is no measure of the marked inequilateral appearance of these leaflets. Midrib curved and prominent, not stout except proximad where it expands abruptly to the sessile base. Secondaries well marked, of medium size and prominence, seven regularly curved camptodrome ones in the broader half of the lamina; six in the narrower half, the basal of which are straight and ascending, the distal of which are more curved and camptodrome like those of the opposite side. Tertiaries thin, largely percurrent.

This distinct type shows very conclusively the foliar features of an *Inga*, many species of which genus have been recognized in recent years in the warmer Tertiary floras of the Western Hemisphere. The present species is not particularly close to any of these, but is, on the other hand, very similar to several Central American and northern South American existing forms. The genus is a large one to which new species are being constantly added. The latest published enumeration<sup>13</sup> lists 9 species from Mexico, and their variety increases southward, 14 being listed from Panama and Colombia, 29 from Peru, and 66 from Brazil. The genus, although present, is much more sparingly represented in the Antilles than on the mainland. The known fossil Miocene species of this general region comprise one from Colombia,<sup>14</sup> one from Panama,<sup>15</sup> one from Costa Rica,<sup>16</sup> and one from the Dominican Republic.<sup>17</sup>

*Occurrence*.—1½ km. west of the telegraph station San Jose del Carmen, State of Vera Cruz.

*Holotype*.—Cat. No. 36821, U. S. N. M.

### Family PAPILIONACEAE.

#### Genus *DIOCLEA* Humboldt, Bonpland, and Knuth.

##### *DIOCLEA* (?) *MEXICANA*, new species.

Plate 1, fig. 4.

Leaflets broadly lanceolate in outline; widest in the middle or slightly below the middle; slightly more tapering distad than proximad; about equally acute at both ends. Margins entire, full and

<sup>13</sup> Pittier, H., Cont. U. S. Nat. Herb., vol. 18, pt. 5, 1916.

<sup>14</sup> Engelhardt, H., Abh. Senck. Naturf. Gesell., vol. 19, p. 36, pl. 8, figs. 1, 2; pl. 9, fig. 8, 1895.

<sup>15</sup> Berry, E. W., U. S. Nat. Mus. Bull. 103, p. 32, pl. 16, fig. 2, 1918.

<sup>16</sup> Berry, E. W., Proc. U. S. Nat. Mus., vol. 59, p. 174, pl. 25, fig. 2, 1921.

<sup>17</sup> Idem., p. 120, pl. 21, fig. 11.

evenly rounded. Texture subcoriaceous. Length about 7.5 to 8 cm. Maximum width about 3 cm. or slightly more. Petiolule not preserved. Midrib stout. Secondaries very thin, numerous, ascending, camptodrome. Tertiaries obsolete.

In some of its features this form suggests such a lauraceous genus as *Mespilodaphne* but the secondaries are more numerous and much less prominent and the character of their endings is leguminous and not lauraceous. Among the great variety of the former alliance the present species appears to resemble the genus *Dioclea* more closely than any of the others. This genus consists of about 20 existing species of high climbing shrubs, mostly South American, but represented in Central America. The only previously described fossil species known to me is a broader ovate one from the Aquitanian of Carniola.<sup>18</sup>

The genus is still sparingly represented in the oriental tropics.

*Occurrence*.—Isthmian railroad  $\frac{3}{4}$  km. north of Palomares on the Saravia estate, State of Oaxaca.

*Holotype*.—Cat. No. 36822, U. S. N. M.

#### LEGUMINOSAE INCERTAE.

Genus **LEGUMINOSITES** Bowerbank.

**LEGUMINOSITES MEXICANUS**, new species.

Plate 4, fig. 1.

Leaflets short petiolulate; ovate and inequilateral in outline; widest below the middle, narrowing upward to a short angular tip; wide and rounded at the base. Margins entire. Texture coriaceous. Length about 3.25 cm. Maximum width about 2.5 cm. Petiolule short, stout and curved, expanded proximad, 2 mm. or less in length. Midrib stout, prominent on the under side of the leaflet, becoming thin distad. Secondaries thin but well marked; eight or nine pairs diverge from the midrib at wide angles, pursue rather straight outward courses, and are camptodrome. Tertiaries obsolete because of the alteration of the leaf substance since burial to a carbonaceous film which slacked in drying.

This appears to me to represent a leguminous leaflet, and the following genera in which certain of the species have very similar leaflets may be enumerated: *Cassia*, *Dalbergia*, *Erythrina*, *Leptolobum*, *Machaerium*, *Pithecolobium*, and *Pterocarpus*. I have no doubt that the fossil represents one of these genera and with better preserved and more abundant material it might be possible to reach a decision. If a guess were permitted I would say it represented either a *Dalbergia* or an *Erythrina*, meanwhile it is referred to the form-genus *Leguminosites*.

<sup>18</sup> Ettingshausen, C. von, Foss. Fl. von Sagor, pt. 2, p. 46, pl. 19, figs. 6-8, 1877.

*Occurrence.*—1½ km. west of the telegraph station San Jose del Carmen, State of Vera Cruz.

*Holotype.*—Cat. No. 36823, U. S. N. M.

**LEGUMINOSITES OAXACENSIS, new species.**

Plate 3, fig. 3.

A flat, narrow, several seeded leguminous pod, prominently margined, of unknown length, about 8.5 mm. wide, the valves coarsely reticulate veined, the seeds lenticular.

This fragment is of unknown botanical affinity and might represent one of many diverse genera of the leguminous alliance. Although probably not of any especial significance the Mexican fossil is much like fragments described by Engelhardt from Loja, Ecuador, as *Leguminosites machaeroides*, *grandis*, and *cassioides*.<sup>19</sup>

*Occurrence.*—Isthmian railroad ¾ km. north of Palomares on the Saravia estate, State of Oaxaca.

*Holotype.*—Cat. No. 36824, U. S. N. M.

**Order GERANIALES.**

**Family RUTACEAE.**

**Genus FAGARA Linnaeus.**

**FAGARA WADII, new species.**

Plate 1, fig. 5.

Leaflets practically equilateral, of medium size, orbicular to elliptical in general outline, being widest in the middle and approximately equally rounded at the apex and base. Margins entire. Texture subcoriaceous. Length ranging from 3.7 to 5 cm. Maximum width ranging from 2.6 to 3.3 cm. Petiolule short, stout, and expanded, about 2 mm. in length. Midrib stout, prominent on the lower surface of the leaflet. Secondaries mediumly stout, five or six subopposite to alternate pairs; these are somewhat unequally paced, subparallel with one another and with the lower lateral margins of the leaflet; they become more ascending and more curved in apical region, arching along the margins, with camptodrome endings. The tertiaries are thin, partially obsolete, those seen are percurrent.

This species conforms closely to the leaves of the existing species of *Fagara* and to some of the abundant fossil forms of the Oligocene of the southern United States, the genus, often confused with its derivative *Zanthoxylon*, appears in the Cretaceous of southeastern North America, and remains a member of the flora of that region throughout

<sup>19</sup> Engelhardt, H., Abh. Senck. Naturf. Gesell., vol. 19, p. 22, pl. 3, figs. 7-9b, 1895.

the Eocene, Oligocene, and lower Miocene. The present species is not unlike *Fagara catahoulensis orbiculata* Berry,<sup>20</sup> but shows its distinctness in its more numerous, thinner secondaries, its elliptical instead of orbicular form, and indistinct areolation. It also resembles somewhat the antecedent *Fagara claibornensis* Berry<sup>21</sup> and *Fagara petraflumensis* Berry<sup>22</sup> of the middle and upper Eocene. The existing species of *Fagara* number over 150 shrubs and trees, cosmopolitan in the warmer parts of the world and including a number of distinctly coastal types.

*Occurrence.*—Isthmian railroad  $\frac{3}{4}$  km. north of Palomares on Saravia estate; 100 meters east of old trans-Isthmian road and Arroya Limon,  $6\frac{1}{2}$  km. northwest of Palomares, State of Oaxaca.

*Holotype.*—Cat. No. 36825, U. S. N. M.

## Family EUPHORBIACEAE.

### Genus DRYPETES Vahl.

#### DRYPETES ELLIPTICA, new species.

Plate 7, fig. 5.

Leaves small, elliptical in general outline; widest medianly and narrowed about equally to the similarly rounded apex and base, the latter slightly broader than the former. Margins entire. Texture subcoriaceous. Length about 5.5 cm. Maximum width about 2.7 cm. Petiole missing. Midrib stout. Secondaries stout, widely spaced, about five subopposite pairs; they diverge from the midrib at wide angles and form wide camptodrome arches some distance within the margins. Tertiaries forming successive arches in the marginal region; internally forming open polygonal meshes. Areolation fine, quadrangular or polygonal, isodiametric.

This type of leaf makes its appearance in the fossil record in the lower Eocene of the Mississippi embayment region and has continued to exist in the Caribbean area from that time to the present. The existing species number about a dozen, ranging from southern peninsular Florida to Brazil. The fossil is not unlike the leaves of the existing white wood, *Drypetes keyensis* Urban, a considerable tree of south Florida and the Antilles. It is also not unlike the Wilcox species *Drypetes prekeyensis* Berry<sup>23</sup>.

*Occurrence.*—Isthmian railroad  $\frac{3}{4}$  km. north of Palomares on the Saravia estate, State of Oaxaca.

*Holotype.*—Cat. No. 36826, U.S.N.M.

<sup>20</sup> Berry, E. W., U. S. Geol. Survey Prof. Paper 93, p. 240, pl. 59, figs. 1-3, 1916.

<sup>21</sup> and <sup>22</sup> Berry, E. W., Idem., 92 (in press).

<sup>23</sup> Berry, E. W., U. S. Geol. Survey Prof. Paper 91, p. 253, pl. 53, fig. 4, 1916.

## Family MELIACEAE.

## Genus CEDRELA Linnaeus.

## CEDRELA MIOCENICA, new species.

Plate 7, fig. 1.

Leaflets sessile, lanceolate-falcate, widest at or below the middle, narrowing upward to the acute tip, and downward to the acuminate base. Margins entire. Texture coriaceous. Length about 8 cm. Maximum width about 1.7 cm. Midrib stout, prominent, curved. Secondaries thin, numerous, subparallel, camptodrome. Tertiaries not visible in the collected material.

This species, which is obviously new, represents a leaflet of a pinnate leaf, of a form rather commonly referred to the genus *Sapindus* by paleobotanists. It appears to me, however, to be more properly compared with *Cedrela*. The latter genus has about a dozen existing species, confined to the American tropics, and largely on the mainland of Central and South America. The only known American fossil species are those described by me from the Eocene of southeastern North America.

*Occurrence*.—1½ km. west of the telegraph station, San Jose del Carmen, State of Vera Cruz.

*Holotype*.—Cat. No. 36827, U.S.N.M.

## Family SIMARUBACEAE.

## Genus SIMARUBA Aublet.

## SIMARUBA VERACRUZIANA, new species.

Plate 7, fig. 6.

Leaflets sessile (?), elliptical in general outline, with a rounded base and an abruptly acuminate tip. Margins entire, evenly rounded. Texture coriaceous. Length about 5 cm. Maximum width, midway between the apex and the base, about 2.6 cm., the one half of the lamina slightly wider than the other, and the tip markedly inequilateral. Midrib stout, curved, prominent on the under side of the leaflet. Secondaries thin, largely immersed, numerous, closely and fairly regularly spaced; they diverge from the midrib at wide angles of between 60° and 70°, pursue practically straight subparallel courses outward and have their tips connected by an arching marginal vein. Areolation not visible in the collected material.

There is some doubt regarding the generic reference of this species because of the limited amount of material and the general similarity to the leaves of certain genera of tropical American Myrtaceae and Sapotaceae.

The genus *Simaruba* in the existing flora contains a limited number of species of arborescent forms, confined to the Americas, where they range from southern Florida through the Antilles to Brazil, and extend northward from South America in the *tierra caliente* of Central America. Fossil species have seldom been recognized, but these include a species in the lower Eocene of southeastern North America<sup>24</sup>, a second and very conclusively identified form in the Miocene of Venezuela,<sup>25</sup> and a third in the Miocene of the Island of Haiti.<sup>26</sup>

*Occurrence.*—1½ km. west of the telegraph station, San Jose del Carmen, State of Vera Cruz.

*Holotype.*—Cat. No. 36828, U.S.N.M.

## Order RHAMNALES.

### Family RHAMNACEAE.

#### Genus GOUANIA Linnaeus.

#### GOUANIA MIOCENICA, new species.

Plate 7, fig. 4.

Leaves of medium size, widest medianly, elliptical-ovate in general outline. Apex bluntly pointed. Base broadly rounded, the margins forming a wide, scarcely perceptible angle where they join the top of the petiole. Leaf substance thin. Margins entire for a greater or less distance above the base, becoming gradually and increasingly undulate distad, until in the upper half of the leaf they are coarsely and regularly crenate-undulate. Length about 6 cm. Maximum width about 4.25 cm. Petiole missing, presumably short. Midrib thin, but prominent. Secondaries six subopposite to alternate pairs, they are thin but prominent and diverge from the midrib at angles ranging from about 55° in the basal pair to 25° in the distal pair; all curve regularly upward subparallel with one another and with the lower lateral margins of the leaf; they ascend in sweeping curves which brings the distal ends of the proximal pair well above the middle of the leaf, and are ultimately camptodrome. The basal secondaries give off on their outer sides four or five sweepingly curved camptodrome tertiaries. The second pair of secondaries also frequently give off laterally one or two similar but smaller camptodrome tertiaries. The enclosed tertiaries are thin, closely spaced, well marked, percurrent nervilles such as commonly characterize the leaves of this family.

<sup>24</sup> Berry, E. W., U. S. Geol. Survey Prof. Paper 91, p. 252, pl. 54, fig. 7, 1916.

<sup>25</sup> Berry, E. W., Proc. U. S. Nat. Mus., vol. 59, p. 573, pl. 109, fig. 2, 1921.

<sup>26</sup> Berry, E. W., Idem, vol. 62, art. 14, p. 6, pl. 1, fig. 8, 1922.

The genus is otherwise unknown in the fossil state except for two very similar species described by Engelhardt<sup>27</sup> from a probably similar Miocene horizon in the Magdalena valley of Colombia. The existing species number more than 40, mostly climbing shrubs, and occur in all tropics, but fully half of that number are peculiar to the rain forest country of the Amazon basin and adjacent regions.

*Occurrence.*—Isthmian railroad  $\frac{3}{4}$  km. north of Palomares on the Saravia estate, State of Oaxaca.

*Holotype.*—Cat. No. 36829, U. S. N. M.

## Order THYMELEALES.

### Family LAURACEAE.

#### Genus NECTANDRA Roland.

##### NECTANDRA TEHUANTEPECENSIS, new species.

Plate 1, fig. 6.

Leaves of medium size, lanceolate in outline, somewhat falcate, widest medianly and equally acutely pointed at the apex and base. Margins entire. Texture coriaceous. Length about 9 to 10 cm. Maximum width 3.8 cm. Petiole stout, its length unknown. Midrib stout, prominent on the under side of the leaf, curved. Secondaries stout, prominent, subparallel, and camptodrome about 10, mostly alternate, regularly spaced pairs diverge from the midrib at angles of about 45°, sweeping upward in ascending regular curves. With the exception of a few percurrent nervilles the tertiaries are obsolete by immersion.

This is a typical *Nectandra*, very similar to several existing and fossil species. Among the latter it is not unlike *Nectandra gosportensis jacksonensis* Berry<sup>28</sup> of the upper Eocene of the Gulf border of the United States, and may possibly represent a more southern Miocene survivor of that form.

The existing species of *Nectandra* number about 70 and are confined to the tropical and subtropical parts of the Western Hemisphere. They, along with other members of the family Lauraceae are especially massed in the rain forests of northern South America, and this South American facies, recognized in the existing flora of the Mexican lowlands, appears to have been foreshadowed during the Tertiary.

*Occurrence.*—Isthmian railroad  $\frac{3}{4}$  km. north of Palomares on the Saravia estate, State of Oaxaca.

*Holotype.*—Cat. No. 36830, U. S. N. M.

<sup>27</sup> Engelhardt, H., Abh. Senck. Naturf. Gesell., vol. 19, pp. 33, 34, pl. 4, figs. 4-7, 1895

<sup>28</sup> Berry, E. W., U. S. Geol. Survey Prof. Paper 92 (in press).

## NECTANDRA AREOLATA Engelhardt.

Plate 4, fig. 3.

*Nectandra areolata* ENGELHARDT, Abh. Senck. Naturf. Gesell., vol. 10, p. 29, pl. 6, figs. 1, 2, 1895.—BERRY, Proc. U. S. Nat. Mus., vol. 59, p. 177, pl. 27, 1921.

Leaves of large size, elliptical acute in general outline, widest in the middle and equally pointed at both ends. Margins entire slightly undulate. Texture coriaceous. Length about 18 cm. Maximum width about 7.5 cm. Petiole short and stout, about 1 cm. in length. Midrib stout, prominent on the under side of the leaf. Secondaries stout proximad, becoming thin distad, prominent on the lower surface of the leaf; 8 to 10 somewhat irregularly spaced pairs diverge from the midrib at angles of 45° or more, and curve regularly upward, ending in camptodrome arches along the margins. Tertiaries well marked, percurrent. Areolation open, polygonal.

This species was described by Engelhardt from the Miocene of Santa Ana, Colombia, and compared with the existing *Nectandra gardneri* Meissner. It was based upon rather imperfect material, but more complete specimens were subsequently described by the present writer from the Miocene of Costa Rica. It is common in the Tehuantepec Miocene and tends to strengthen the conviction that the Colombia, Costa Rica, and south Mexican beds are very similar in age.

*Occurrence*.—Isthmian railroad  $\frac{3}{4}$  km. north of Palomares on the Saravia estate, State of Oaxaca.

*Plesiotype*.—Cat. No. 36831, U. S. N. M.

## Genus MESPILODAPHNE Nees.

## MESPILODAPHNE PALOMARESENSIS, new species.

Plate 1, fig. 1.

Symmetrical ovate-lanceolate leaves of small to medium size, widest medianly and about equally acuminate at the apex and base; with evenly curved, entire margins; and subcoriaceous texture. Length about 7 cm. Maximum width about 2.75 cm. Petiole stout, presumably long, but preserved for only a short distance. Midrib stout, prominent, straight. Secondaries mediumly stout, regularly spaced, subparallel and camptodrome; about seven subopposite pairs diverge from the midrib at angles of about 55° or 60°, curving regularly upward. The areolation is indistinctly preserved.

Among previously described fossil forms this species falls naturally in the group which includes *Mespilodaphne pseudoglauca* Berry and *Mespilodaphne couchatta* Berry of the lower Eocene of southeastern North America<sup>29</sup>. It is quite possible that this Miocene species

<sup>29</sup> Berry, E. W., U. S. Geol. Survey Prof. Paper 91, pp. 306, 307, pl. 80, figs. 4, 6; pl. 87, fig. 3, 1916.

of southern Mexico represents a southward restriction of descendants of these Eocene forms. It is also similar to *Mespilodaphne hispaniolana* Berry of the Miocene of the Island of Haiti<sup>30</sup>. It is much like numerous existing species of *Mespilodaphne*. The genus contains numerous existing species confined to the American tropics.

*Occurrence*.—Isthmian railroad  $\frac{3}{4}$  km. north of Palomares on the Saravia estate, State of Oaxaca.

*Holotype*.—Cat. No. 36832, U. S. N. M.

**Genus GOEPPERTIA** Nees.

**GOEPPERTIA** c.f. **TERTIARIA** Berry.

Plate 5, fig. 5.

*Goepertia tertiaria* BERRY, Proc. U. S. Nat. Mus., vol. 59, p. 176, pl. 25, fig. 1, 1921.

Leaves of medium size, elliptical oval in general outline, widest below the middle, with an acute tip and a rounded base. Margins entire, full and evenly rounded. Texture coriaceous. Length about 12 cm. Maximum width about 5.75 cm. Petiole missing. Primaries three, supra basilar, all prominent on the lower surface of the leaf, the midrib stoutest; the laterals diverge from the midrib about 5 mm. above its base, at acute angles of about 25°, curving upward. Secondaries comprise a few camptodrome pairs in the tip of the leaf, several broadly curved ascending ones from the outer sides of the lateral primaries, and an opposite pair from near the base of the midrib. The tertiaries are thin and percurrent, or inosculate midway between the primaries or secondaries and primaries. Areolation a fine polygonal lauraceous mesh.

This is a type commonly referred to *Cinnamomum* and I know of no certain characters for distinguishing certain species of *Goepertia* and *Cryptocarya* from that genus, and am therefore inconsistent in not adhering to custom. The present species is very similar to several species of *Goepertia*, a genus with numerous existing species confined to the American tropics, and I am also influenced by the large number of almost exclusively tropical American species of the tribe *Cryptocaryeae* that have leaves of the *Cinnamomum* type. The present species was described originally from the Miocene of Costa Rica and is represented by a single, slightly smaller fragment in the Mexican Miocene, which is certainly very closely allied to, if not identical with, the Costa Rican type.

*Occurrence*.—Isthmian railroad  $\frac{3}{4}$  km. north of Palomares on the Saravia estate, State of Oaxaca.

*Plesiotype*.—Cat. No. 36833, U. S. N. M.

<sup>30</sup> Berry, E. W., Proc. U. S. Nat. Mus., vol. 62, art. 14.

## Order MYRTALES.

## Family MYRTACEAE.

## Genus MYRCIA DeCandolle.

## MYRCIA SARAVIANA, new species.

Plate 5, fig. 1.

Leaves small, ovate-lanceolate and falcate; widest below the middle and tapering upward to the acuminate tip, and downward to the acute base. Margins entire, slightly undulate. Texture subcoriaceous. Length about 3.5 cm. Maximum width about 1 cm. Petiole missing. Midrib stout, curved. Secondaries numerous, approximately straight, subparallel; diverging from the midrib at wide angles, their tips connected by a slightly arched, acrodrome marginal vein.

The present species may be readily matched by the leaves of several existing species of this genus. Among previously described fossil forms it appears to be most similar to *Eugenia ovalifolia* Engelhardt<sup>31</sup>, described from the Tertiary basin of Loja in Ecuador. *Myrcia* was present around the shores of the Gulf of Mexico and the Caribbean from the Upper Cretaceous to the present, and a considerable number of fossil forms have been described in recent years. The existing species number over 400 and are confined to the American tropics, being especially massed in northern South America.

*Occurrence*.—Isthmian railroad  $\frac{3}{4}$  km. north of Palomares on the Saravia estate, State of Oaxaca.

*Holotype*.—Cat. No. 36834, U. S. N. M.

## Family LECYTHIDACEAE.

## Genus LECYTHIDOPHYLLUM, new genus.

## LECYTHIDOPHYLLUM COURATARIOIDES, new species.

Plate 6, figs. 3, 4.

Leaves of large size, obovate and somewhat inequilateral in general outline, widest above the middle. Apex abruptly and bluntly angular. Base cuneate, markedly inequilateral. Margins entire, somewhat undulate. Texture subcoriaceous. Length about 17 cm. Maximum width about 7 cm. Petiole stout, its length unknown. Midrib stout and prominent. Secondaries stout, about nine subopposite pairs diverge from the midrib at angles of about 55°, curving regularly upward, subparallel and ascending, arching close to the margins until their identity is lost in the tertiary areolation. Tertiaries thin, very closely spaced, obliquely and irregularly percurrent,

<sup>31</sup> Engelhardt, H., Abh. Senck. Naturf. Gesell., vol. 19, p. 16, pl. 1, fig. 14, 1895.

curving and inosculation in an intricate fashion, and connected by cross nervilles, forming lanceolate meshes whose long axes are at an angle of about 60° with the midrib.

Although the type material is somewhat broken the peculiar venation stamps this form as a distinct type in this flora, and one that is clearly referable to the family Lecythydaceae. In the presence of some doubt as to the most closely related existing genus of this peculiar and interesting family I have proposed the form genus *Lecythydophyllum* for its reception. The family is essentially South American but *Grias*, *Couroupita*, *Japarandiba*, and perhaps others occur in Central America. Very few fossil forms have been compared with the existing members of this family. The genus *Couratari* Aublet is represented in the Miocene of Ecuador<sup>32</sup> by a form not very dissimilar from the present species, and a species of *Lecythis* has been described from the lower Miocene of Chile.<sup>33</sup> The present occurrence represents, as far as I know, the first record of a fossil member of the family outside of South America.

*Occurrence*.—Isthmian railroad  $\frac{3}{4}$  km. north of Palomares on the Saravia estate, State of Coxaca.

*Cotypes*.—Cat. No. 36835, 36845, U. S. N. M.

### Family MELASTOMATACEAE.

#### Genus MELASTOMITES Unger.

#### MELASTOMITES ANGUSTUS, new species.

Plate 6, fig. 5.

Leaves of small size, lanceolate in outline, widest below the middle and acuminate at both ends, the apex being slightly more narrowed than the base. Margins entire. Texture subcoriaceous. Length about 5 cm. Maximum width about 1.2 cm. Apparently sessile. Midrib curved, relatively very stout. Lateral primaries one on each side, thin, suprabasilar, acrodrome; connected with the midrib by numerous, closely spaced, approximately straight nervilles; giving off on the outside numerous thin camptodrome branches.

This small leaf, although not unlike forms frequently referred to the genus *Cinnamomum* of the Lauraceae, is considered by me to represent the family Melastomataceae, which is such an extensive modern family and so largely developed in the American tropics. None of the few fossil forms that have been recognized are similar to the present species. The genus is present near the Oligocene-Miocene boundary in Panama and in the Miocene of the Dominican Republic.

<sup>32</sup> Engelhardt, H., Abh. Senck. Naturf. Gesell., vol. 19, p. 24, pl. 2, figs. 3-4a, 1895.

<sup>33</sup> Engelhardt, H., Idem., vol. 16, p. 677, pl. 10, fig. 1, 1891.

*Occurrence*.—8 km. west of Palomares at the head of Arroya Zapote, State of Oaxaca.

*Holotype*.—Cat. No. 36836, U. S. N. M.

**MELASTOMITES OBOVATUS, new species.**

Plate 6, fig. 6.

Leaves relatively short and broad, obovate or subelliptical and somewhat inequilateral in general outline; with broadly rounded apex and slightly narrowed base. Margins entire. Texture subcoriaceous. Length about 4.5 cm. Maximum width about 2 cm. Apparently sessile. Primaries five, thin, subequal, diverging from the base of the leaf at acute angles and acrodrome; the outer ones marginal; connected by nearly straight, transverse nervilles.

This species is based upon a sparse amount of material rather indifferently preserved, but it shows clearly the characters of the leaves of this large, tropical, and mostly American family. Its exact generic relationship is uncertain, and like the preceding lanceolate species it is referred to the form genus *Melastomites*.

*Occurrence*.—Isthmian railroad  $\frac{3}{4}$  km. north of Palomares on the Saravia estate, State of Oaxaca;  $1\frac{1}{2}$  km. west of the telegraph station, San Jose del Carmen, State of Vera Cruz.

*Holotype*.—Cat. No. 36837, U. S. N. M.

## Order GENTIANALES.

### Family APOCYNACEAE.

#### Genus APOCYNOPHYLLUM Unger.

**APOCYNOPHYLLUM MEXICANUM, new species.**

Plate 4, fig. 2.

Leaves oblong-lanceolate in outline, more tapering distad than proximad. Apex more acute than the base. Margins entire, full and evenly rounded. Texture coriaceous. Length about 12 cm. Maximum width about 3.2 cm. Petiole missing. Midrib very stout and prominent. Secondaries relatively thin, numerous, widely spaced; about 12 pairs diverge from the midrib at wide angles of about  $65^\circ$ , are relatively straight for two-thirds of the distance to the margins, and then curve rapidly upward and are camptodrome; the lower ones arching along the margins from the ends of the percurrent tertiaries; the upper ones more abruptly camptodrome. Tertiaries mostly obsolete.

In so far as the present species furnishes diagnostic characters these indicate the family Apocynaceae, but, as is commonly the case among the members of this family, generic characters are not clearly differentiated in the leaves. The species is hence referred to the con-

venient form genus *Apocynophyllum*, which has many described species. None of these merit especial comment in the present connection.

*Occurrence*.—1½ km. west of the telegraph station, San Jose del Carmen, State of Vera Cruz.

*Holotype*.—Cat. No. 36838, U.S.N.M.

**Genus ALLAMANDA Linnaeus.**

**ALLAMANDA CARMENENSIS, new species.**

Plate 7, fig. 2.

Leaves of medium size; broadly lanceolate in outline; widest medianly, and tapering equally to the similarly acute apex and base. Margins entire, full and evenly rounded. Texture subcoriaceous. Length about 12 cm. Maximum width about 4 cm. Petiole missing. Midrib stout, straight and prominent. Secondaries thin, numerous, equally spaced, subparallel; they diverge from the midrib, alternately, at angles of about 45°, sweep upward in long ascending curves, and end camptodromely. Tertiaries obsolete.

This characteristic leaf is clearly referable to the Apocynaceae, and its resemblance to the leaves of the existing species of *Allamanda* appears to warrant its reference directly to that genus instead of to the form genus *Apocynophyllum*. *Allamanda* comprises about a dozen existing species of trees or shrubs, the latter often climbing in habit. Their range extends from the Antilles and Central America to Brazil, and they are especially characteristic of the South American tropical rain forest. The only previously described fossil species is a somewhat similar one from the lower Miocene of Chile.<sup>34</sup>

*Occurrence*.—1½ km. west of the telegraph station, San Jose del Carmen, State of Vera Cruz.

*Holotype*.—Cat. No. 36839, U.S.N.M.

**Order PERSONALES.**

**Family BIGNONIACEAE.**

**Genus CRESCENTIA Linnaeus.**

**CRESCENTIA CUCURBITINOIDES, new species.**

Plate 5, fig. 2.

Leaves obovate in general outline, with acute tip, and gradually narrowed, cuneate base. Margins entire. Texture subcoriaceous. Length about 13.5 cm. Maximum width, above the middle, about 5.25 cm. Petiole missing. Midrib prominent on the under side of the leaf, stout, curved. Secondaries stout, widely spaced, about

<sup>34</sup> Engelhardt, H., Abh. Senck. Naturf. Gesell., vol. 16, p. 658, pl. 6, fig. 4, 1891.

six pairs, diverging from the midrib at angles of about  $55^\circ$ , curved, ascending, camptodrome. Tertiaries thin, usually well marked, arching along the margins, generally straight internally, forming with the intermediates from the midrib subparallel with the secondaries, an open isodiametric mesh, becoming percurrent distad.

This species, which is represented by a half a dozen broken specimens is almost exactly like the leaves of the existing *Crescentia cucurbitina* Linnaeus, a small coastal tree which ranges from southern peninsular Florida through the Antilles, and from southern Mexico to Panama and Venezuela. This resemblance has suggested the specific name of the fossil. The genus has six or seven existing species and has not previously been recognized in the fossil state. It is confined to America between the latitudes of southern Florida and Brazil.

*Occurrence.*—Isthmian railroad  $\frac{3}{4}$  km. north of Palomares on the Saravia estate, State of Oaxaca.

*Holotype.*—Cat. No. 36840, U.S.N.M.

#### Genus **BIGNONOIDES**, new genus.

Proposed for the winged seeds of any generically undeterminable member of this family. At present with the features of the single type species described below.

#### **BIGNONOIDES ORBICULARIS**, new species.

Plate 3, fig. 4.

Seeds compressed, round in outline and lenticular in cross section, about 3 mm. in diameter; located at the center of a circular wing which is faintly and radially veined and has a more or less irregular margin, the whole about 1.25 cm. in diameter.

A great many genera both in this and other families have superficially similar winged fruits. This is especially true of the family Malpighiaceae which is so largely developed in tropical America. None of these, so far as I know, have a central seed and continuous radial wing. On the other hand there are certain genera of the Bignoniaceae, such as *Callichlamys*, *Jacaranda*, etc., in which some of the modern species have seeds like those of the fossil, which has influenced the present identification. The term for the present genus would preferably be *Bignonites*, but this has already been used by Saporta for a form from the Oligocene of Aix, afterward changed to *Rhopalospermites* and transferred to the Proteaceae.

Among previously described fossil forms the only one deserving of mention is one from the Tertiary of the Loja basin in Ecuador which Engelhardt described <sup>35</sup> as *Banisteria aceroides*. This is very

<sup>35</sup> Engelhardt, H., Abh. Senck. Naturf. Gesell., vol. 19, p. 14, pl. 2, figs. 18, 19, 1895.

similar in appearance, but not exactly identical with the Tehuantepec fossil.

*Occurrence.*—Isthmian railroad  $\frac{3}{4}$  km. north of Palomares on the Saravia estate, State of Oaxaca.

*Holotype.*—Cat. No. 36841, U.S.N.M.

## Order RUBIALES.

### Family RUBIACEAE.

#### Genus RONDELETIA Plumier.

##### RONDELETIA, (?) species.

Plate 7, fig. 3.

This fragment scarcely warrants an attempt at a diagnosis or a specific name. It is distinct, however, from the other elements in the Tehuantepec Miocene flora, and its numerous, straight, parallel, ascending secondaries, and peculiar tertiary venation make it easy to recognize and suggest that it represent a fossil species of the genus *Rondeletia*.

This genus comprises about 60 existing species of shrubs and trees, confined to the American Tropics, and largely represented in the Antilles with about 35 species, and in Central America with about 25 species. It is sparingly represented in northern South America. The only known fossil species known to me is one found in the Gatun formation of Panama.<sup>36</sup>

*Occurrence.*—Isthmian railroad  $\frac{3}{4}$  km. north of Palomares on the Saravia estate, State of Oaxaca.

Cat. No. 36842, U. S. N. M.

#### Genus GUETTARDA Endlicher.

##### GUETTARDA COOKEI Berry (?).

*Guettarda cookei* BERRY, Proc. U. S. Nat. Mus., vol. 59, p. 125, pl. 21, figs. 5, 6, 1921.

Fragmentary specimens representing the genus *Guettarda* are tentatively referred to this species which was described recently from the Miocene of the Dominican Republic. The genus contains about 50 existing species found chiefly in tropical America, and the present fossil species appears to be most like the existing *Guettarda elliptica* Swartz of the Antilles.

*Occurrence.*—Isthmian railroad three-fourths kilometer north of Palomares on the Saravia estate, State of Oaxaca.

Cat. No. 36843, U. S. N. M.

<sup>36</sup> Berry, E. W., U. S. Nat. Mus. Bull. 103, p. 42, pl. 18, fig. 3, 1918.

## EXPLANATION OF PLATES.

## PLATE 1.

- FIG. 1. *Mespilodaphne palomaresensis* Berry.  
 2. *Gymnogramme wadii* Berry.  
 3. *Acrostichum mexicanum* Berry.  
 4. *Dioclea* (?) *mexicana* Berry.  
 5. *Fagara wadii* Berry.  
 6. *Nectandra tehuantepecensis* Berry.

## PLATE 2.

- FIG. 1. *Coussapoa veracruziana* Berry.

## PLATE 3.

- FIG. 1. *Moquillea mexicana* Berry.  
 2. *Anona saraviana* Berry.  
 3. *Leguminosites oaxacensis* Berry.  
 4. *Bignonoïdes orbicularis* Berry.  
 5. *Liquidambar incerta* Berry.  
 6. *Connarus carmenensis* Berry.  
 7. *Ficus talamancana* Berry (?).

## PLATE 4.

- FIG. 1. *Leguminosites mexicanus* Berry.  
 2. *Apocynophyllum mexicanam* Berry.  
 3. *Nectandra areolata* Engelhardt.

## PLATE 5.

- FIG. 1. *Myrcia saraviana* Berry.  
 2. *Crescentia cucurbitinoides* Berry.  
 3. *Inga miocenica* Berry.  
 4. Ray of a palm.  
 5. *Goeppertia* c. f. *tertiaria* Berry.

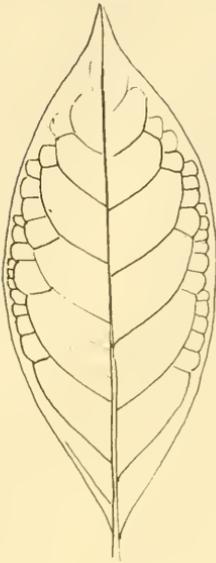
## PLATE 6.

- Figs. 1, 2. *Anacardites lanceolatus* Berry.  
 3, 4. *Lecythidophyllum couratarioides* Berry  
 5. *Melastomites angustus* Berry.  
 6. *Melastomites obovatus* Berry.

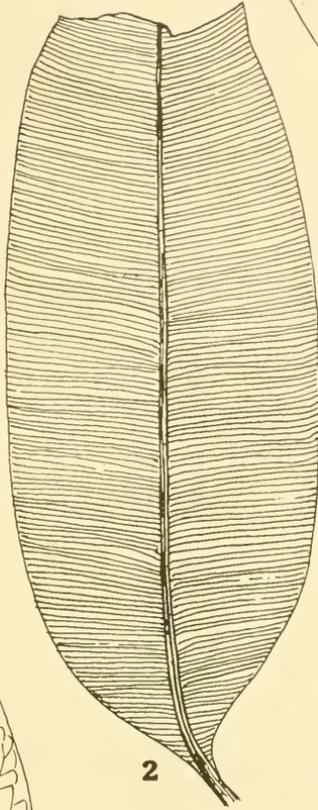
## PLATE 7.

- FIG. 1. *Cedrela miocenica* Berry.  
 2. *Allamanda carmenensis* Berry.  
 3. *Rondeletia*, (?) species.  
 4. *Gouania miocenica* Berry.  
 5. *Drypetes elliptica* Berry.  
 6. *Simaruba veracruziana* Berry.

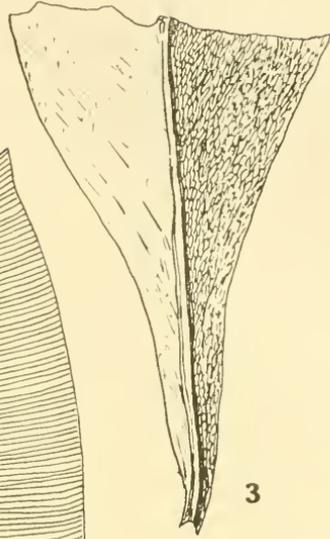




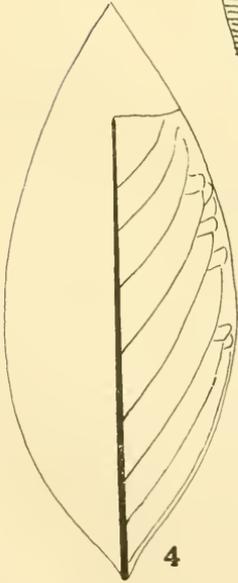
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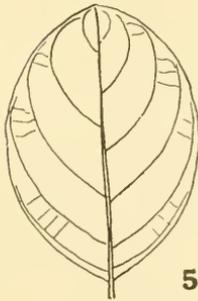
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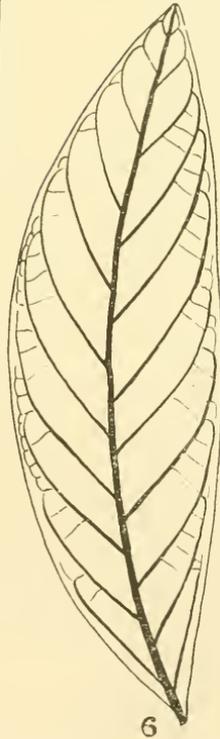
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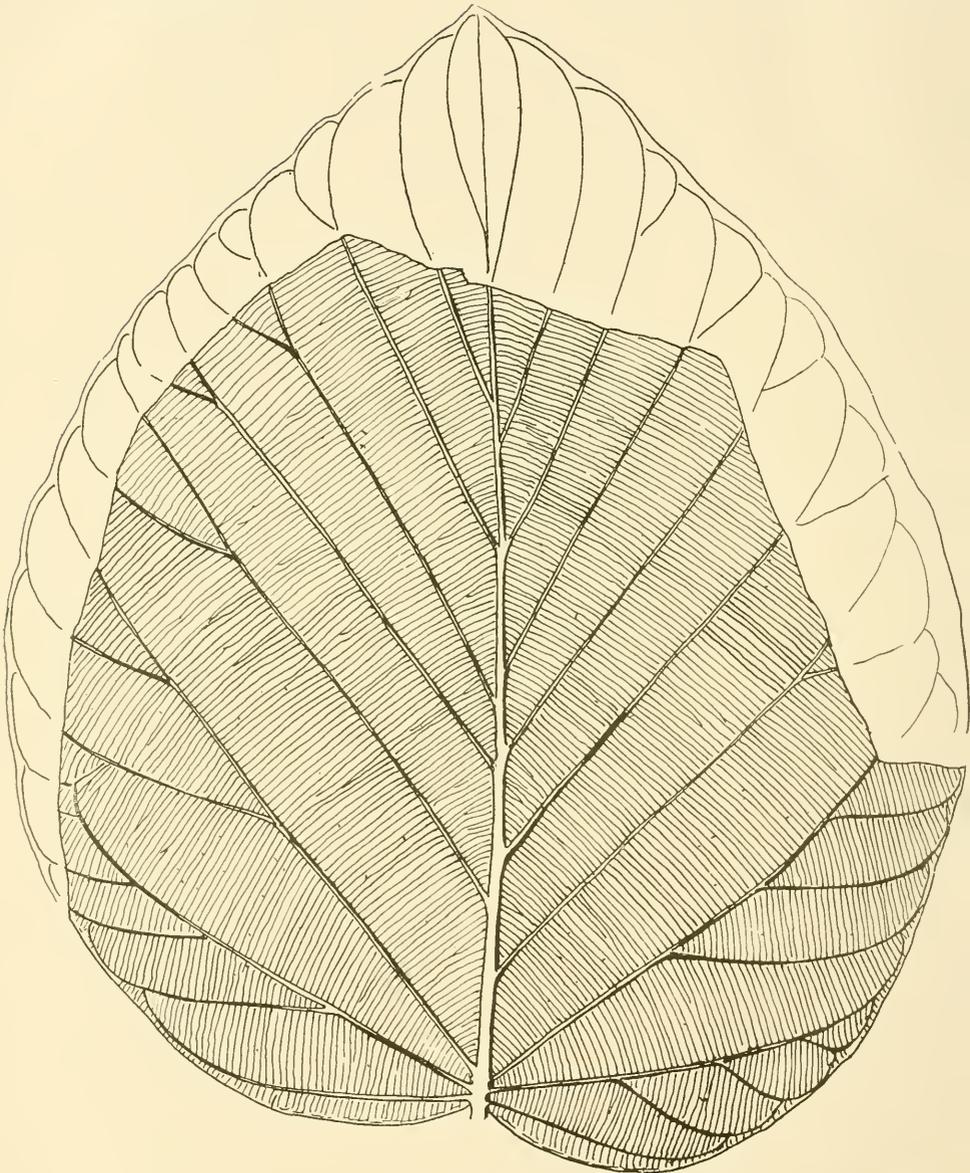
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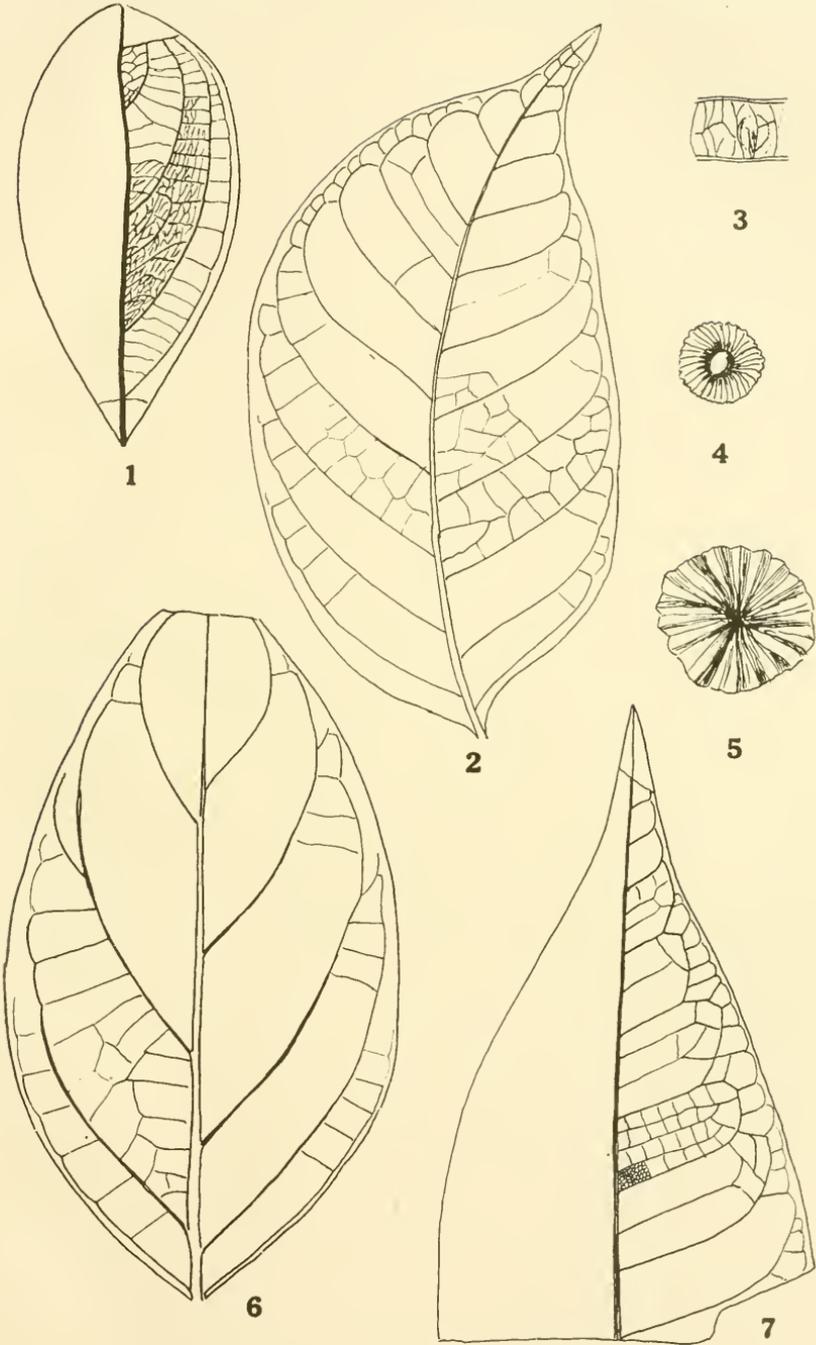
MIocene PLANTS FROM SOUTHERN MEXICO.

FOR EXPLANATION OF PLATE SEE PAGE 27.



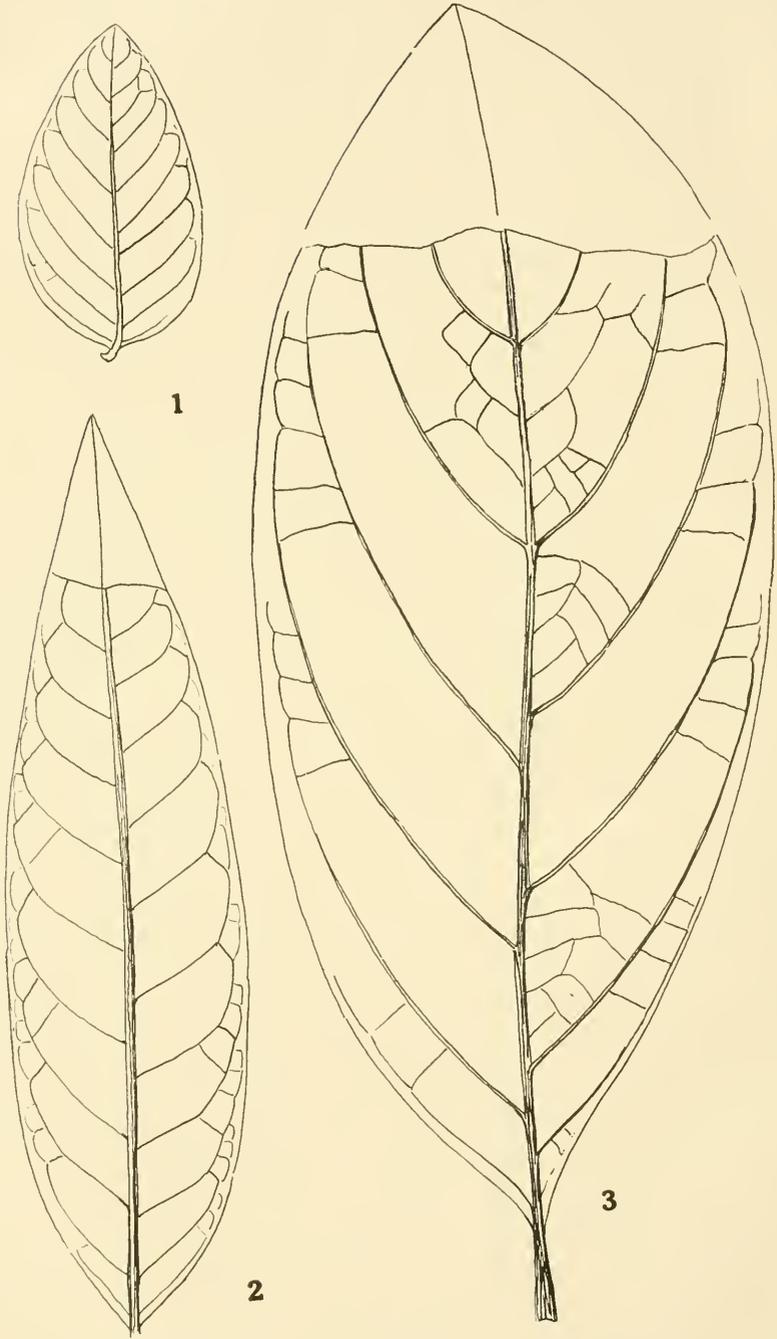
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FOR EXPLANATION OF PLATE SEE PAGE 27.



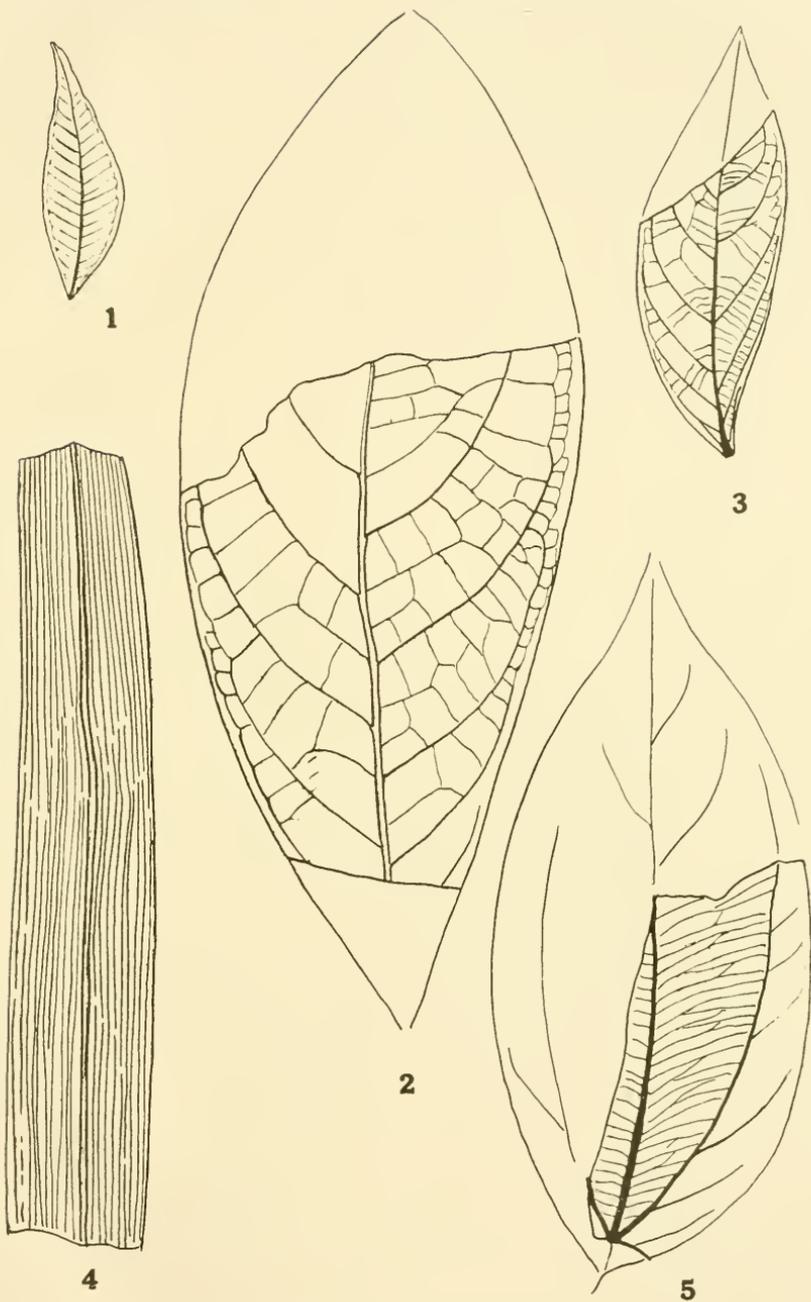
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FOR EXPLANATION OF PLATE SEE PAGE 27.



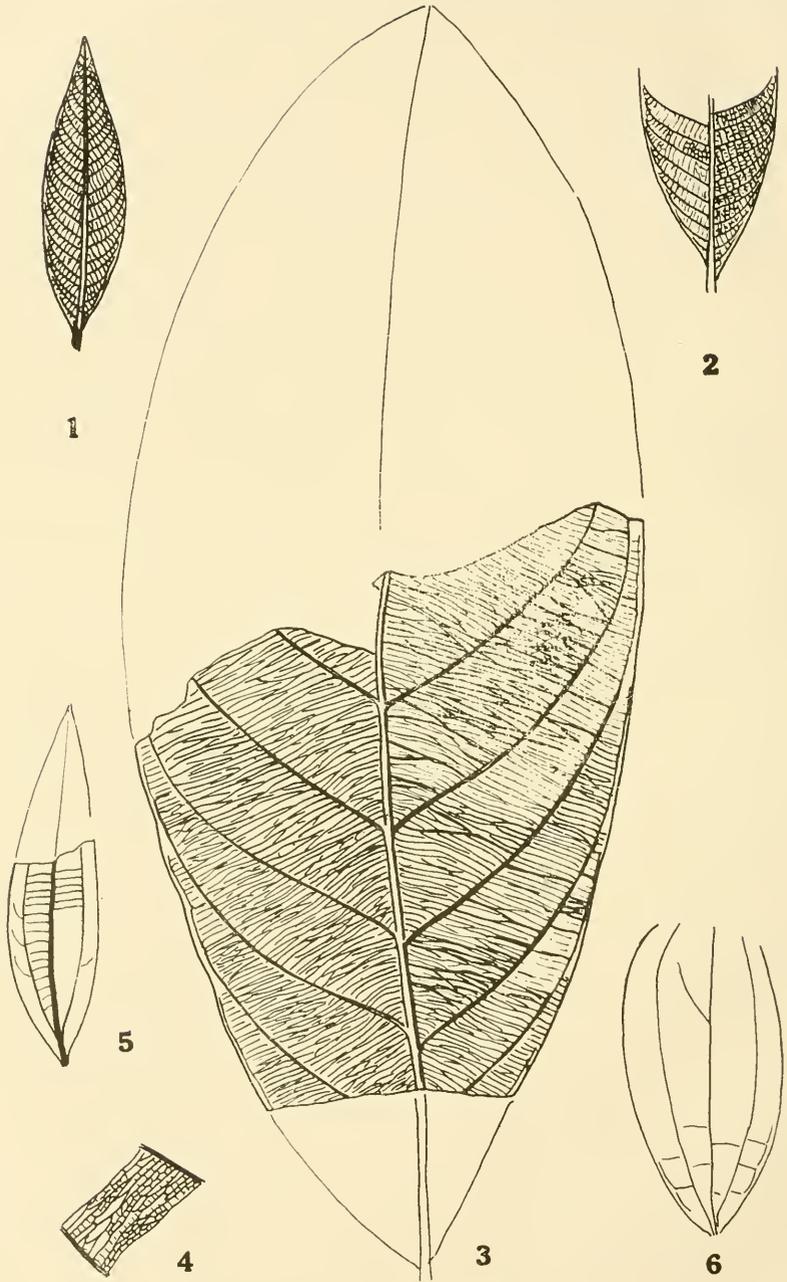
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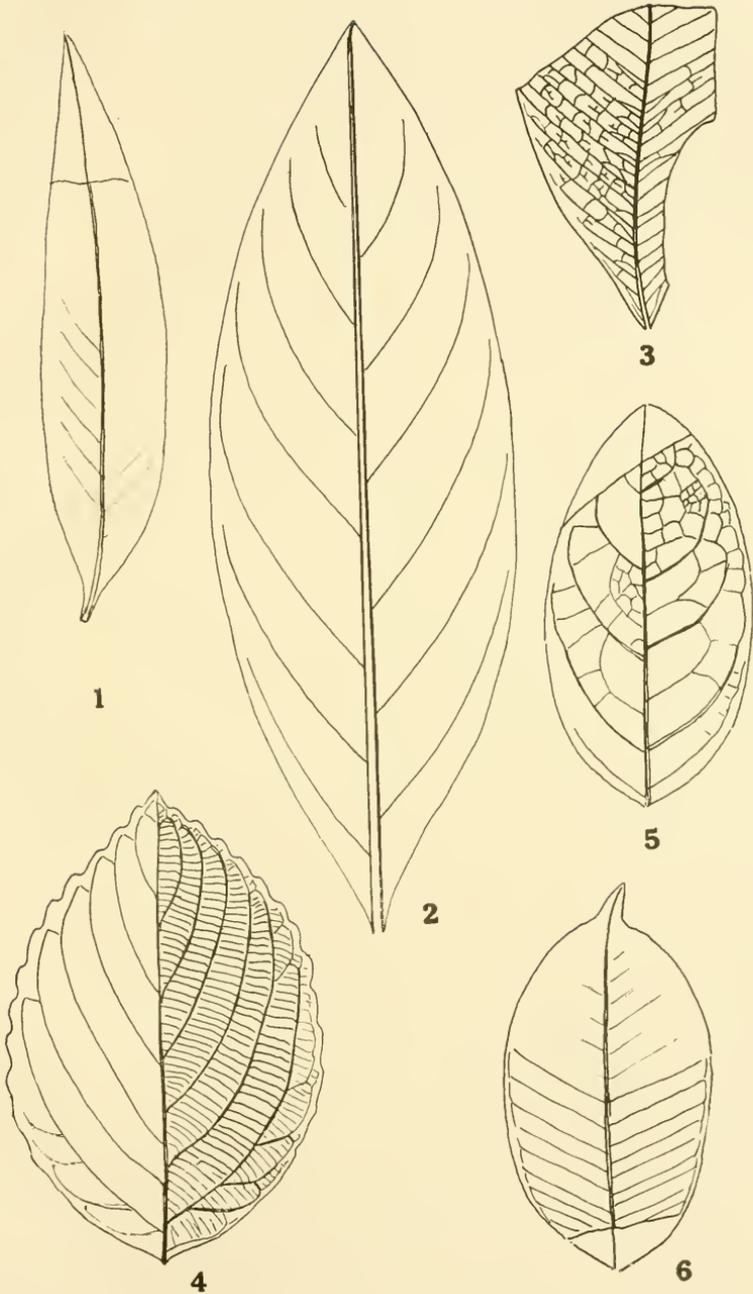
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