

CLASSIFICATION OF THE GENUS ANNONA, WITH DESCRIPTIONS OF NEW AND IMPERFECTLY KNOWN SPECIES.

By W. E. SAFFORD.

DIVISION OF THE GENUS INTO NATURAL GROUPS.

INTRODUCTORY NOTES.

A critical study of the genus *Annona* has led the writer to place the American species in fourteen natural subdivisions or sections. These sections, arranged in four groups, are composed of closely allied species, in some cases showing their relationship by peculiarities of leaf structure, in others by the structure of the stamens and carpels or form of the flower, and in others by peculiarities of the fruit and seed. Some of the sections are more sharply defined than others and between several of them there are species which appear to be connecting links; but this is equally true of many well-established natural divisions of plants and does not make it less desirable to group species in such a manner as to indicate their relationships and at the same time to facilitate their study.

CHARACTERS OF THE GENUS.

In all species of *Annona* the leaves are alternate, 2-ranked, entire, and devoid of stipules. The flowers may be solitary or geminate, or they may be clustered in fascicles of several. They are never axillary nor terminal, but are sometimes apparently so by the abortion of an axillary branch from the base of which they issue, or that of a terminal bud, the vestiges of which may be at length almost or entirely lost from the growth being directed to the development of the fruit. In a few cases, as in the common soursop (*Annona muricata*), the inflorescence is caulifloral, issuing from the old bark of the trunks, limbs, or branches.

The typical *Annona* flower has a 3-parted calyx, the lobes of which are valvate in bud. The corolla is composed of 6 petals in 2 series, the inner petals alternating with the outer and consequently opposite the sepals or calyx lobes. In all cases the outer petals are valvate, or edge to edge. In the type species, *Annona muricata* (pl. 1), the overlapping inner petals are broadly ovate and somewhat smaller than the outer. In other species the inner petals are scarcely larger than the

EXPLANATION OF PLATE 1.—Field photograph by G. N. Collins, taken in Porto Rico. Natural size.

stamens, as in *A. squamosa* (fig. 1), or they may be entirely wanting, as in *A. acuminata* (fig. 2). In species where they are normally absent

inner petals sometimes occur, either in the form of small stamen-like bodies with a pair of sterile pollen sacs on their back, or as miniature petals clothed with an indument more or less like that of the outer petals. Sometimes one or more inner petals are abnormally developed and thrust themselves between two of the outer petals, as in the Annonella of Santo Domingo (*Annona rosei*); while in *A. cornifolia* and the closely allied *A. nutans*, to be described hereafter, the flower has a 6-lobed gamopetalous corolla composed of 3 narrow lobes alternating with 3 broad ones, approaching somewhat the structure of a *Rollinia* flower; and in several species abnormal flowers occur which have a 4-parted calyx and 8 petals or a 2-parted calyx with 4 petals, in each case in 2 series.

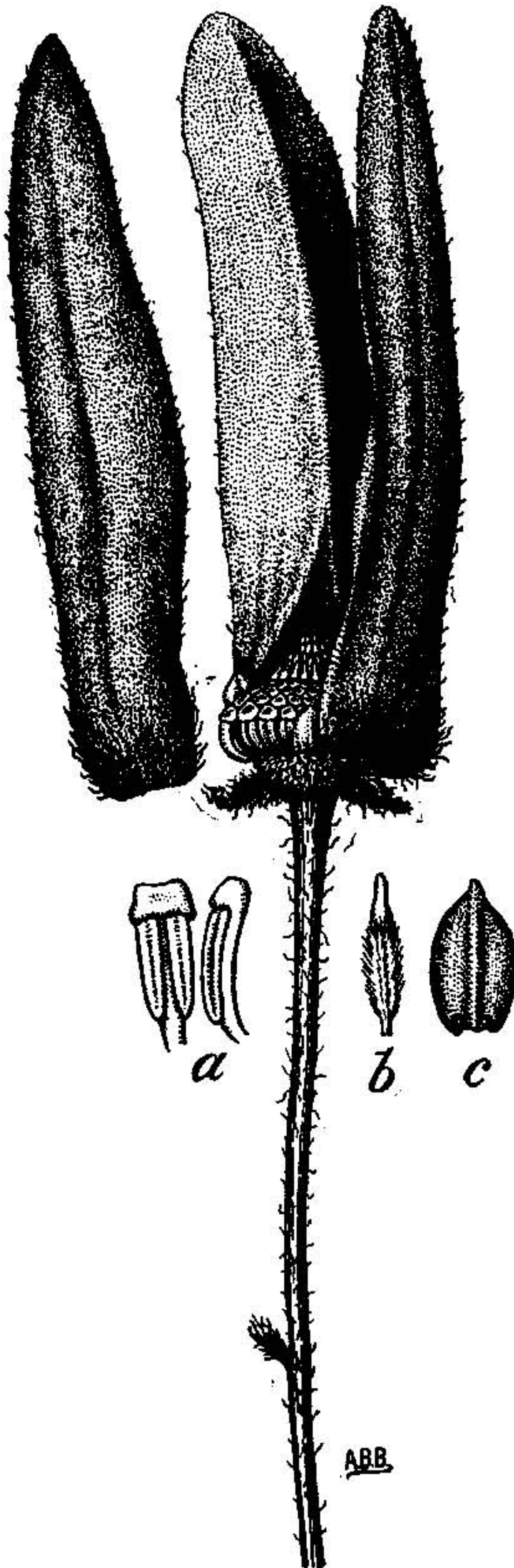


FIG. 1.—Flower of *Annona squamosa*. a, Stamens; b, carpel; c, inner petal. Flower scale 4; a, b, c, scale 8.



FIG. 2.—Flower of *Annona acuminata*. Natural size.

The essential parts (pl. 2) consist of an andrœcium, composed of numerous stamens closely crowded on a convex or conoid receptacle

EXPLANATION OF PLATE 2.—Gynœcium surrounded by andrœcium, A, seen from above; B, from the side, with part removed. Photographed from material in the U. S. National Herbarium by Albert Mann. Scale 6.

(torus), and a gynœcium, composed of a cluster of carpels issuing from its center.

The stamens (fig. 3, *a*) have a short filament, 2 linear, parallel pollen sacs opening extrosely by a longitudinal slit, and a connective usually terminating in a swollen head or hoodlike process above the pollen sacs. These hoods are very closely packed until the flower reaches maturity (pl. 2) and serve like thatch or tiling to protect the pollen from moisture and from fungus spores. In some cases the connective tips are broadly expanded and velvety or clothed with hairs; in others they are fleshy points not exceeding the two pollen sacs in width, as in the section *Annonella* and its allies. In the pollen sacs the pollen grains are arranged in columns of tetrads and are usually of a yellowish color, but sometimes nearly white and sometimes of a deep orange or amber color.

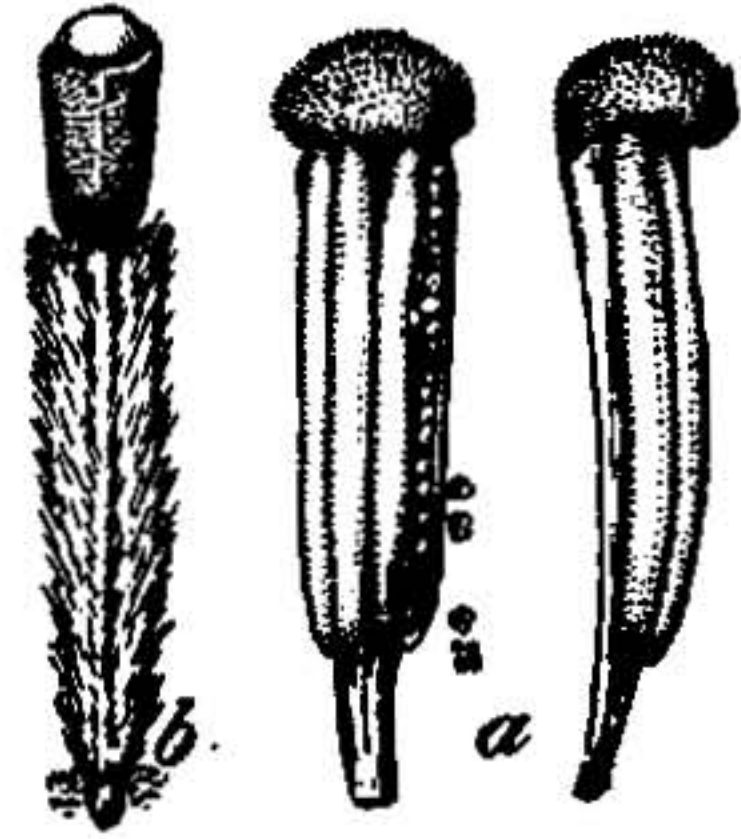


FIG. 3.—Essential parts of the flower of *Annona muricata*. *a*, Stamens, one showing pollen sac dehiscing down the back; *b*, carpel. Scale 10.

The pistils (fig. 3, *b*) each consist of a single carpel. The ovary contains a single basal ovule and is usually clothed with appressed or ascending hairs. In most sections the ovaries are separate in the flower (discrete), as in *Annona muricata* and *A. montana* (pl. 3);

in a few they are from the beginning united in a solid mass (concrete), as in *A. glabra* (fig. 19, p. 15). The ovaries are sometimes produced into processes which persist in the fruit as fleshy or hard points, as in *A. muricata* (pl. 1) and *A. purpurea*. Sometimes the ovaries are comparatively long and slender, as shown in plate 3; sometimes, as in *A. jenmanii* (fig. 4), the ovary is comparatively short and bears a long, fleshy, club-shaped style terminating in a tuberculate stigma. Usually the outer styles are more robust than the inner ones and their stigmas are more distinctly hairy or muriculate than those of the latter, as in *A. holosericea* and *A. nutans*. These outer styles together with their ovaries have in some cases been mistaken for sterile stamens, but they are

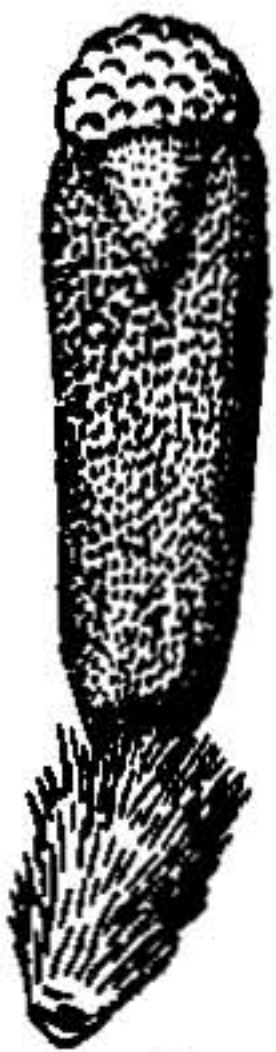


FIG. 4.—Carpel of *Annona jenmanii*. Scale 20.

essentially a part of the gynœcium, of which they form the periphery, and the constriction between the style and ovary is usually distinctly marked. No such division or constriction is to be found in the stamens. As the time of pollination approaches a viscous fluid exudes from the stigmas, gluing together the styles and offering a medium

for the development of the pollen. The flowers are proterogynous, the stigmas maturing before the pollen sacs dehisce.

The compound fruit, or syncarpium, is formed by the growing together of the carpels and torus into a fleshy mass, usually of an ovoid, spheroid, or cordiform shape, the individual carpels being indicated on the surface by areoles more or less distinctly outlined either with incised lines, as in *Annona reticulata* (fig. 25, p. 18), or by raised ridges, as in *A. scleroderma* (fig. 22, p. 17), and frequently bearing the produced tips of the ovaries, as in *A. muricata*, *A. purpurea*, and *A. cercocarpa*. The areoles are sometimes swollen or gibbous, with or without a small wart or tubercle near their apex. Sometimes they are quite smooth or very faintly outlined, as in *A. cascarilloides*, *A. glabra*, and smooth varieties of *A. cherimola*. In most cases the fruit is greenish or yellowish when mature; in a few species it is glaucous or pruinose, as in *A. squamosa*; or it may become suffused with red, especially on the sunny side, as in the bullock's heart (*A. reticulata*). In the South American *A. cornifolia* and the closely allied *A. nutans* it is bright orange red.

The seeds have the basal embryo and large ruminant or wrinkled endosperm which characterize all Annonaceae and there is usually a conspicuous swollen caruncle around the hilum. In most species the testa is thin and membranous, revealing the wrinkles of the endosperm beneath, but in *Annona longiflora* and *A. diversifolia* it is thick, hard, and smooth, like the shell of a nut.

GEOGRAPHICAL DISTRIBUTION.

The genus *Annona* is confined almost exclusively to tropical and subtropical America. At an early date, however, certain species were introduced into the warmer regions of the Old World for the sake of their edible fruits, and were described as distinct. In addition to these there are a few species endemic in tropical Africa.

The latter belong apparently to three distinct groups, one of which, consisting of *Annona klainii* Pierre, in which there are sometimes 8 petals and a 4-parted calyx, has been segregated as a section, *Anonastrium*. Another, including *A. senegalensis* Pers. and *A. stenophylla* Engl. & Diels, has been placed in the same section with *A. muricata* L., but departs from that section in having the inner petals narrow and triquetrous, instead of broad and imbricate in aestivation. The third, consisting of *A. glauca* Schum. & Thonn., has both the outer and inner petals broadly ovate, and the coriaceous, sessile leaves rounded at the apex and narrowed or cuneate at the base. As the present

author has been unable to secure specimens of these African species of *Annona*, he can not with certainty assign them to sections.¹

SPECIES INCORRECTLY REFERRED TO ANNONA.

Several African plants originally described as *Annonas* have been found to be generically distinct; as in the case of *Annona mannii* Oliver and *A. laurentii* Engl. & Diels, which have been placed by Engler and Diels in the genus *Anonidium*. In this genus, the flowers are more or less unisexual, as in *Raimondia*, but the stamens differ radically from those of the latter genus in having the connective thickened and dilated at the extremity over the pollen sacs.

Several American plants were removed from the genus at an early date on account of peculiarities of their flowers or fruits, as in the case of *Rollinia mucosa* and *R. silvatica* and several species of *Duguetia*. A few others are undoubtedly distinct and should be raised to generic rank, as has been done in the case of *Anonidium*; among them, *Annona longifolia* Aubl. and *A. rhizantha* Eichl., the latter of which bears the same relation to the genus *Duguetia* that *Raimondia* bears to *Annona*. Included in material recently received from M. Augustin De Candolle the author finds a species, described by Kunth under the name of *Annona quinduensis*, which, on account of its peculiar stamens and unisexual flowers, must be assigned to the recently described genus *Raimondia*. Of this species an amended description is given hereafter, together with descriptions of two new genera: *Geanthemum*, already recognized as a distinct section by Robert E. Fries, and *Fusaea*, based upon Baillon's section of the

¹ Since writing the above the author has received, through the kindness of Professor Urban, a series of fine specimens of African *Annonas* from the Berlin Herbarium, including original specimens, or type material, of *Annona klainii* Pierre. He was surprised to find this species very closely allied to *A. glabra* L. (*A. palustris* L.), which also occurs on the east coast of Africa, in the same region as that in which *A. klainii* was collected. It is possible that the type of the latter species is an abnormal specimen of *A. glabra*, which not infrequently has a 4-parted calyx and 8 petals in 2 series of 4, both the inner and outer series valvate in aestivation. *Annona senegalensis* Pers. is remarkably variable, occurring sometimes as a small shrub less than a meter high, and sometimes as a large tree, as in the form occurring in the vicinity of Lindi, on the east coast of Africa (Busse, nos. 2823, 2990^a). The flowers are 6-petaled, with the inner petals narrow, connivent, their tips meeting above the center of the gynœcium. The seeds are small, oblong, hard, smooth, and glossy, with relatively large caruncles at the base, somewhat like those of *A. cornifolia* and *A. nutans* of southern Brazil and Paraguay. It is possible that the species *A. senegalensis* as now understood may be found to be composed of several species. Certainly several of the forms show more decided differences than those which separate *A. klainii* from *A. glabra* or some of the South American species allied to *A. tomentosa* R. E. Fries from one another. *Annona glauca* Schum. & Thonn. is a well-defined species quite distinct from *A. senegalensis*.

same name. In addition to these must be mentioned *Annona sessiliflora* Benth., which proves to belong to the genus *Guatteria* and must take the name *Guatteria sessiliflora* (Benth.).

SCHEME OF THE PROPOSED SUBDIVISIONS.

Group I. GUANABANI (SOURSOPS).

Section 1. *Euannona*. Type species, *Annona muricata* L.

Section 2. *Psammogenia*. Type species, *Annona salzmanni* A. DC.

Section 3. *Ulocarpus*. Type species, *Annona purpurea* Moc. & Sessé.

Group II. PILAEFLOBAE (SILKY ANNONAS).

Section 4. *Helogenia*. Type species, *Annona paludosa* Aubl.

Section 5. *Pilannona*. Type species, *Annona sericea* Dunal.

Section 6. *Gamopetalum*. Type species, *Annona cornifolia* St. Hil.

Group III. ACUTIFLORAE (SHARP-PETALED ANNONAS).

Section 7. *Phelloxylon*. Type species, *Annona glabra* L.

Section 8. *Atractanthus*. Type species, *Annona acutiflora* Mart.

Group IV. ATTAE (CUSTARD APPLES).

Section 9. *Chelonocarpus*. Type species, *Annona scleroderma* Safford.

Section 10. *Atta*. Type species, *Annona squamosa* L.

Section 11. *Ilama*. Type species, *Annona diversifolia* Safford.

Section 12. *Saxigena*. Type species, *Annona bullata* A. Rich.

Group V. ANNONELLAE (DWARF ANNONAS).

Section 13. *Annonula*. Type species, *Annona cascarilloides* Wright.

Section 14. *Annonella*. Type species, *Annona globiflora* Schlecht.

KEY TO THE GROUPS.

Flowers subglobose or broadly pyramidal in bud.

Corolla 6-petaled; petals broad, in 2 series.

Inner petals imbricate..... I. GUANABANI (p. 6).

Inner petals valvate..... III. ACUTIFLORAE (p. 14).

Corolla 3-petaled or, if 6-petaled, inner petals much narrower than outer or rudimentary.

Apex of the connective broadly expanded above the pollen sacs; flowers of medium size..... II. PILAEFLOBAE (p. 10).

Apex of the connective not broadly expanded, scarcely exceeding the pollen sacs in width; flowers small..... V. ANNONELLAE (p. 21).

Flowers elongate and more or less triquetrous in bud.....

IV. ATTAE (p. 16).

CHARACTERS OF THE GROUPS AND SECTIONS.

Group I. GUANABANI (SOURSOPS).

(Section Guanabani Mart., in part.)

Flower buds subglobose or broadly pyramidal; flowers large; petals 6, the outer valvate, thick, broadly ovate and usually cordate, the inner somewhat smaller, with the edges thinner and overlapping (imbricate), forming a dome-like covering over the essential parts, usually clawed at the base.

KEY TO THE SECTIONS.

Leaves with minute pockets or pits in the axils of

the lateral nerves..... 1. EUANNONA (p. 7).

Leaves without pockets in the axils of the nerves.

Blades flat, thick, coriaceous, the lateral nerves impressed on both surfaces..... 2. PSAMMOGENIA (p. 8).

Blades more or less conduplicate and undulate, submembranaceous, the lateral nerves impressed above, very prominent beneath. 3. ULOCARPUS (p. 9).

Section 1. EUANNONA Safford.

(Guanabani Mart. in part. Euannona Safford, Journ. Washington Acad. Sci. 1: 118. 1911, restricted.)

Type species, *Annona muricata* L. (pl. 1).

This section is distinguished from all other sections of the genus *Annona* by minute pits or pockets in the axils of the lateral nerves of the leaves (fig. 5), sometimes quite conspicuous, as in the case of *Annona montana* Macfad., but often scarcely visible to the naked eye. The peduncles are solitary or geminate, in the type species frequently caulifloral, the flowers large, 6-petaled, the 3 outer petals thick, valvate, broadly ovate, usually cordate at the base and acute or acuminate at the apex. The 3 inner petals are somewhat smaller and thinner, concave, with their edges imbricate or overlapping and forming a dome-like covering for the essential parts (pl. 6), obovate or suborbicular, obtuse or rounded at the apex, and

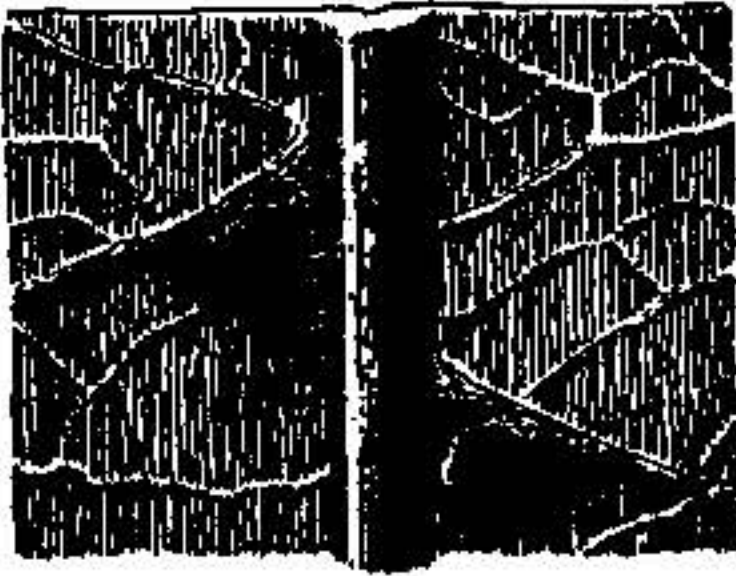


FIG. 5.—Leaf of *Annona montana*, showing axillary pockets. Scale 4.

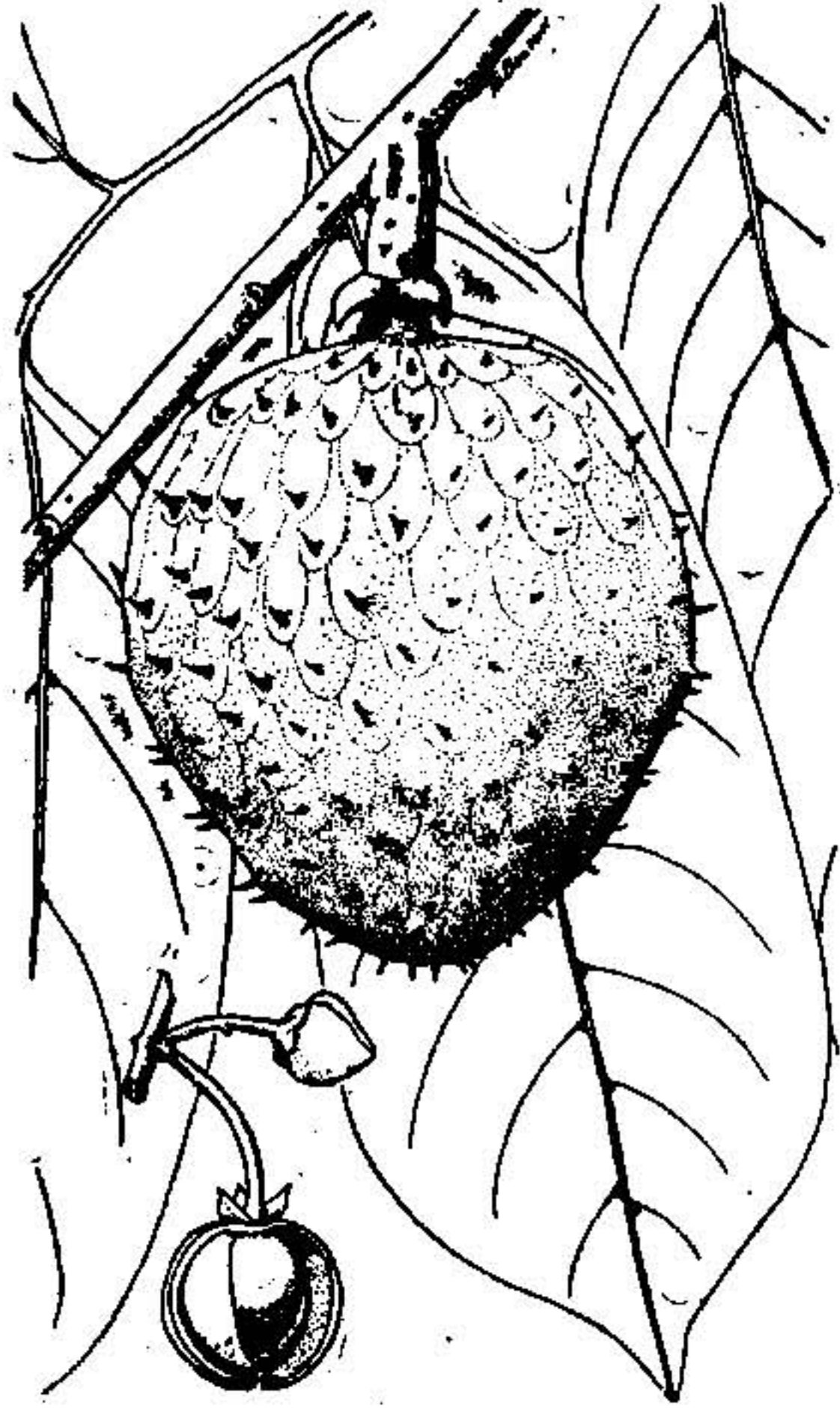


FIG. 6.—*Annona montana*. Flower, fruit, and leaves. Scale $\frac{1}{2}$.

usually clawed at the base. The ovaries are linear and clothed with hairs, a solitary ovule at the base and an ovoid or oblong style at the apex (fig. 3, b), and are quite distinct (discrete) in the flower (pl. 3). The fleshy fruit (syncarpium) is muricate with fleshy prickles (fig. 6), consisting of the persistent tips of the ovaries from which the jointed styles become detached soon after pollination.

In addition to *Annona muricata* L., which has been cultivated from prehistoric times for the sake of its pleasantly acidulous, juicy fruit, this section includes several very closely related wild species, the first of which to receive a binary Latin name in accordance with botanical usage was *Annona montana*

EXPLANATION OF PLATE 3.—Showing discrete ovaries of the section Euannona. Photographed from material in the U. S. National Herbarium by W. S. Clime. Scale 6.

Macfad., the "wild soursop" of the West Indies (pl. 7). Very closely allied to this are *A. sphaerocarpa* Splitg., the "bosch-zuurzak," or wild soursop of Surinam (pl. 8, B), and *A. marcgravii* Mart., based upon the Brazilian "araticú ponhê" described by Marcgrave in 1648 (pl. 10). These species will be discussed later, together with the question as to the identity of Marcgrave's "araticú apé," a species closely resembling *A. muricata*. Other species belonging to this section are *A. coriacea* Mart. and the dwarf *A. pygmaea* Warming (fig. 7).

The section *Euannona* differs from the section *Guanabani*, hitherto accepted by botanists, chiefly in the elimination of *Annona glabra* L., in which the ovaries are fused together in the flower, on account of which the writer has made it the type of a section *Phelloxylon*, described below. The African *Annona*

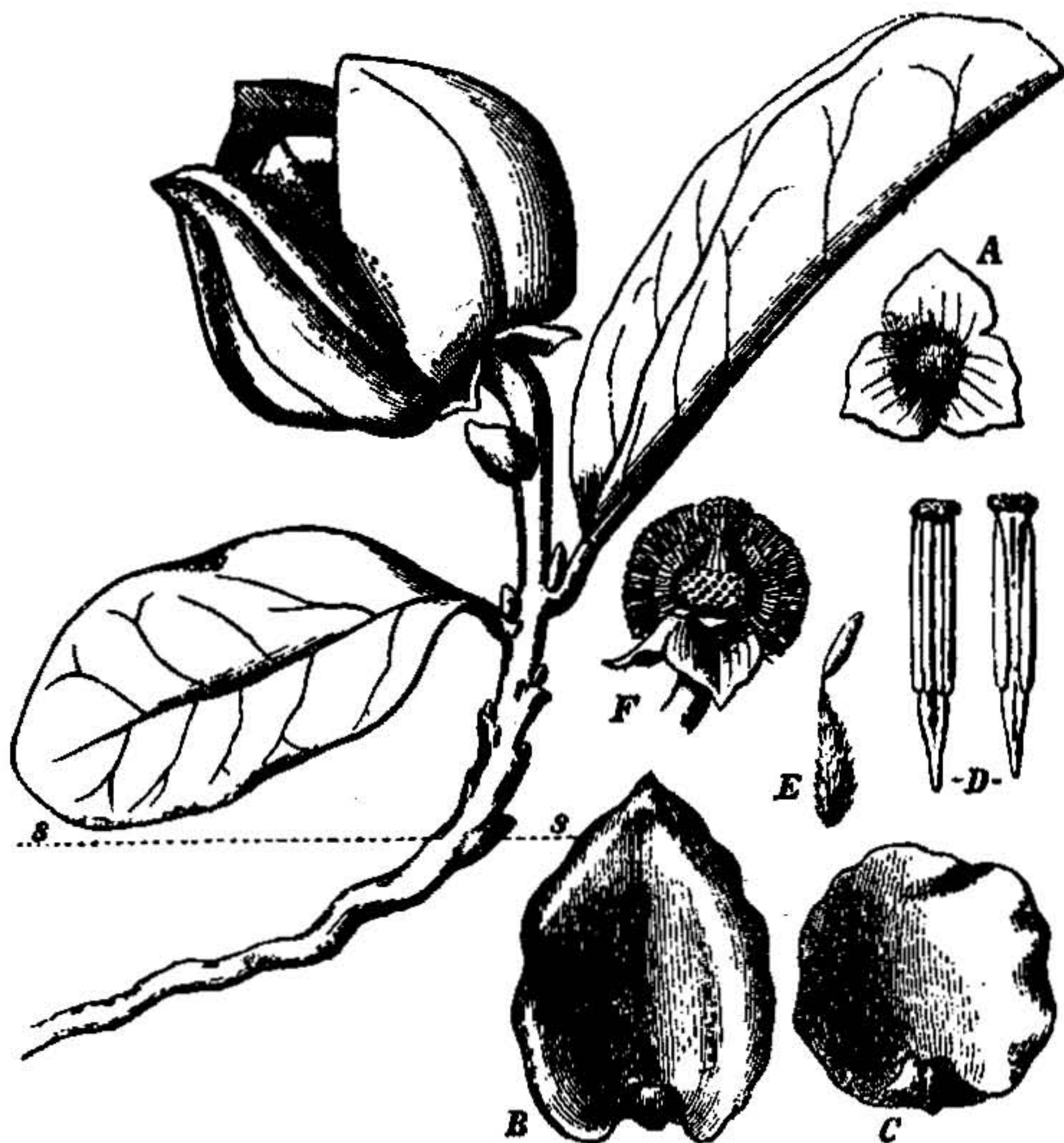


FIG. 7.—*Annona pygmaea*. *s, s*, Surface of soil; *A*, calyx seen from above; *B*, outer petal; *C*, inner petal; *D*, stamens; *E*, hairy ovary tipped with fleshy style; *F*, flower deprived of its petals and part of its stamens. Reproduced from Warming.

senegalensis Pers. and *A. stenophylla* Engl. & Diels, are also excluded on account of their narrow, triquetrous inner petals.

Section 2. PSAMMOGENIA sect. nov.

Type species, *Annona salzmanni* A. DC. (fig. 8; pl. 11).

The flowers of this section bear a close resemblance to those of *Euannona* and, as in that section, they are sometimes geminate. The leaves, however, in their coriaceous texture and their peculiar nerves, which appear to be impressed on both surfaces instead of being more or less prominent beneath, differ from the leaves of *Euannona* and from all other sections of the genus.

The appressed-pilose ovaries with the terminal style very much constricted at the base resemble those of the section *Euannona* (fig. 7, *E*) and differ from those of the sections *Phelloxylon* and *Chelonocarpus*, in which the ovaries are fused together even in the early stages of the flower; and the section is further separated from *Phelloxylon* by the form of the inner petals, which are not valvate.

Section 3. ULOCARPUS sect. nov.

Type species, *Annona purpurea* Moc. & Sessé (pls. 12-14).

In this section the flowers are very much like those of *Euannona*, with their thick, valvate outer petals and their concave, imbricate inner ones which form a dome-like canopy over the essential parts (fig. 9), but the ovaries are relatively shorter and the styles longer and more robust (fig. 10, *b*) and the velvety, truncate extremities of the connectives of the stamens form a very close waterproof covering above the pollen sacs (pl. 2). The leaves in this section also are quite different in form and texture, and they sometimes reach a very large size, as in the type species of the section and the closely allied *A. involucrata* Ball. They are also deciduous and are quite devoid of the pits in the axils of the nerves, which characterize the section *Euannona*. The inflorescence is peculiar, further, from the fact that it is enveloped when young with imbricated bracts (fig. 11), which, in *A. purpurea* and *A. involucrata*, persist in a more or less perfect state like a second calyx beneath the true calyx. The leaves of the type species bear a resemblance to those of *A. paludosa* Aubl., the type of the next section in order, which may be regarded as a connecting link between the *Pilaeflorae*, or silky Annonas, and the Guanabani or soursops. The fruits, commonly called "cabezas de negro" (negro heads), differ from those of *Euannona* in having the protuberances of a pyramidal shape, rigid, and covered with a feltlike indument, with a median groove on the side opposite the peduncle. In the opinion of the author *Annona crassiflora* Mart., together with the plants described and figured by Barbosa Rodrigues under

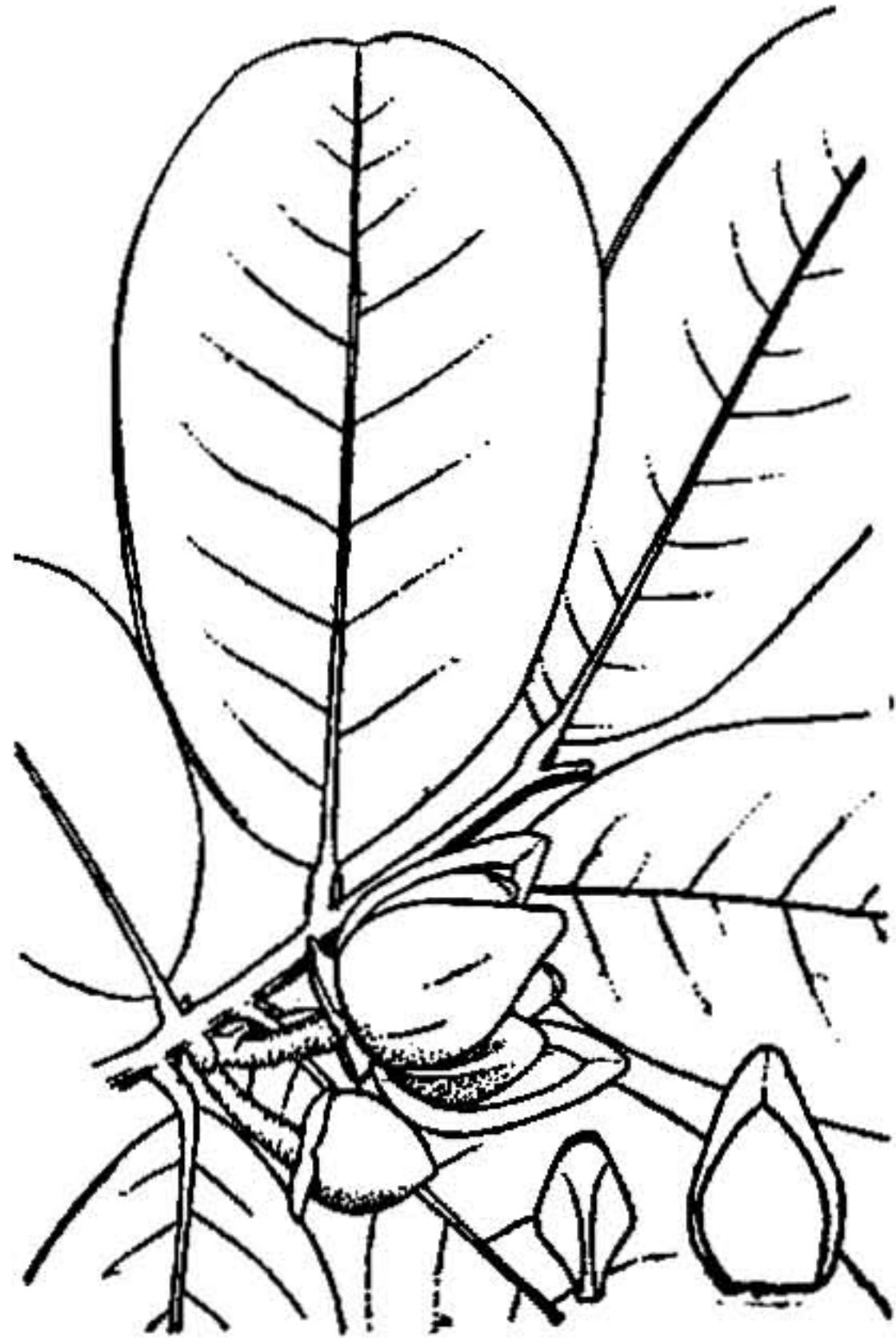


FIG. 8.—*Annona salzmanni*. Leaves and geminate flowers, an inner and an outer petal below. From type specimen in the De Candolle Herbarium. Scale $\frac{1}{2}$.



FIG. 9.—Flower of *Annona purpurea*. One inner and one outer petal removed. Scale $\frac{1}{2}$.

cence is peculiar, further, from the fact that it is enveloped when young with imbricated bracts (fig. 11), which, in *A. purpurea* and *A. involucrata*, persist in a more or less perfect state like a second calyx beneath the true calyx. The leaves of the type species bear a resemblance to those of *A. paludosa* Aubl., the type of the next section in order, which may be regarded as a connecting link between the *Pilaeflorae*, or silky Annonas, and the Guanabani or

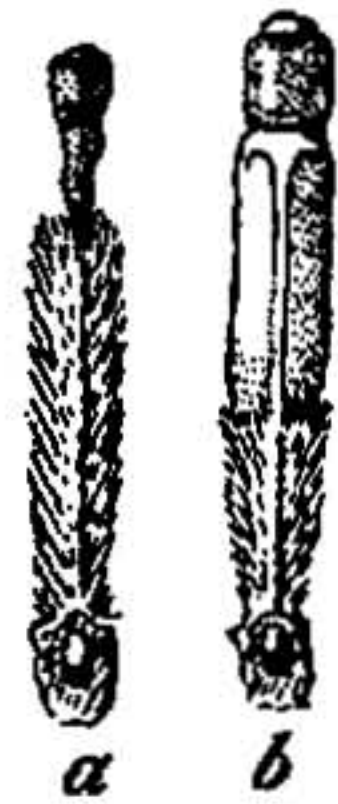


FIG. 10.—Carpels (a) of *Annona montana* and (b) of *A. purpurea*. Scale 5.

soursops. The fruits, commonly called "cabezas de negro" (negro heads), differ from those of *Euannona* in having the protuberances of a pyramidal shape, rigid, and covered with a feltlike indument, with a median groove on the side opposite the peduncle. In the opinion of the author *Annona crassiflora* Mart., together with the plants described and figured by Barbosa Rodrigues under

the names *Annona rodriguesii* (figs. 12, 13) and *A. macrocarpa*, belong to this section.

Some confusion exists as to the identity of *Annona rodriguesii* and *A. macrocarpa*, described by Rodrigues, both of which are referred by Robert E.

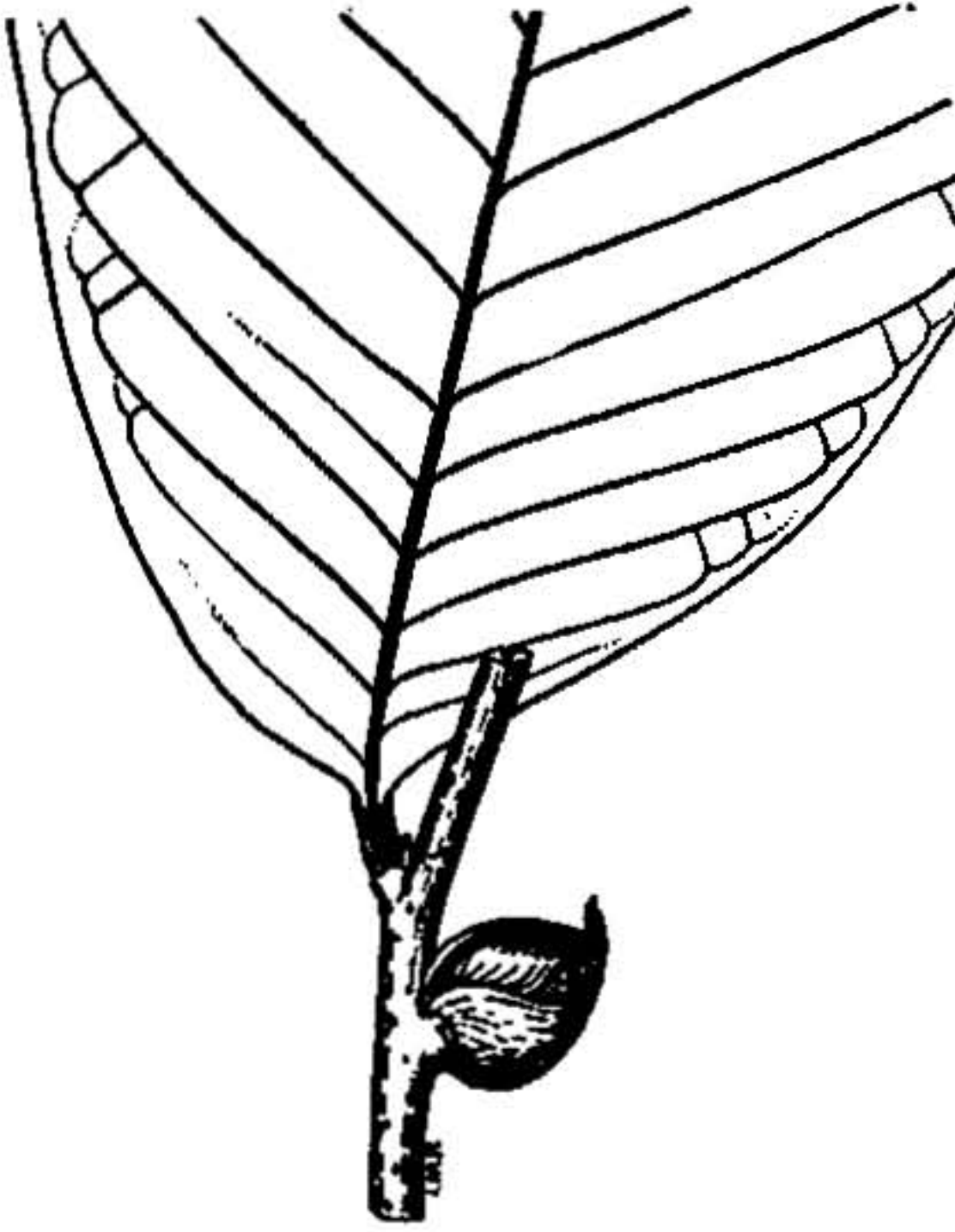


FIG. 11.—*Annona involuocrata*, showing involuocral envelope of inflorescence. From specimen in U. S. National Herbarium. Scale $\frac{1}{2}$.

Fries to Martius's *A. crassiflora*. It is not surprising that Rodrigues should have been misled, for the plant figured by Martius as *A. crassiflora*¹ does not correspond with his description of that species. According to the latter the fruit of *A. crassiflora* is a typical *cabeza de negro*, with "sharply umbonate" areoles and not smooth as depicted in the figure, and the leaves "shortly and obtusely acuminate or rounded at the apex," instead of emarginate, while the recurved peduncles, $\frac{1}{2}$ inch long, shown in the figure, correspond with Martius's description of his *A. coriacea*.

As seen by the accompanying illustrations (figs. 12, 13) the flower of *Annona rodriguesii* has very thick outer petals and smaller inner petals, very much as in *A. purpurea*, and the large subglobose fruit with its grooved, stout protuberances is also much like that of the Venezuelan *manírote* (*A. purpurea*). Its pulp is described as very fragrant when

ripe, of an agreeable sweet taste, and so aromatic that it imparts a spicy odor to the urine of those who eat of it in abundance. The name of this section is suggested by the form of the fruits, the protuberances of which, like short crisp curls, have caused them to be named "cabeza de negro," or "negro-head."

GROUP II. PILAEFLORAE (SILKY ANNONAS).

(Section *Pilae florae* Mart., amended.)

Flower buds globose or depressed-globose (oblate); petals 3 or 6, the outer broadly ovate or orbicular, concave, valvate (except in section 6), and in most cases sericeous-pubescent on the outside, the inner when present much narrower and somewhat shorter than the outer, neither valvate nor imbricate, but performing the function of weather strips to cover the cracks between the outer petals; in section 6 the outer and inner petals united to form a 6-lobed gamopetalous corolla, the 3 outer broad petals open in estivation and overlapping the edges of the 3 inner and narrower lobes.

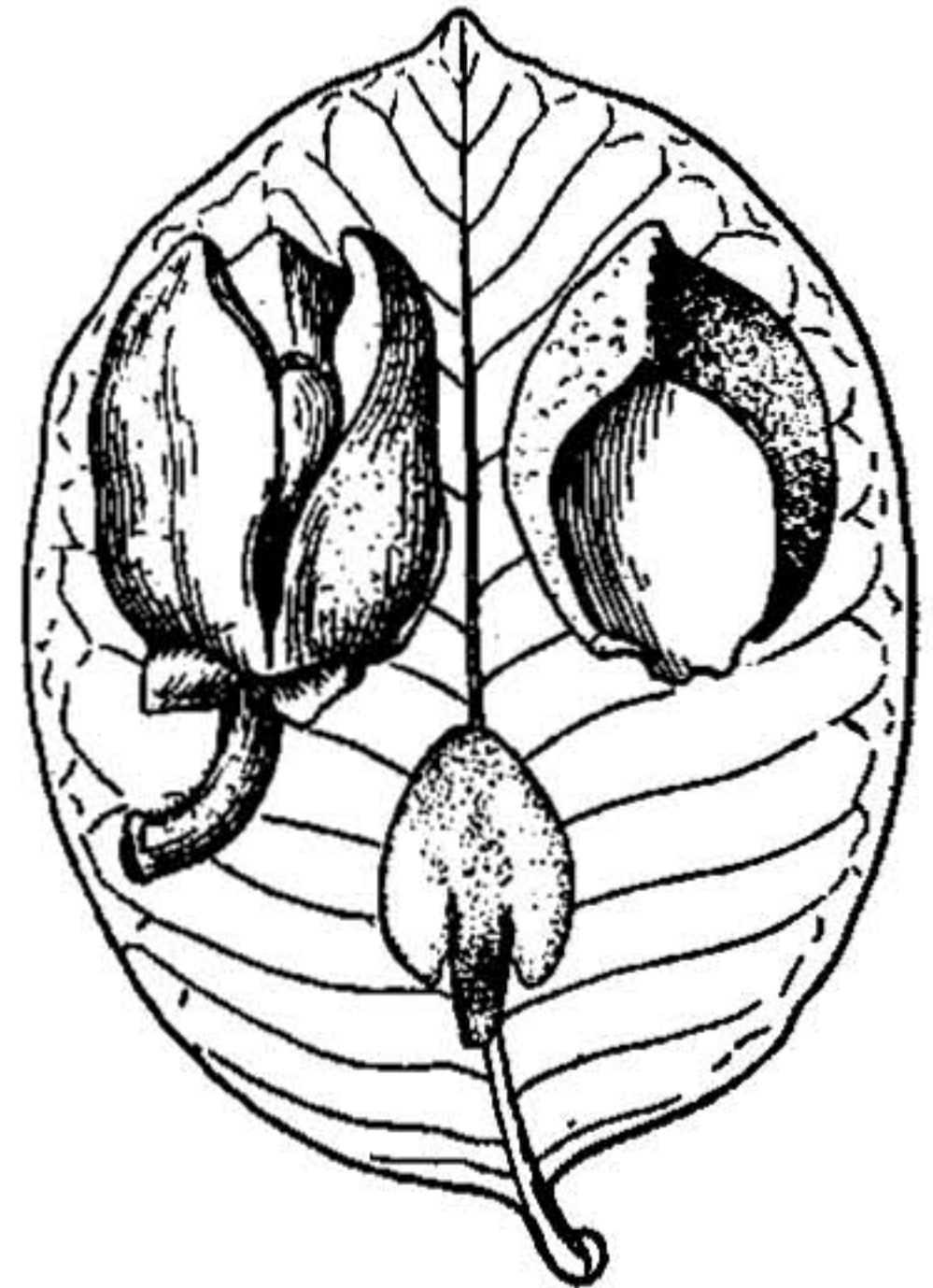


FIG. 12.—Leaf and flower of *Annona rodriguesii*. After Rodrigues. Scale $\frac{1}{2}$.

¹ Mart. Fl. Bras. 13¹: pl. 2. 1841.

KEY TO THE SECTIONS.

- Corolla gamopetalous, 6-lobed..... 6. GAMOPETALUM (p. 13).
 Corolla polypetalous.
 Petals normally 3, broadly ovate or suborbicular, concave; inner petals when present more or less imperfect..... 5. PILANNONA (p. 12).
 Petals normally 6, the outer ones broadly ovate or suborbicular, the inner ones oblong or linear..... 4. HELOGENIA (p. 11).

Section 4. HELOGENIA sect. nov.

Type species, *Annona paludosa* Aubl. (pl. 17; fig. 14).

This appears to be intermediate between the Guanabani and the Pilaeflorae and may be regarded as a link connecting the two groups. From the former

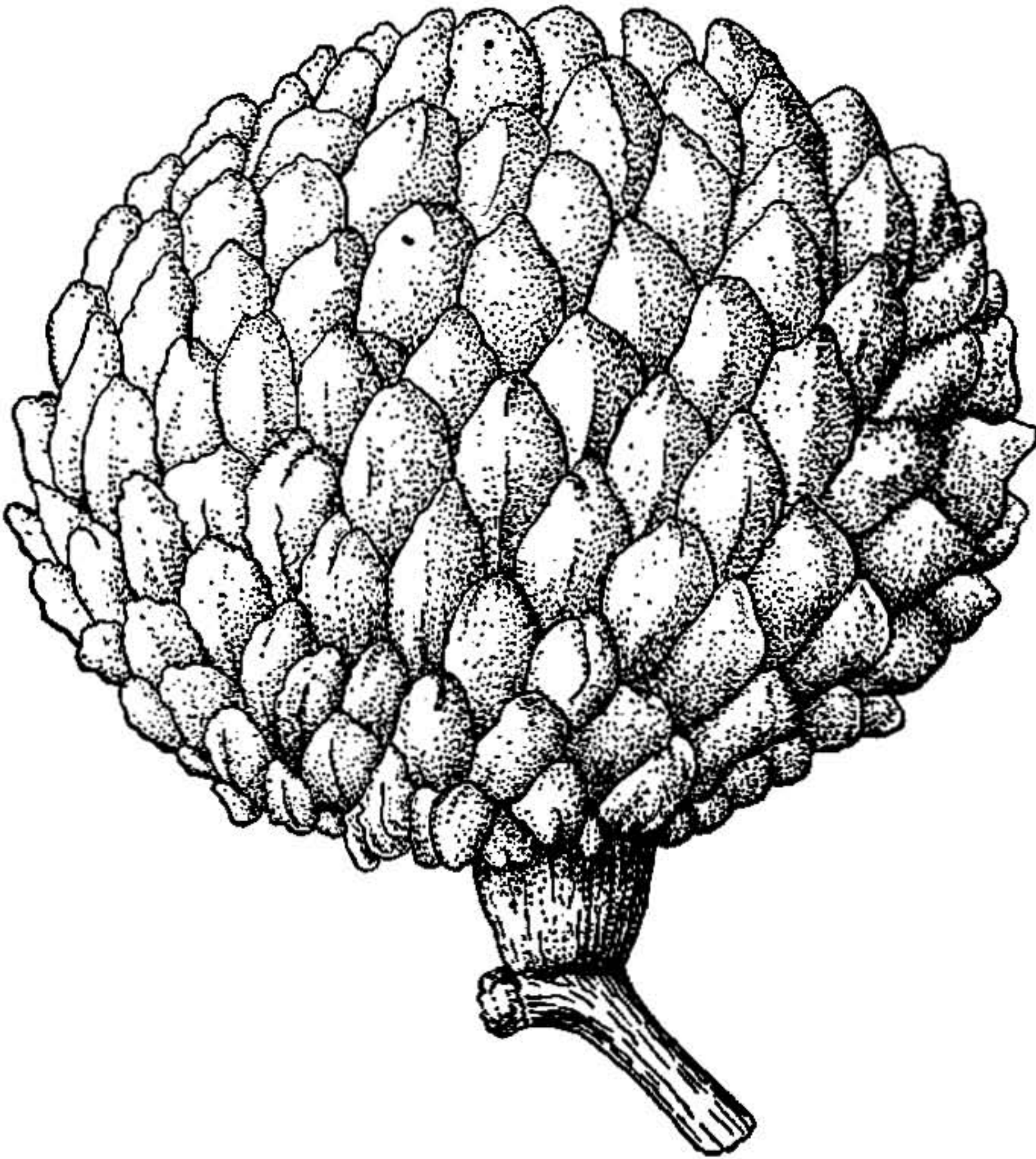


FIG. 13.—Fruit of *Annona rodriguesii*. After Rodrigues. Scale $\frac{1}{2}$.

it differs in having the narrow, lanceolate or linear inner petals of the present group. From *Pilannona* it differs in having the corolla normally 6-petaled instead of 3-petaled. The texture of the leaves (pl. 17) suggests affinities with both *Annona purpurea* (section *Ulocarpus*) and *A. jenmani* (section *Pilannona*), and that it is really allied to these two sections is indicated by the character of the stamens and carpels, as well as by the muricate fruit.

The name *Helogenia* is suggested by the habitat of the type species, which grows in swamps. Other species included in the section are perhaps xero-

phytic and may perhaps not be very closely related to the type. They are placed here, however, on account of their narrow inner petals, which, like those of *A. paludosa*, are neither imbricate nor valvate. Among them are *A. crotonifolia* Mart., *A. tomentosa* R. E. Fries, and *A. malmeana* R. E. Fries.

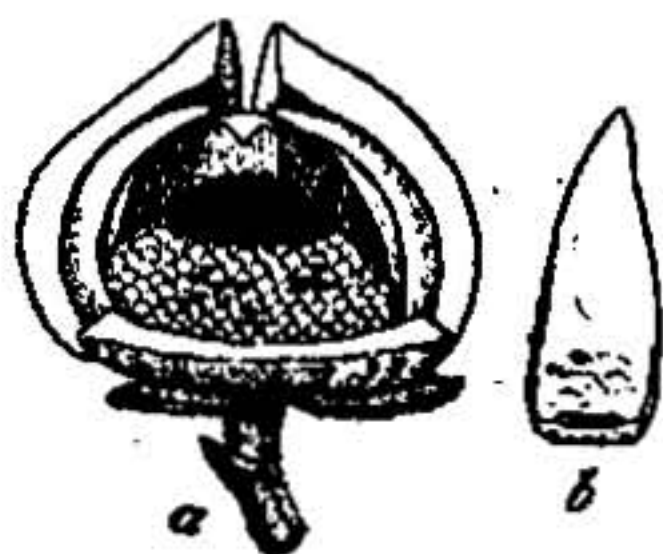


FIG. 14.—Flower of *Annona paludosa*. *a*, Flower, one outer petal removed; *b*, an inner petal.

Section 5. PILANNONA Safford.¹

Type species, *Annona sericea* Dunal (fig. 15).

In this section the flowers are normally 3-petaled, but sometimes are provided with more or less imperfect inner petals like those of *A. paludosa* Aubl. The connectives of the stamens are expanded into a broad head, which is usually muriculate with fine glossy points and sometimes bears straight or slightly curved diaphanous hairs. The gynoecium is usually a solidified mass of carpels, the tips of the styles forming a convex or disklike area composed of minutely tuberculate stigmas, very much as in *A. paludosa*; or the stigmas may be clothed with hairs, as in *A. holosericea* (fig. 16). The fruit is usually velvety and covered with projections, though in some cases (as in *A. longipes* Safford) the latter are reduced to appressed points. In addition to the

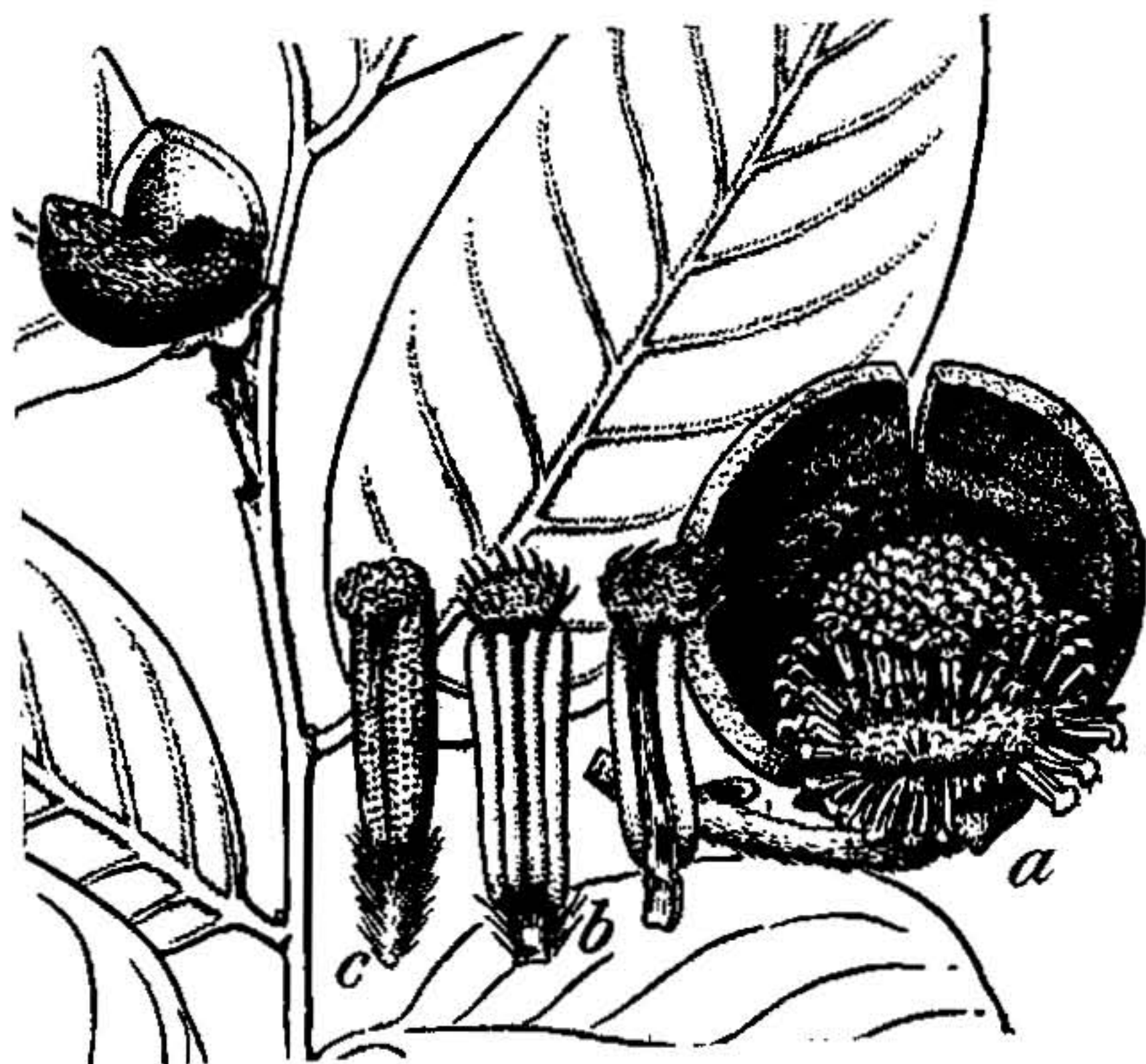


FIG. 15.—Flower and essential parts of *Annona sericea*. *a*, Flower with petal removed; *b*, stamens; *c*, carpel. From type material. *a*, Scale 3; *b*, *c*, scale 15.

species assigned to this section in the publication cited above, may be mentioned *Annona sancta-crucis* S. Moore, which has edible fruits about the size of an orange, *A. scandens* Diels, with small, oblong, velvety fruit, collected near Tarpoto, Peru, by Ule (no. 6521), and *A. hypoglauca* Mart. with flowers in clusters of 2 to 4.

¹ Contr. U. S. Nat. Herb. 16: 264. 1913.

Section 6. GAMOPETALUM sect. nov.

Type species, *Annona cornifolia* St. Hil. (pls. 18, A, 20).

This section is distinguished from all others by its gamopetalous flowers, the corolla (fig. 17) being composed of 3 broad and 3 narrow lobes, the edges of the latter, corresponding to inner petals, lapped over by those of the former. It is further distinguished by the connectives of the stamens (fig. 17, c), which have a broad terminal head expanded above the pollen sacs and echinulate, very much like those of the section *Pilannona*; by the ovaries, which (fig. 17, d) are quadrangular-prismatic and very closely crowded but distinct in the flower; and by the fleshy, 4-cornered styles, constricted at the base, terminating in swollen, ovoid or spheroid stigmas, those on the periphery of the gynœcium being velvety or clothed with minute glandular hairs, the inner ones less hairy

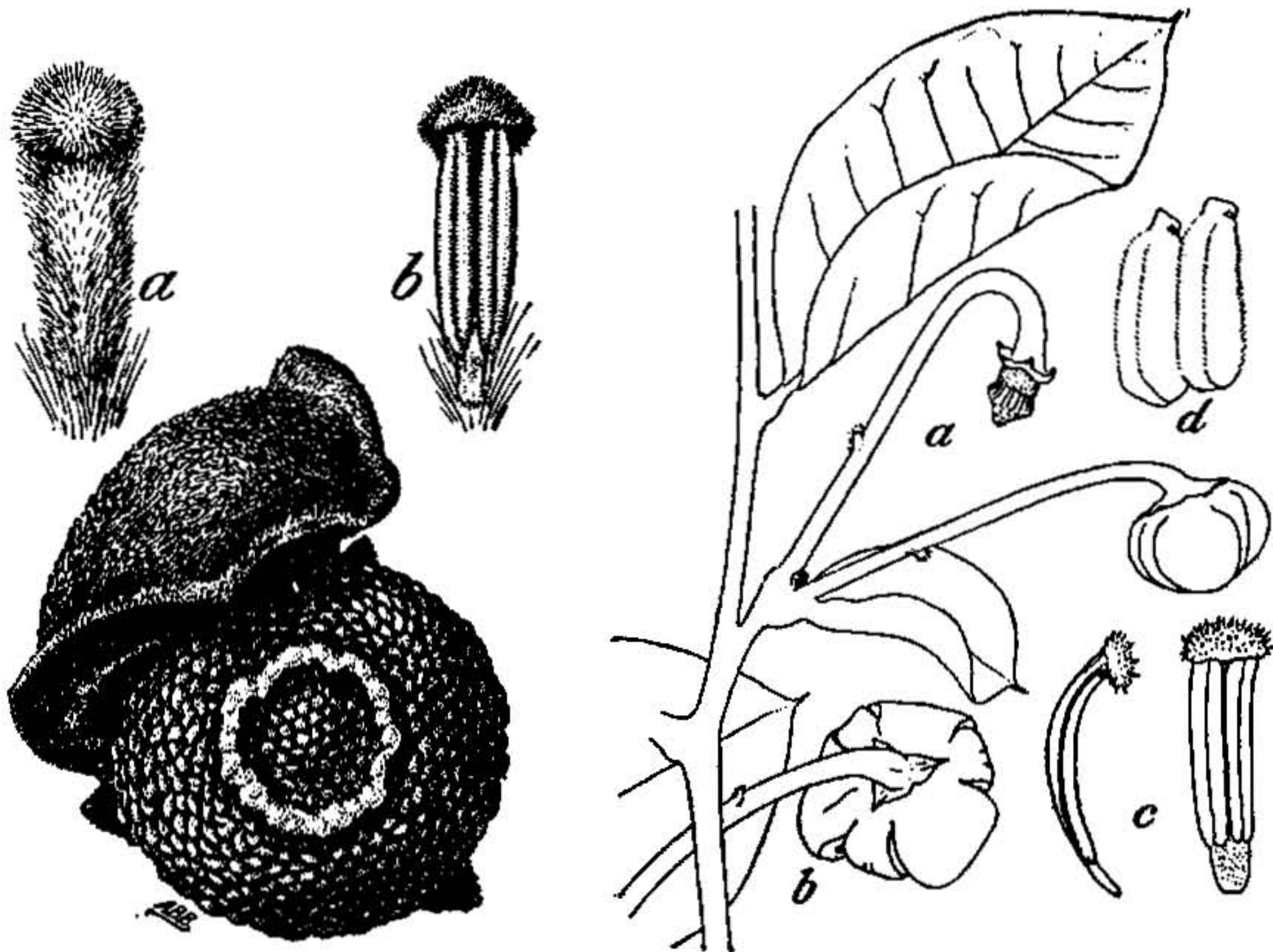


FIG. 16.—Flower of *Annona holosericea*, with two petals removed. a, Carpel; b, stamen. From type specimen. Flower, scale 4; a, b, scale 12.

FIG. 17.—*Annona nutans* and *A. cornifolia*. a, Twig of *Annona nutans* with geminate flowers; b, leaf and flower of *A. cornifolia*; c, stamens, and d, ovaries of *A. nutans*. a, b, Natural size; c, scale 10; d, scale 20.

or minutely papillose, all of them cemented in a solid mass after pollination and soon becoming detached from the ovaries. From the peculiarities of the essential parts and from the general habit of growth this section appears to be allied to *Pilannona*; in the gamopetalous corolla it seems to form a link between the genera *Annona* and *Rollinia*. In addition to the type this section includes the closely allied *Annona nutans* Fries, of Paraguay (pl. 21), *A. spinescens* Mart., and probably *A. walkeri* S. Moore. *Annona fagifolia* St. Hil. & Tul. of Southern Brazil, is also gamopetalous, the 3 inner petals adnate to the outer connate petals near the base. This species, though not very close to *A. cornifolia*, must also be placed in this section. The fruit of the type species is about the size of a hen's egg, ovate-globose, and of a bright orange red color

when ripe, with the component carpels tuberculate and often terminating in a point. The seeds are short and broad with conspicuous caruncles, very much like those of the African *A. senegalensis*.

Group III. ACUTIFLORAE (SHARP-PETALED ANNONAS).

(Section Acutiflorae Mart. in part.)

Petals 6, ovate or lanceolate, both outer and inner petals valvate, acute.

KEY TO THE SECTIONS.

- Flower buds depressed conoid or pyramidal; leaves subcoriaceous, glossy laurel-like..... 7. PHELLOXYLON (p. 14).
Flower buds more or less fusiform or conoid-acuminate; leaves membranaceous..... 8. ATRACTANTHUS (p. 15).

Section 7. PHELLOXYLON sect. nov.

Type species, *Annona glabra* L. (pl. 4; figs. 18-20).

In this section the corolla bears a superficial resemblance to that of *Euannona*, but the inner petals are acute and valvate (fig. 19) and the venation of the coriaceous, glossy, laurel-like leaves is quite distinct, conspicuously

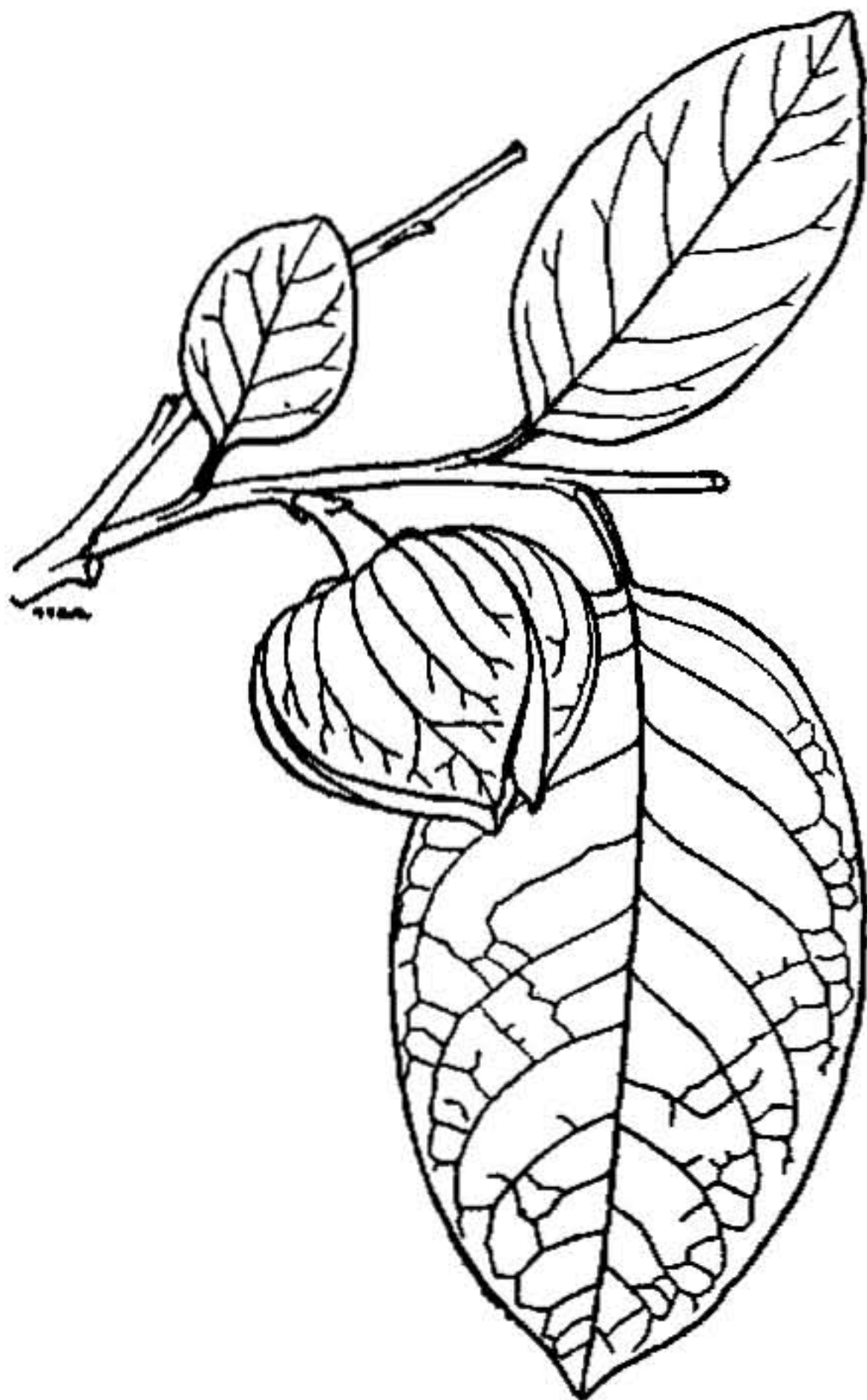


FIG. 18.—Flower of *Annona glabra*, from Miami, Florida. From specimen in herbarium of the New York Botanical Garden. Scale $\frac{1}{2}$.

reticulate when dry and lacking the minute axillary pockets of *Annona muricata* and its allies. The chief peculiarity of this section, however, is the form of its gynæcium (fig. 20), which has the ovaries closely cemented together even in the flower. The wood, especially that of the roots, is very light and corklike and is used for floats of fishing nets and for stoppers of bottles. It is commonly known as "corkwood" and this name has suggested that which is here proposed for the section. The fruit (pl. 4) is smooth and apple-like in appearance, with the areoles only faintly indicated on the surface.

This section is typified by a species, which was described by Linnaeus under two distinct botanical names: First, as *Annona glabra*, in the first edition of his *Species Plantarum* (1753), his description being based on Catesby's figure of a plant growing in the Bahama Islands; afterwards, as *Annona palustris*, in the second edition of his *Species Plantarum* (1762), his description being based on Sir Hans Sloane's

account of specimens of the Jamaican "water apple" growing "at and above the bridge over the Black-River in St. Dorothy's." Fortunately the localities in which the type plants of both descriptions grew are definitely fixed and many specimens from both localities are to be found in herbaria, especially in the Herbarium of the New York Botanical Garden. Those of each locality show

EXPLANATION OF PLATE 4.—Fruit and flower bud, photographed in Venezuela by H. Pittier. Natural size.

considerable variation in the size of the leaves and the flowers, but a careful comparison of them shows that the "alligator apple" of the Bahamas (*Annona glabra* L.) and the "water apple" of Jamaica (*Annona palustris* L.) are indistinguishable, a fact which was recognized by St. Hilaire, who, in company with Desfontaines, made a careful comparison of the two. In referring to the confusion of the two species St. Hilaire says: "*Anona glabra*, then, is still a species as little known as in the time of Linnæus. That immortal naturalist cites no other synonym of his species than the phrase and figure of Catesby, in whose work only a vague notion of the plant in question can be obtained. Lamarck, while copying Catesby, added to that

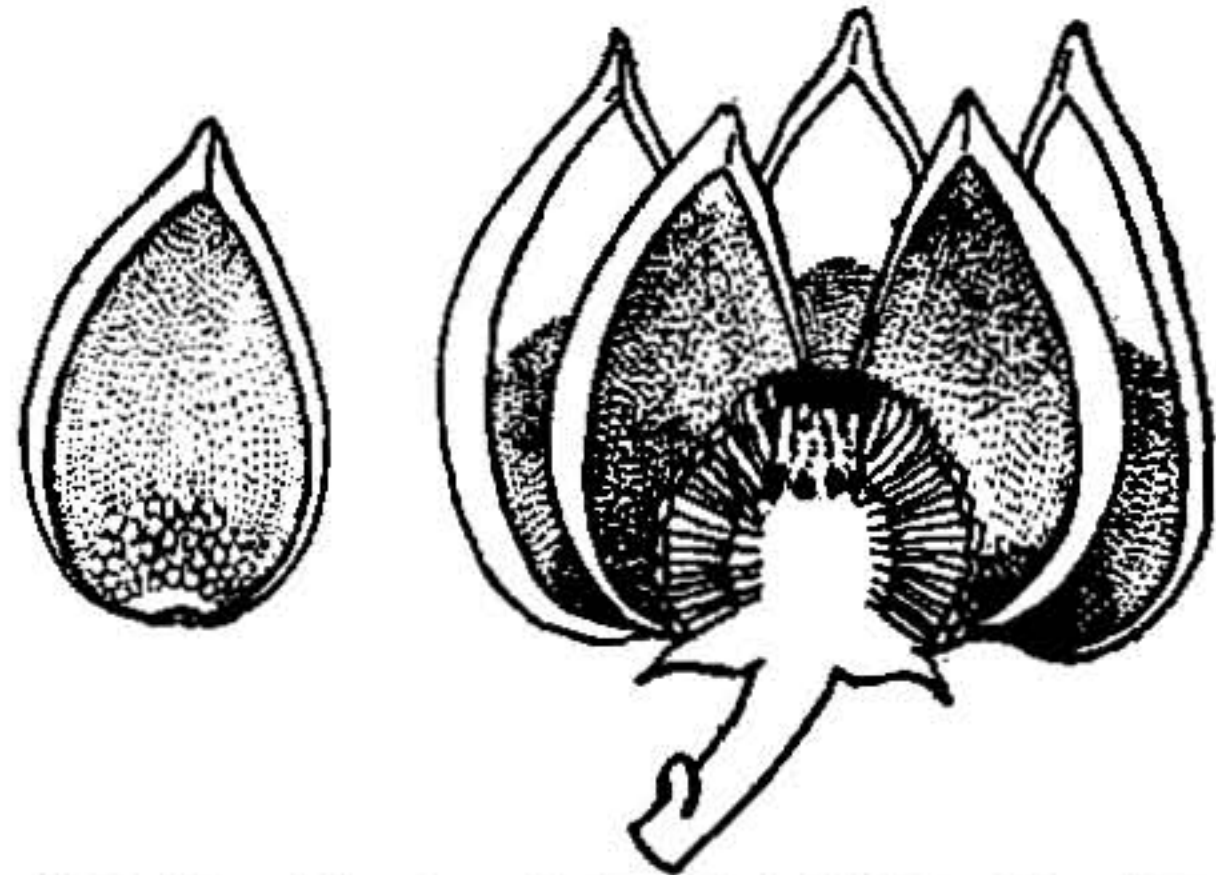


FIG. 19.—Flower of *Annona glabra*, showing valvate inner petals. One petal removed. Natural size.

author's description features borrowed from other species. As for Willdenow, he did nothing more than copy Linnæus, and contented himself with adding to the synonym from Catesby another synonym borrowed from DuRoi. Moreover, it is quite evident that he had not time to read the text of the *Harbkesche Baumzucht*; for its author states that he based his description of *Anona glabra* on a young plant sent from England under that name, but of which he saw neither the flowers nor the fruits; and as he adds that this young tree growing in a pot had *dentate* leaves, it is certain that the plant was not even an *Anona*. It is perfectly evident that if Willdenow had taken the trouble to read all the descriptions cited by him, he would never have reached the end of his first volume, and the impossibility which one finds of verifying so many obscure synonyms shows how necessary it is for botanists to free themselves from the obligation of citing them. To indicate them without investigation is but to multiply and perpetuate errors; to verify them is fruitlessly to spend time which would be more usefully employed in observing."¹

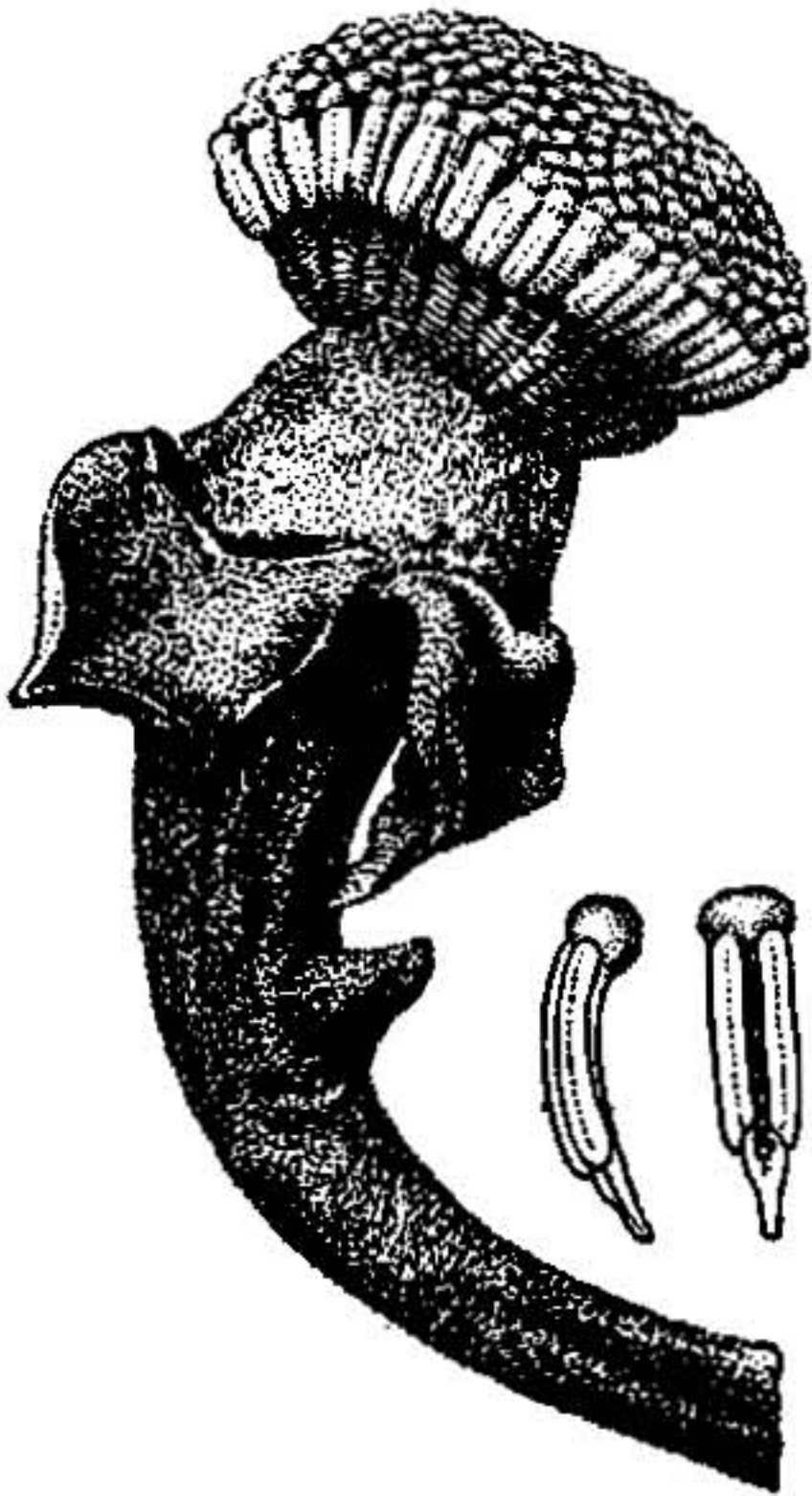


FIG. 20.—Gynæcium of *Annona glabra*, showing consolidated ovaries. Styles borne on the ovaries; two stamens at the side. Scale 4.

as to its relationship to the typical *A. glabra*, which is found on the adjacent coast.

Section 8. ATRACTANTHUS sect. nov.

Type species, *Annona acutiflora* Mart. (pl. 22).

In this section the flower bud is acuminate. The outer petals are united at the base but open widely when the flower is mature (fig. 21). The inner petals

¹ St. Hilaire, Augustin de. *Plantes Usuelles des Brasiliens* 30: 5. 1824.

are acute and valvate and bear a keel or midrib on the back. The stamens terminate in a velvety, expanded connective tip and the hairy ovaries are grouped into a conoid gynœcium. The flowers are fascicled in extra-axillary or cauliflorous clusters of two or three, like those of the section *Chelonocarpus*,



FIG. 21. ← *Annona acutiflora*.
Leaves and flowers. Natural size.

usually only 1 or 2 flowers of the cluster developing fruit. Fruit (immature specimens only observed) resembling that of *A. cherimola* (fig. 48, p. 41). The name of the section, which is included in Martius's *Acutiflorae*, is suggested by the more or less fusiform flower-bud.

Atractanthus seems to be intermediate between *Phelloxylon* and *Chelonocarpus*, resembling the former in its acute, valvate inner petals and the latter in its clustered peduncles.

GROUP IV. ATTAE (CUSTARD APPLES).

Section *Attæ* Mart., in part.)

Inner petals when present minute and scale-like, often not exceeding the stamens in length; outer petals linear or oblong, swollen and concave at the base, and usually keeled within or triquetrous above. This section includes the subsection *Oblongiflorae*, or *Cherimoliac*, of Martius, but excludes the *Pilaeiflorae*, described above.

KEY TO THE SECTIONS.

- Peduncles with amplexicaul leaflike bracts at the base; seeds with thick testa like the shell of a nut..... 11. *ILAMA* (p. 19).
- Peduncles without amplexicaul leaflike bracts at the base; testa of seeds thin.
- Leaves with thick conspicuous reticulating veins beneath between the lateral nerves..... 12. *SAXIGENA* (p. 20).
- Leaves with the veins not conspicuously reticulated beneath.
- Fruit thick-shelled when mature, with the areoles separated by raised ridges; pulp aromatic, mango-flavored, watery 9. *CHELONOCARPUS* (p. 18).
- Fruit thin-skinned when mature, with the areoles more or less gibbous. tuberculate or smooth, sometimes separated by impressed lines; pulp sweet or sweet-acidulous, sometimes insipid, custard-like..... 10. *ATTA* (p. 18).

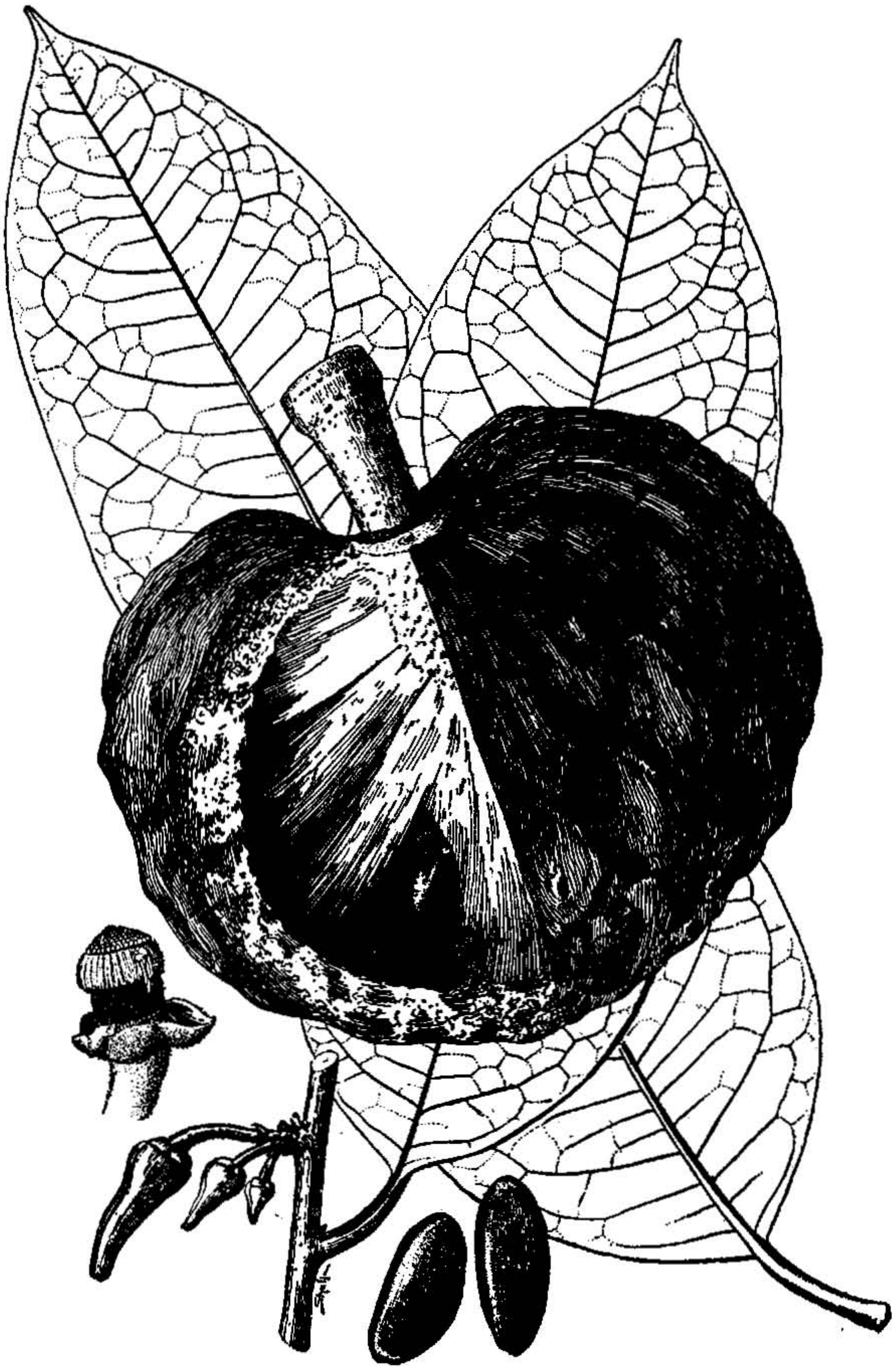


FIG. 22.—*Annona scleroderma*. Leaves, fruit, flower, and seeds. Flower enlarged, the rest natural size.

Section 9. CHELONOCARPUS Safford.¹

Type species, *Annona scleroderma* Safford, the hard-shelled custard apple of Guatemala (fig. 22).

In this section the inflorescence is usually caulifloral, several flowers issuing in a fascicle or on a very short specialized branchlet from the bark of the old

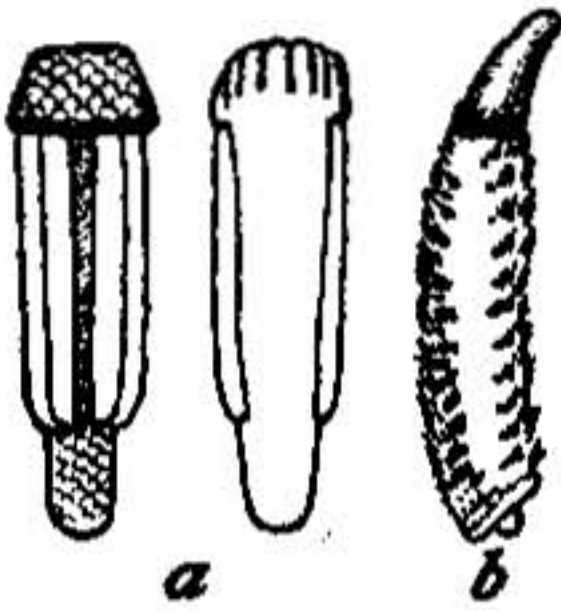


FIG. 23.—(a) Stamens and (b) carpel of *Annona scleroderma*. Scale 12.

stems or branches, somewhat as in the genus *Raimondia*, but all of them perfect instead of unisexual and with the connective broadly expanded and truncate at the apex above the pollen sacs (fig. 23, a) and the carpels closely appressed to form a compact gynœcium (fig. 24). The ovaries are clothed with appressed hairs and the styles are ovate and constricted at the base (fig. 23, b). The corolla resembles that of the section *Atta*, with three oblong or linear petals excavated at the base to receive the essential parts; or if inner petals are present these are very minute and inconspicuous.

The fruit is spherical or subglobose with a hard shell having the surface divided into polygonal areoles by obtuse raised ridges.



FIG. 25.—*Annona reticulata*, the common custard apple. Scale $\frac{1}{2}$.

seeds are comparatively large, compressed, and smoothly polished. The name of the section is suggested by the resemblance of the shell of the fruit to tortoise shell. The leaves are coriaceous, oblong and acuminate, with the secondary nerves not prominent.

Besides the type, this section includes *Annona testudinea* Safford and *A. pittieri* Donn. Smith.

Section 10. ATTA Mart.

Type species, *Annona squamosa* L., the sugar apple or "pomme-cannelle" (fig. 1, p. 2).

This group includes most of the commercial custard apples. The flower buds are in most of the species long and slender, but sometimes oblong or pyriform. The corolla (fig. 26) is apparently 3-petaled, but there are usually 3 inner petals present, often no longer than a stamen, with a texture similar to that of the connective of the stamens and usually with a longitudinal



FIG. 24.—Flower of *Annona pittieri*. Petals removed. Scale 4.

¹ Journ. Washington Acad. Sci. 3: 103. 1913.

keel on the outer surface. The outer petals are keeled within or triquetrous above and concave at the swollen base, to inclose the essential parts. The stamens terminate in a broadly expanded connective and the ovaries, except at the base, are distinct, though crowded, and form a compact cone with their tapering, appressed, fleshy styles. The leaves are usually membranaceous, with a tendency in several species to conduplication. The peduncles are in groups of 2 or 3 or sometimes solitary, usually issuing from near the base of a new branchlet and never caulifloral. The leaflike amplexicaul bracts at the base of the peduncles which characterize the following section (Ilama) are absent. This section includes, in addition to the type species, the well-

known chirimoya (*Annona cherimola* Mill.), the long-flowered chirimoya of Jalisco (*A. longiflora* S. Wats.), the common custard

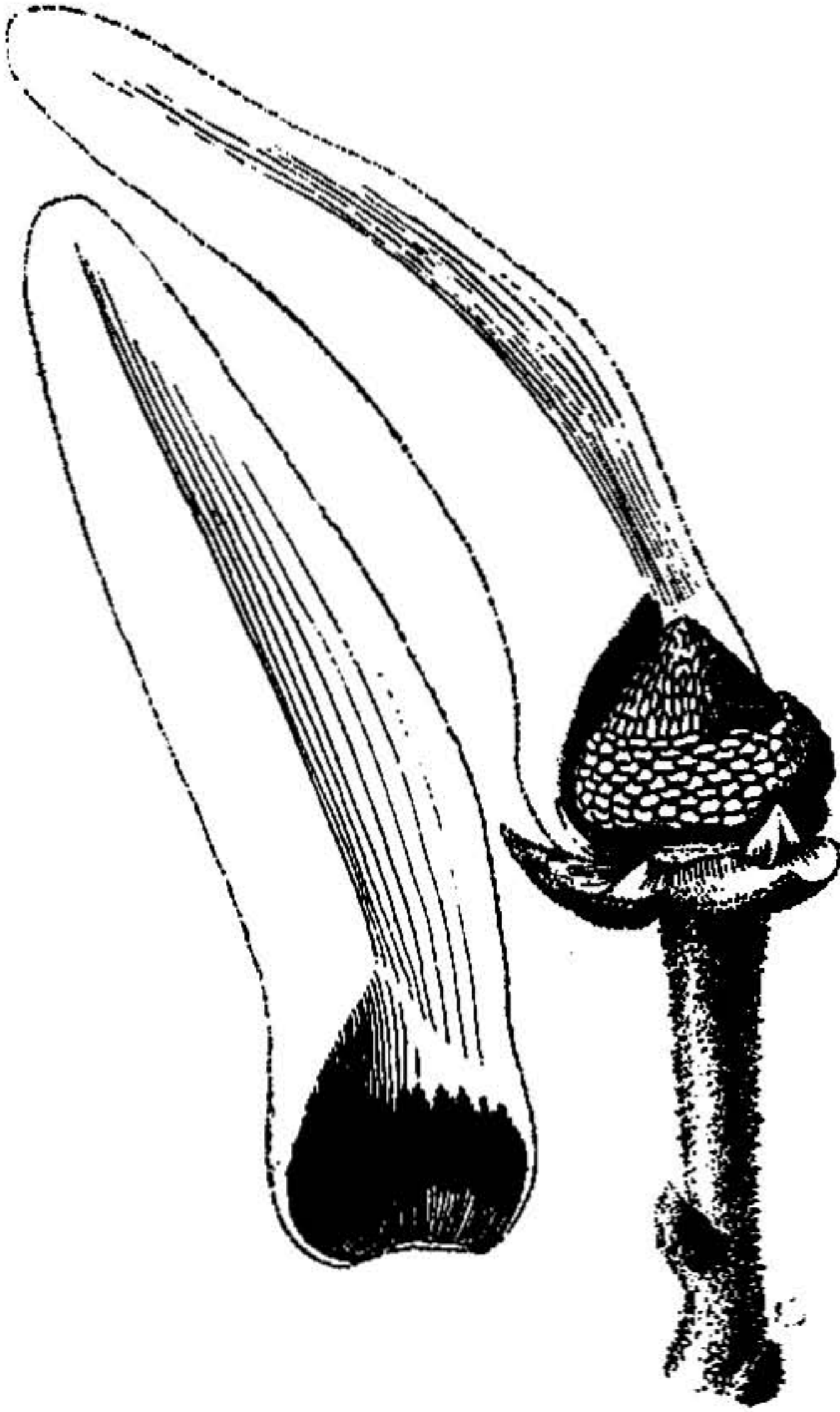


FIG. 26.—Flower of *Annona cherimola*. Showing essential parts and minute inner petal. Scale 4.

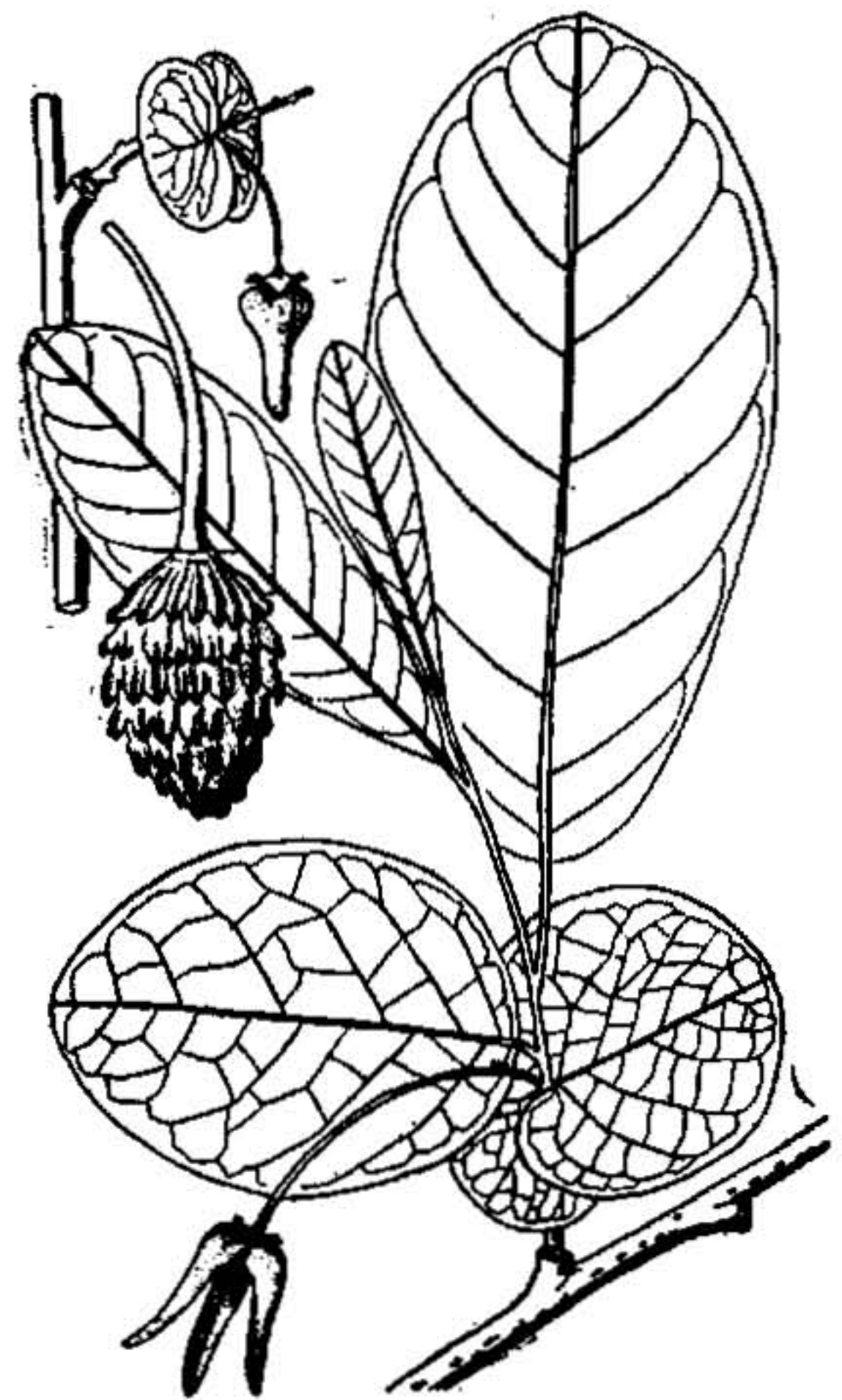


FIG. 27.—*Annona diversifolia*. Leaves, flower, and fruit. From type in U. S. National Herbarium. Scale $\frac{1}{2}$.

apple or bullock's heart (*A. reticulata* L., fig. 25), and two new species to be described below: *A. lutescens*, the "anona amarilla" of Central America (pl. 23; figs. 49-52, pp. 42, 43); *A. praetermissa* of Jamaica; and *A. palmeri*, the dwarf wild Annona of Acapulco (pl. 24; figs. 53, 54, pp. 44, 45).

Section 11. ILAMA Safford.

Type species, *Annona diversifolia* Safford,¹ commonly called "ilama" at Colima, Tlatlaya, and Acapulco (pl. 5; fig. 27).

¹ Journ. Washington Acad. Sci. 2: 118. 1912.

This group includes, in addition to the type, a single species, *Annona macrophyllata* Donn. Smith (pl. 26), to be redescribed below. It is chiefly distinguished from the other groups by the presence of

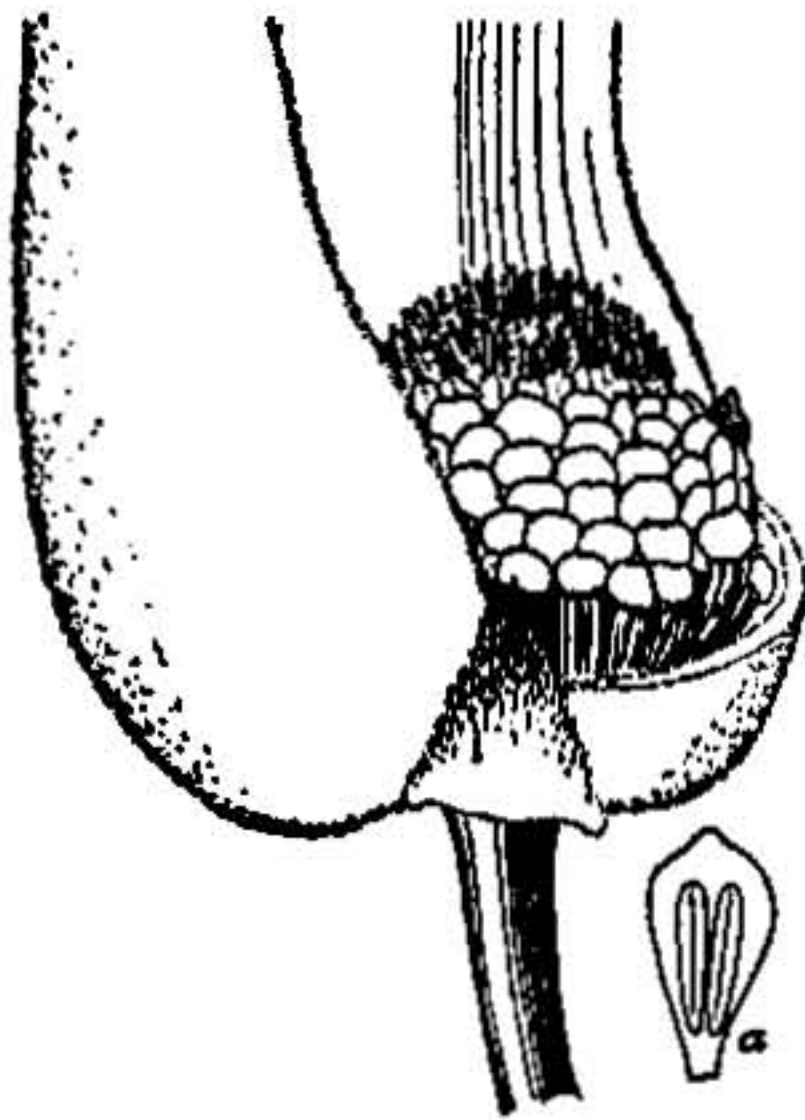


FIG. 28.—Flower of *Annona diversifolia*. Base of flower with an outer petal removed and (a) inner petal with rudimentary pollen sacs. From type specimen. Scale 4.

broadly ovate or orbicular, amplexicaul, leaflike bracts at the base of the peduncle and of flowering branchlets. In shape the flowers suggest those of the section *Atta*, but the petals open to the base and the inner petals when present are stamen-like and bear rudimentary pollen sacs (fig. 28). The fruit of the type species (pl. 5) is large, fleshy, and aromatic, with the juicy pulp frequently pink or rose-tinted. It is shaped "like a pineapple cheese" and is usually covered with large stout protuberances, though sometimes these are lacking in fruits of the same tree, as shown in the lower right-hand corner of plate 5. The seeds (fig. 29, a) differ

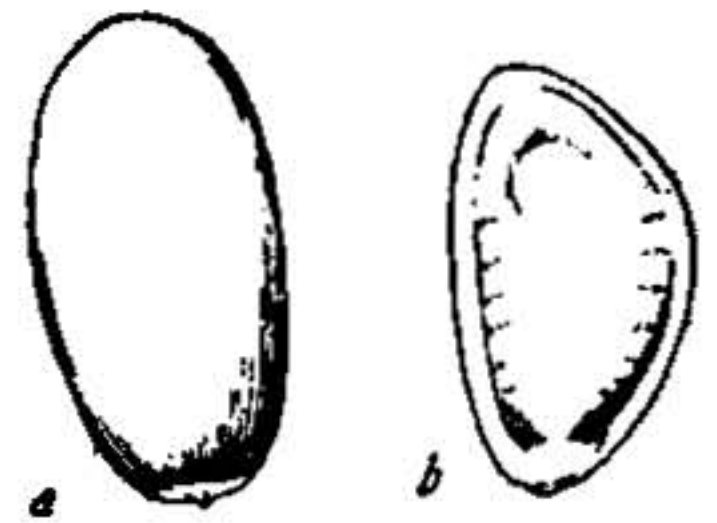


FIG. 29.—(a) Seed of *Annona diversifolia* and (b) one of *A. cherimola*. Natural size.

from those of all other *Annonas* known to the writer in having a hard, thick, smooth, terete testa, like the shell of a hazel nut.

Section 12. SAXIGENA sect. nov.

Type species, *Annona bullata* A. Rich. (pls. 27, 28).

The shrubs and small trees composing this section bear a general resemblance to those of the section *Atta*; but the leaves are remarkable for the close network of prominent veins between the lateral nerves (figs. 30, 31), and the stamens, instead of having the connective terminal broadly expanded into a hood above

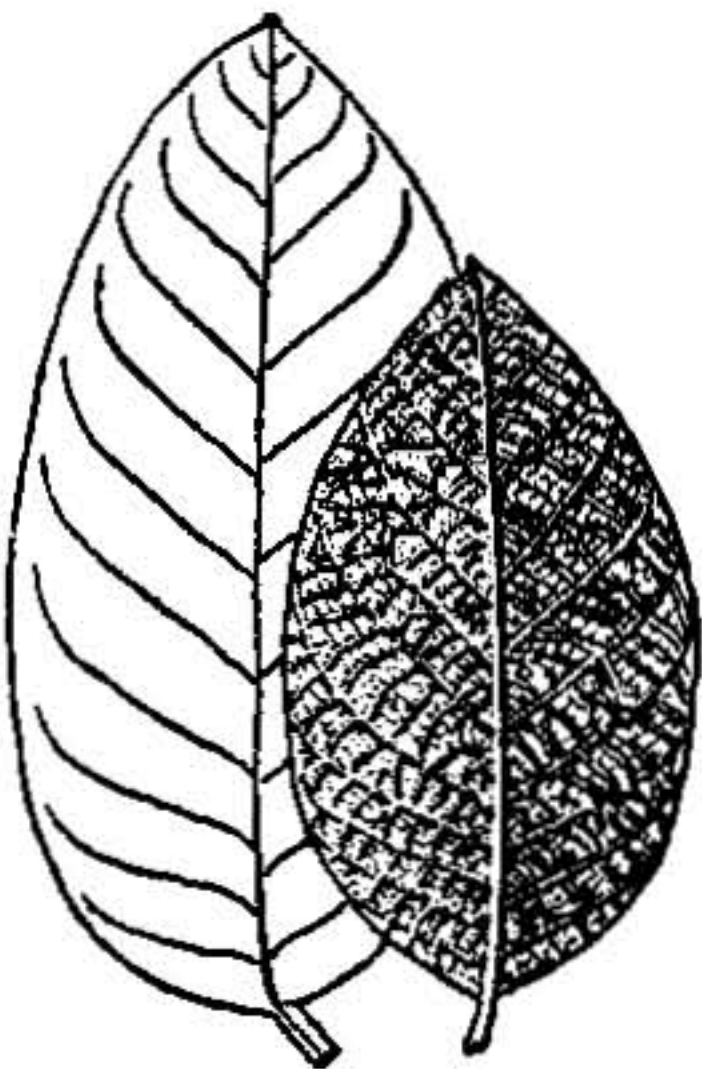


FIG. 30.—Leaves of *Annona bullata*. Scale $\frac{1}{2}$.

the pollen sacs, usually have it produced into a short, fleshy, obtuse tip scarcely equaling the breadth of the two pollen sacs, thus approaching those of the group *Annonellae*. In addition to the type species this section includes the closely allied *Annona crassivenia* (pls. 29, 30), the remarkably reticulated suborbicular leaf of which is shown in the

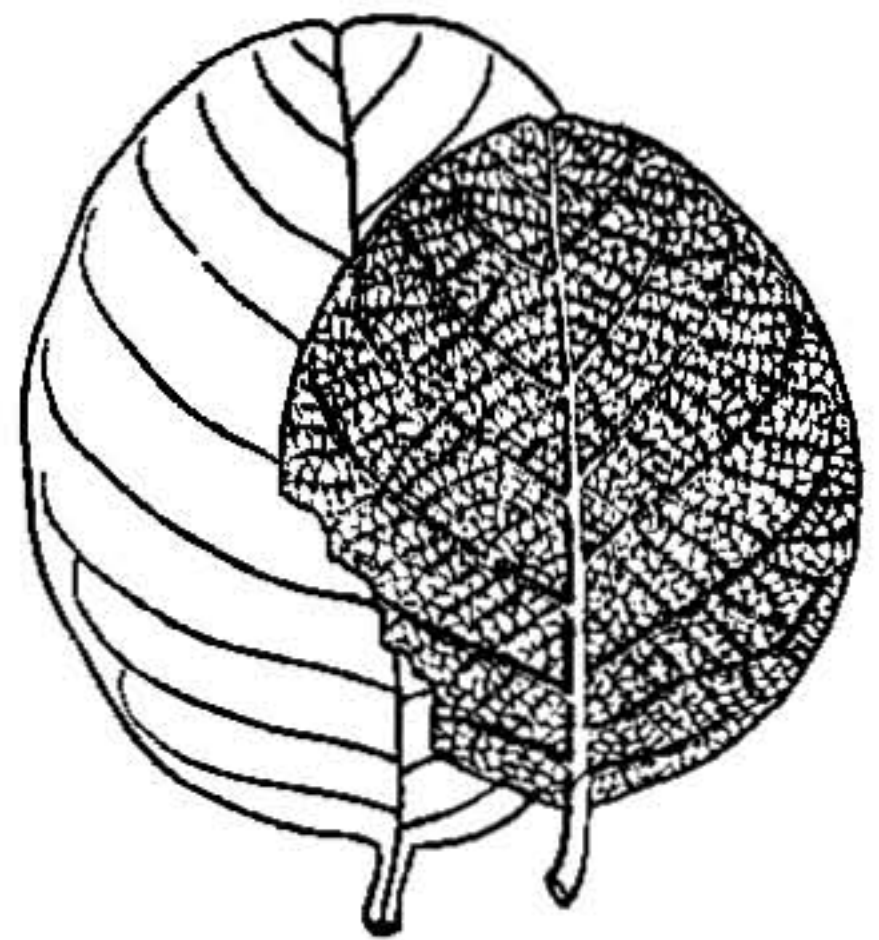


FIG. 31.—Leaves of *Annona crassivenia*. From specimens collected by Van Hermann as cited. Scale $\frac{1}{2}$.

accompanying illustration (fig. 31). The fruit (fig. 32) resembles that of a chirimoya in general appearance.

EXPLANATION OF PLATE 5.—Field photographs received through American consul, Marion Letcher, taken near Acapulco, State of Guerrero, Mexico. Scale of B indicated by Mexican peso.

The name applied to the section is suggested by the habitat of the type species, the plant being known in Cuba as the "laurel de cuabal"—i. e., laurel of rocky places.

GROUP V. ANNONELLAE (DWARF ANNONAS).

(Anonellae Baill.)

Flowers small, spheroid or conoid; petals 3 or 6, the outer ones thick and fleshy, the inner often rudimentary or entirely lacking; stamens remarkable for the comparatively small development of the apex of the connective, this not exceeding in width the two pollen sacs.

KEY TO THE SECTIONS.

Flower buds

pointed..... 13. ANNONULA (p. 21).

Flower buds

spheroid or
ovoid and

obtuse..... 14. ANNONELLA (p. 21).

Section 13. ANNONULA sect. nov.

Type species, *Annona cascarilloides*

Wright of western Cuba (pl. 31; figs. 60, 61, pp. 51, 52).

Flowers small, conoid or oblong-conoid; petals 3, triquetrous, hollowed at the base; apex of the

stamen-connectives not as broad as the two pollen sacs; leaves small, oblong-elliptical, coriaceous with revolute margins and with a thick midrib and lateral nerves almost at right angles with it. The venation of the leaves is very different from that of all other sections of the genus and the leaves and bark are characterized by a pungent aromatic taste like that of allspice.

In addition to the type species above mentioned this section includes *Annona sclerophylla* (pl. 32; figs. 33, 62, p. 53), a hitherto undescribed species from eastern Cuba. The name of this section, a diminutive form of *Annona*, is suggested by the dwarf, scrubby habit of the plants.

Section 14. ANNONELLA Baill.

Type species, *Annona globiflora* Schlecht. (pl. 35; figs. 34, 35, 63, p. 54).

Shrubs or small trees with comparatively small, punctulate, membranaceous or subcoriaceous leaves, reticulate-veined between the lateral nerves; flowers

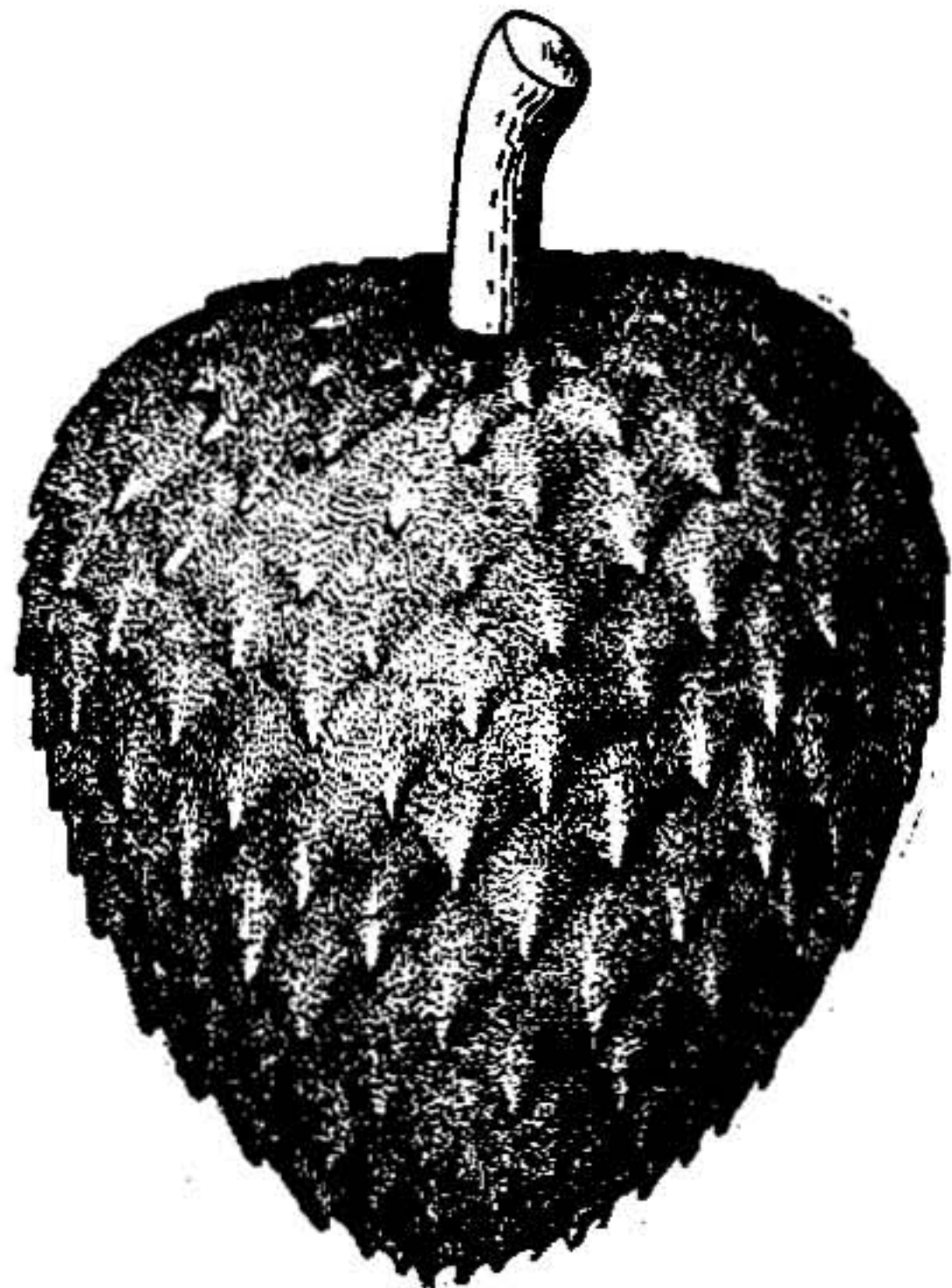


FIG. 32.—Fruit of *Annona bullata*. Natural size. Drawing by Theodore Bolton from type material.

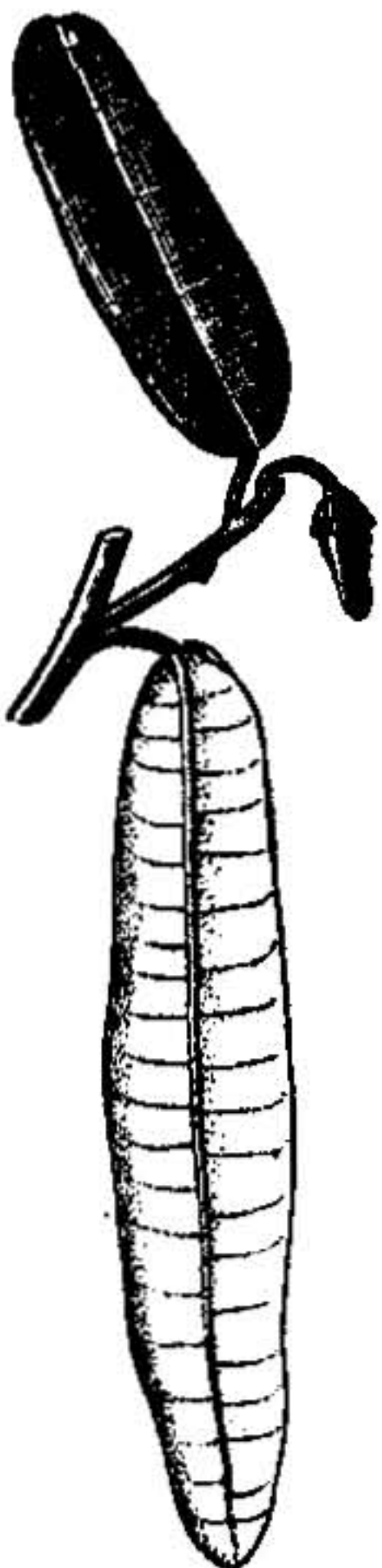


FIG. 33.—Leaves of *Annona sclerophylla*. Showing peculiar venation. From type specimen. Natural size.

(figs. 63, 64, pp. 54, 55) small, often no larger than a pea, on short slender peduncles, either solitary or geminate; petals 3 or 6, the outer ones thick, concave, broadly ovate or suborbicular; connectives of the stamens remarkable in not being broadly dilated above the pollen sacs; carpels free, the ovaries pilose and tipped with a tapering glabrous style; fruit (fig. 35) no larger than a peach with the areoles indistinctly outlined, gibbous and obtuse or terminating in a small point. The flowers are for the most part 3-petaled, but occasionally one or more inner petals are present. In addition to the type species this section includes *Annona bicolor* Urban (pl. 34), of Santo Domingo, the fruit of which is described and figured for the first time in the present paper, and *A. rosei* Safford (pl. 35), a new species which was recently discovered by Dr. J. N. Rose on the south coast of the island of Santo Domingo.

NEW AND IMPERFECTLY KNOWN SPECIES OF ANNONA.

Annona montana Macfad.

Annona montana Macfad. Fl. Jam. 7. 1837.

Section Euannona. A tree usually of small dimensions, but sometimes reaching the height of 15 meters; leaves coriaceous, glabrous, dark green and very glossy as though varnished above, lighter green beneath, very similar to those of *Annona muricata* L., but larger, obovate-oblong, acute or rounded at the base and abruptly acuminate at the apex, usually about 12 to 18 cm. long and 5 to 6.5 cm. broad; flowers similar to those of *Annona muricata*, but with the 3 outer petals obtuse or acute, rarely acuminate, normally about 4 cm. long and 3 cm. broad, sometimes much larger (6 cm. long and 4 cm. broad), valvate, cordate-ovate, apparently glabrate on the outside but clothed with minute appressed hairs as seen under the microscope; inner petals imbricate, thin-edged, broadly obovate, usually rounded at the apex and narrowed at the base into a slender claw; calyx lobes triangular, acute, often persistent at the base of the fruit; peduncles thickest at the apex, glabrous, solitary or in pairs, extra-axillary, sometimes apparently axillary when issuing from the base of a new branchlet, often opposite a leaf, about twice the length of the petioles and bearing 2 small, sessile or semiamplexicaul, more or less persistent bractlets, these ovate or orbicular in shape and acute at the apex; receptacle truncate-conoid or subcylindrical, 5 to 6 mm. in diameter and 4.5 to 5 mm. high, thickly covered with minute straight hairs; stamens very numerous, in 18 to 20 rows, club-shaped, 4.3 to 5.5 mm. long, the two parallel pollen sacs 2.5 to 3 mm. long and the expanded connective above them 0.5 mm. thick and 1 mm. broad with its surface minutely muriculate; carpels forming a cluster (gynœcium) at the apex or center of the receptacle, 5 to 5.8 mm. high, the styles 3 mm. long covered with chestnut-colored sericeous hairs, the stigmas 2 to 2.8 mm. long, pale brown and velvety, broad at the end and tapering to the slender base, becoming glued together into a flat or convex surface by a viscous exudation just before the dehiscing of the pollen sacs and separating from the tips of the styles after pollination; fruit broadly ovate or subglobose, tomentose at first, at length glabrate, varying in size from that of

an orange to 15 cm. in diameter, with fleshy prickles shorter and straighter than those of the fruit of *A. muricata* protruding from the inconspicuous hexagonal, or U-shaped areoles; pulp white at first, turning yellowish when ripe; seeds yellow, light brown, or tan-colored, smooth and hard, enveloped when fresh in a white pellicle, ovate compressed, larger and lighter colored than those of *A. muricata*, about 20 mm. long, 13 mm. broad, and 7 mm. thick when mature and containing a hard white ruminate endosperm. (PLATES 6, 7.)

TYPE LOCALITY: Orchard, Port Royal Mountains, Jamaica.

DISTRIBUTION: West Indies and perhaps Central America and northern South America, usually growing along streams in the mountains but sometimes occurring near sea level.

SPECIMENS EXAMINED:

CUBA: Without definite locality, *Wright* 1847; near Camaguey, on banks of streams (seeds) *Luaces* 32248; Santa Clara, Trinidad Mountains, *Britton, Earle & Wilson* 4761.

HAYTI: Bayeux, near Port Margot, *Nash* 85 (1903).

SANTO DOMINGO: Woods near Iguama River, a tree 40 feet high, *Taylor* 313 (1909).

PORTO RICO: Coamo Springs, *Underwood & Griggs* 510, *Guy N. Collins*, photographs no. 2878, 2879, U. S. Dept. Agr., Bur. Plant Ind.; Coamo, Rio Fuerte Valley, *Sintenis* 3129, 6294; Peñuelas, on river bank, *Sintenis* 4840; near Mayagüez, flowers in formalin, U. S. Dept. Agr. Economic Coll. 3479.

GUADELOUPE: Without definite locality, along streams, "corossol bâtard," *Père Duss* 3984.

MARTINIQUE: Lezard, banks of stream, *Père Duss* 1764a; without definite locality, *Hahn* 188, 1018 (distributed as *A. palustris*).

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FIG. 34.—*Annona globiflora*. Leaves, flowers, and fruit. Scale $\frac{1}{2}$.

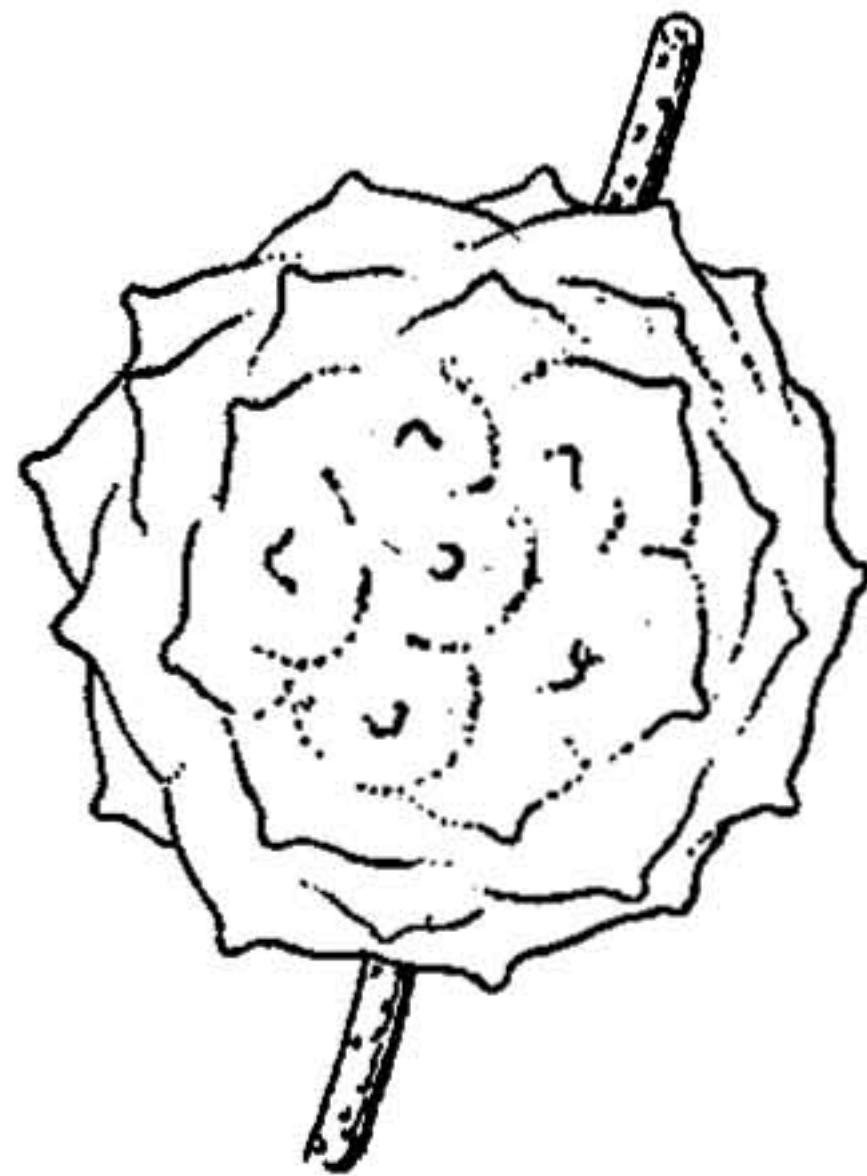


FIG. 35.—Fruit of *Annona globiflora*. Natural size.

SPECIMENS EXAMINED—Continued.

JAMAICA: Hope River Valley, *Wm. Harris* 9979; between Hope Gardens and Constant Springs, *Maxon* 2152, *Guy N. Collins*, photographs 6814, 6758, U. S. Dept. Agr., Bur. Plant Ind.

AFRICA: Experimental Garden, Kamerun, Versuchsanstalt, nos. 274, 281.

LOCAL NAMES: Prickly apple, Mountain soursop, Wild soursop (Jamaica); Guanabano cimarron (Cuba, Santo Domingo, Porto Rico); Corossolier maron (Haiti, Guadeloupe); Corossolier bâtard (Martinique).

This species is frequently confused with *Annona glabra* L. and has been repeatedly distributed as the latter species. It can readily be distinguished, however, by its imbricate inner petals or by the small pits in the axils of the lateral nerves of its leaves above described.

EXPLANATION OF PLATES 6, 7.—Pl. 6, unusually large flowers of *Annona montana*, the lower one with two outer petals and one inner petal removed to show the hemispherical androecium, from the center of which issues the gynoecium. From photograph of specimens in formalin from Mayagüez, Porto Rico, received by the Bureau of Plant Industry, May 12, 1910, made under the author's direction by L. V. Hallock, of the U. S. Department of Agriculture. Pl. 7, *Annona montana* Macfad., showing leaves with the minute pockets in the axils of the lateral nerves and immature fruit. From field photograph of fruit growing at Coamo Springs in files of the Bureau of Plant Industry, taken by Mr. Guy N. Collins, June 29, 1901 (no. 2878).

Annona sphaerocarpa Splitg.

Annona sphaerocarpa Splitg. Tijdsch. Nat. Gesch. 9: 96. 1842.

Section Euannona. A tree of moderate height with a thick trunk and the habit of *Annona muricata*; woody branches gray, speckled with whitish lenticels; leaves oblong-lanceolate to oblong-obovate, glabrous, coriaceous, acutish, very finely reticulate-veined, glossy above, 12 to 20 cm. long, 5 to 10 cm. broad, with a petiole 6 to 10 mm. long, grooved above, thick; peduncles solitary or in pairs, 1-flowered, 2.5 cm. long, thickened at the extremity, glabrous, with a broad ovate obtuse bracteole above the base and sometimes one near the middle; calyx lobes broad, obtuse, appressed to the corolla, reflexed after blooming; petals thick, yellow, the outer almost an inch long, ovate, concave, acutish, the inner ones shorter, concave, obovate, quite obtuse, narrowed abruptly into a subtriquetrous claw; stamens numerous, the apex of the connective capitate and velvety; torus pubescent; carpels concrete at the base, clustered into a conoid gynoecium; fruit large, spherical, yellowish when mature, 10 to 12.5 cm. in diameter, obscurely areolate, not scaly, the areoles unarmed or bearing small short straight protuberances easily rubbed off in handling; seeds ovate, compressed, yellowish, about 18 mm. long, with the embryo in the base of the albumen. (PLATE 8, B. FIGURE 36.)

Type in the Leyden Herbarium, collected by Friedrich Ludwig Splitgerber near Paramaribo, Surinam, November, 1837 (no. 110).

DISTRIBUTION: Surinam (Dutch Guiana); Panama (cultivated in hospital grounds at Ancon).

SPECIMENS EXAMINED:

SURINAM: Vicinity of Paramaribo, *Kuyper*, September 29, 1912, with photograph of fruit (U. S. Nat. Herb., nos. 691787, 691788).

SPECIMENS EXAMINED—Continued.

PANAMA: Hospital grounds at Ancon, February 13, 1911, *Pittier* 2724 (U. S. Nat. Herb., no. 676859).

BRAZIL: Without definite locality, *Sellow* 1209 (Berlin Herb.).

LOCAL NAMES: Bosch-zuurzak, "Wild soursop" (Surinam).

From this species *Annona muricata* L. differs in its cordate, acuminate outer petals and in its fruits. The close relationship between *Annona sphaerocarpa* and *A. montana* is apparent from the accompanying illustrations. One of the chief differences between the two species is the greater size of the leaves of *A. sphaerocarpa*. *Pittier's* no. 2724, collected in the hospital grounds at Ancon, on the Isthmus of Panama, is here referred to this species. The protuberances on the fruit are smaller than those on the fruit of *A. montana* and in some cases are nearly absent. Should the two species prove to be identical the name *Annona montana* Macfad., being the earlier, must prevail. If *A. sphaerocarpa* should prove to be identical with *A. marcgravii* Mart., and distinct from *A. montana*, it must take the former name, which was given one year previously. The three species are undoubtedly closely related.

EXPLANATION OF PLATE 8.—A, immature fruit of *Annona montana*, from photograph made at Coamo Springs, Porto Rico, June 29, 1901, by G. N. Collins (no. 2879). B, fruit of *A. sphaerocarpa*, from photograph made in Paramaribo, September 29, 1912, by Dr. J. Kuyper.

Annona marcgravii Mart.

Annona marcgravii Mart. Fl. Bras. 13¹: 5. 1841.

Annona muricata Vell. Fl. Flum. 239. 1825.

Atlas 5: pl. 126. 1827, not L. Sp. Pl. 536. 1753.

Section Euannona. A tree of moderate size, the ascending branches forming a dense oblong crown; bark grayish white, smooth, or lightly furrowed; branchlets glabrous, pale brown, bearing numerous inconspicuous pale brown lenticels; leaves usually obovate-oblong and acute at the base, sometimes subelliptical and rounded at the base, coriaceous at length, above deep green and very glossy, as if varnished, paler beneath, 8 to 25 cm. long by 4 to 9.5 cm. broad, shortly and usually obtusely acuminate; petiole 4 to 10 mm. long, terete and grooved above; midrib prominent beneath; lateral nerves (about 10 on each side) slightly curved and connected by a network of anastomosing veins; peduncles solitary or geminate, if the latter, usually one only persisting and bearing fruit, glabrous, 12 to 25 mm. long, with a small broad semiamplexicaul acutish bracteole

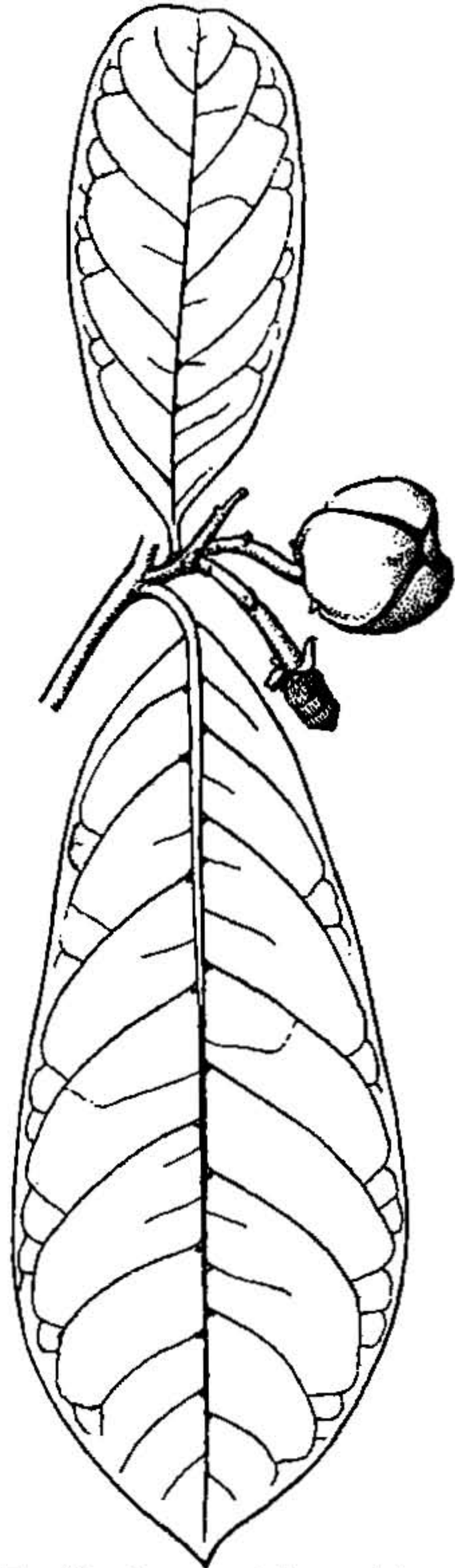


FIG. 36.—Leaves and flower of *Annona sphaerocarpa*. Scale $\frac{1}{2}$.

about the middle and usually one at the base; flowers large, borne on branches; outer petals erect, broadly cordate-ovate, acute or acutish, more than 25 mm. long, thick, valvate, greenish white or pale yellow, clothed on the outside with minute silky white hairs (visible under the microscope); inner petals about half as large as and thinner than the outer, connivent over the essential parts, imbricate; torus densely rufous-villous; stamens closely crowded, the swollen terminal heads of the connectives minutely muriculate like those of *A. muricata*; carpels distinct, with the linear pistils clothed with appressed pale rufous sericeous hairs; fruit ovate-globose, conoid (turbinate), ovoid-oblong, or spheroid, tomentose at first, at length glabrate, muricate with fleshy prickles very much as in *Annona muricata*, but these smaller and sometimes almost wanting or at length broken off, green at first but usually brownish at length; pulp when immature white, at length yellowish and soft, with the odor of fermenting dough and with an unpleasant taste; seeds yellow or light tan color to chestnut, smooth and glossy, obovate-oblong, compressed, marginate, 12 to 24 mm. long, by 8 to 12 mm. broad, enveloped when fresh in a thin white membrane. (PLATES 9, 10.)

This species was based by Martius upon the descriptions of Piso and Marcgrave of the Brazilian "araticú ponhê."¹

DISTRIBUTION: Brazil, Province of Minas, near Bahia and Pernambuco, to French and Dutch Guiana and Venezuela.

SPECIMENS EXAMINED:

BRAZIL: Bahia, "in sabulosis maritimis, an sponte? Arbor 10 pedalis, trunci diameter pedalis," 1830, *Salzmann* 5 (Herb. De Candolle); without definite locality *Sellow* (Berlin Herb. 6).

VENEZUELA: Sacupana, lower Orinoco River, April, 1896, *Rusby & Squires* 100 (U. S. Nat. Herb. no. 325549; Herb. Phila. Acad. Sci.); near Carácas, March, 1913, *Pittier* 5855 (with photographs of leaves, unopened flower, and fruit).

LOCAL NAMES: Araticú ponhê (Brazil); Guanábana cimarrona (Venezuela); Corossol sauvage (French Guiana).

The "araticú ponhê" of Brazil was first described in 1648 by Piso and Marcgrave, together with the "araticú apé," which differs from it in having dark-colored instead of yellow seeds. The resemblances of both these species to the "guanábana," or soursop (*Annona muricata* L.), was pointed out; but these authors were apparently unfamiliar with the latter species, described under the name "guanabanus" by Oviedo, whose description they repeat at length. The *araticú apé* was supposed to be identical with Oviedo's "guanabanus," by Plukenet, who published an accurate figure of its leaves.² Martius, however, bases a distinct species upon it, which he calls *Annona pisonis*, in honor of Piso, though he never saw a specimen of the plant nor of its fruit. Martius also erroneously refers to the *A. muricata* of Linnæus the *A. muricata* of Velloso, which was undoubtedly the *araticú ponhê*, or wild soursop, as is shown by the conspicuous pits in the axils of the lateral nerves of the leaves.³ These exist in the leaves of the cultivated soursop (*A. muricata* L.), but are so minute as to be almost imperceptible to the naked eye.

Upon the *araticú ponhê*, as described by Piso and Marcgrave, Martius bases his *Annona marcgravi*, which is so closely allied to the wild soursop of the West Indian Islands (*A. montana* Macfad.) that it may, perhaps, be regarded as a form of that species. If the two prove to be specifically identical, the name

¹ Piso, Med. Bras. 69. 1648. Marcgr. Hist. Nat. Bras. in Piso, Med. Bras. 93. (fig.) 1648.

² Pluk. Phytogr. 4: pl. 134, f. 2. 1769.

³ Vell. Fl. Flum. 5: pl. 126. 1827.

A. montana Macfad. must stand, according to the rules of priority. The following description of the *araticú ponhé*, upon which Martius bases his *Annona marcgravii*, applies almost equally as well to the wild soursop of Jamaica and Porto Rico. The chief difference seems to be in the greater size of the leaves of the South American tree.

"A tree with the trunk, form of the branches, and color of the bark resembling those of an orange, but with different leaves, flowers, and fruit. Its leaves are about $\frac{1}{2}$ foot long, alternate, above deep green and glossy, beneath pale green, thick, solid to the touch, scarcely 2 digits broad, shaped like the human tongue, and acuminate at the apex. The flower is large and conspicuous, exceeding the flower of a *Fritillaria*, entirely yellow, with 3 outer cordiform petals $1\frac{1}{2}$ digits long, thick as orange peel and standing erect. These contain within them 3 other smaller petals half as thick, overlapping in such a way as to form a sort of hollow globe as large as a walnut. The stamen [androcium] is round and yellow, as large as a hazelnut with a small rounded apex [gynœcium]; both the stamen and the apex are furnished with tiny tubercles [the stamen connectives and stigmas] which resemble the pores in the flesh of a man when chilled [goose flesh.]

"The flower, as I have said, is entirely yellow, with a sweet but sickening odor. It blossoms principally in the months of September, October, and November. The flower is deciduous; for many open day by day, and after a few hours fall of their own accord, making a noise in dropping, as though the tree had been struck by somebody with a stick, for the flower is heavy and large. The flower is followed by a fruit which ripens chiefly in December and January.

"It cannot be eaten, however, unless it drops off of its own accord, for then it is soft like pap. It is of a turbinate shape [conoid] 4 or 5 digits long, and 7 or 8 digits in circumference where the peduncle is attached. On the outside the color is green and white mixed, or uniform pale green, and it looks as if the skin were composed of scales, for it is marked by green lines into pale greenish areoles [squamæ], each areole having a small tubercle in the middle, brown, so that it looks like a pine cone. When it falls it is soft so that it can be peeled with the fingers like old putrid cheese. It contains a yellowish flesh or pulp composed of pyramidal segments, intermixed with fibrous particles and many kernels or seeds. The odor of the pulp may not unfittingly be compared to fermenting bread dough, to which some honey has been added. The taste is sweetish subacid and somewhat bitter, unpleasant to me, but with an agreeable odor. At the place where the peduncle is inserted the fruit contains within it a lump of harder flesh shaped like a suppository which can be pulled out. This is eaten and is offered at the table as a most choice tidbit. The seeds of the fruit are oval in shape, the size of a faba, smooth and hard, of a golden yellow color and glossy, inclosed when fresh in a kind of white pellicle. The inside kernel is composed of a white hard substance with a taste not unlike that of the root of *Helenium*, or bitterish sweet."

The fruit of this species varies considerably in the development of the prickles on the surface and in its general form, which, in the original description of Marcgrave, is called turbinate, but which in the accompanying figure is ovate-oblong and by Martius is described as globose-ovate with the protuberances on the subrhomboid areoles at length obliterated. Its very close affinity to *A. montana* Macfad. and *A. sphaerocarpa* Splitg. has already been mentioned.

Considerable variation in the form of the leaf occurs, and the writer was at first inclined to separate those specimens in which the leaf blades were rounded

at the base and subelliptical in outline from those in which they were sharp at the base and obovate-oblong in form; but further study showed both forms of leaves to be occasionally found in the same specimen, so that no such specific or varietal distinction could be made. In all leaves, however, the peculiar pits in the axils of the lateral veins of the leaves occur, though in some cases they are scarcely visible without the aid of a lens. It is this peculiarity chiefly which sets apart all the true soursops (section *Euannonia*) from other groups of the genus. Another peculiarity which wild soursops possess in common is the very glossy upper surface of the leaves, which appear to have a coating of varnish. This feature does not occur in the cultivated soursop (*A. muricata*) which, moreover, often has caulifloral flowers and has the well-known large, juicy, sweet-acidulous fruits, while the fruits of wild soursops can scarcely be called edible, and their flowers are never caulifloral.

EXPLANATION OF PLATES 9, 10.—Pl. 9, photograph of leaves and unopened flower, together with young fruit. Taken in the field in the Bosque de Catoche, near Caracas, Venezuela, February 22, 1913, by H. Pittier. Pl. 10, photograph of fruit, same source. Both natural size.

Annona salzmanni A. DC.

Annona salzmanni A. DC. Mém. Soc. Phys. Hist. Nat. Genève 5: 197. 1832.

Section *Psammogenia*. A tree of medium height with a much branching crown and a thick trunk; branches rather glabrous, bearing numerous prominent light-brown or whitish lenticels, clothed when young with minute appressed ferruginous hairs; bud scales densely ferruginous-pilose; leaf blades obovate to oblong or obcordate, rounded or retuse at the apex and rounded or obtusely cuneate at the base with the blade abruptly decurrent on the petiole, 5 to 10 cm. long and 3.5 to 6 cm. broad, coriaceous, glabrous or nearly so when mature, but with sparse fine straight whitish appressed hairs along the midrib and veins beneath, visible under the microscope; upper surface pale olive green (in dry specimens), with the midrib, nerves, and veins impressed, the latter inconspicuous; lower surface rufous or tan-colored, with the midrib prominent; lateral nerves (10 to 12 on each side), impressed, inconspicuous, connected by impressed reticulating veins; parenchyma (of thick adult leaves) not pellucid-punctate; margin entire, more or less revolute; petiole short, thick and swollen, 5 to 7 mm. long, broadly grooved above, clothed with appressed sericeous hairs at first, at length glabrate; peduncles in pairs or solitary, extra-axillary, sometimes apparently axillary when situated a short distance above a leaf axil, often opposite a leaf as in many other Annonaceae, clothed with fine short appressed ferruginous hairs, 1-flowered, 12 to 20 mm. long, thickest at the apex, erect, with 1 to 3 ovate acute ferruginous-hirtellous bracts at the base; calyx gamosepalous, 3-lobed, broadly cup-shaped, 2 cm. wide, clothed on the outside with appressed ferruginous hairs like those of the peduncle, the lobes rounded or triangular, thick, obtuse at the apex, 8 to 9 mm. long and equally broad at the base; flower buds ovoid or subpyramidal and subtriangular in cross section, acutish or rounded at the apex, rufous-sericeous; petals thick, ovate, acute or acutish, the outer ones valvate, 25 to 29 mm. long and 18 mm. broad, rufous-sericeous on the outside and lined within with fine brown tomentum; inner petals smaller, narrowed or clawed at the base, 2 to 2.5 cm. long and 1 to 1.2 cm. broad, ovoid or subrhomboid, not overlapping or imbricate, acute or acutish, clothed on both surfaces with fine brown tomentum; stamens numerous, soon falling off, 4 mm. long, the connective expanded or capitate above the parallel linear pollen sacs, its surface minutely verrucose or muriculate with glossy points; torus convex or conoid-truncate, its surface densely clothed with minute

short pale rufous hairs; carpels forming a dense cluster (gynœcium) at the apex of the conoid torus, the ovaries linear, distinct, 2 to 2.7 mm. long, clothed with appressed ferrugineous silky hairs; styles articulate, falling off after pollination; fruit not observed. (PLATE 11. FIGURES 38, 39.)

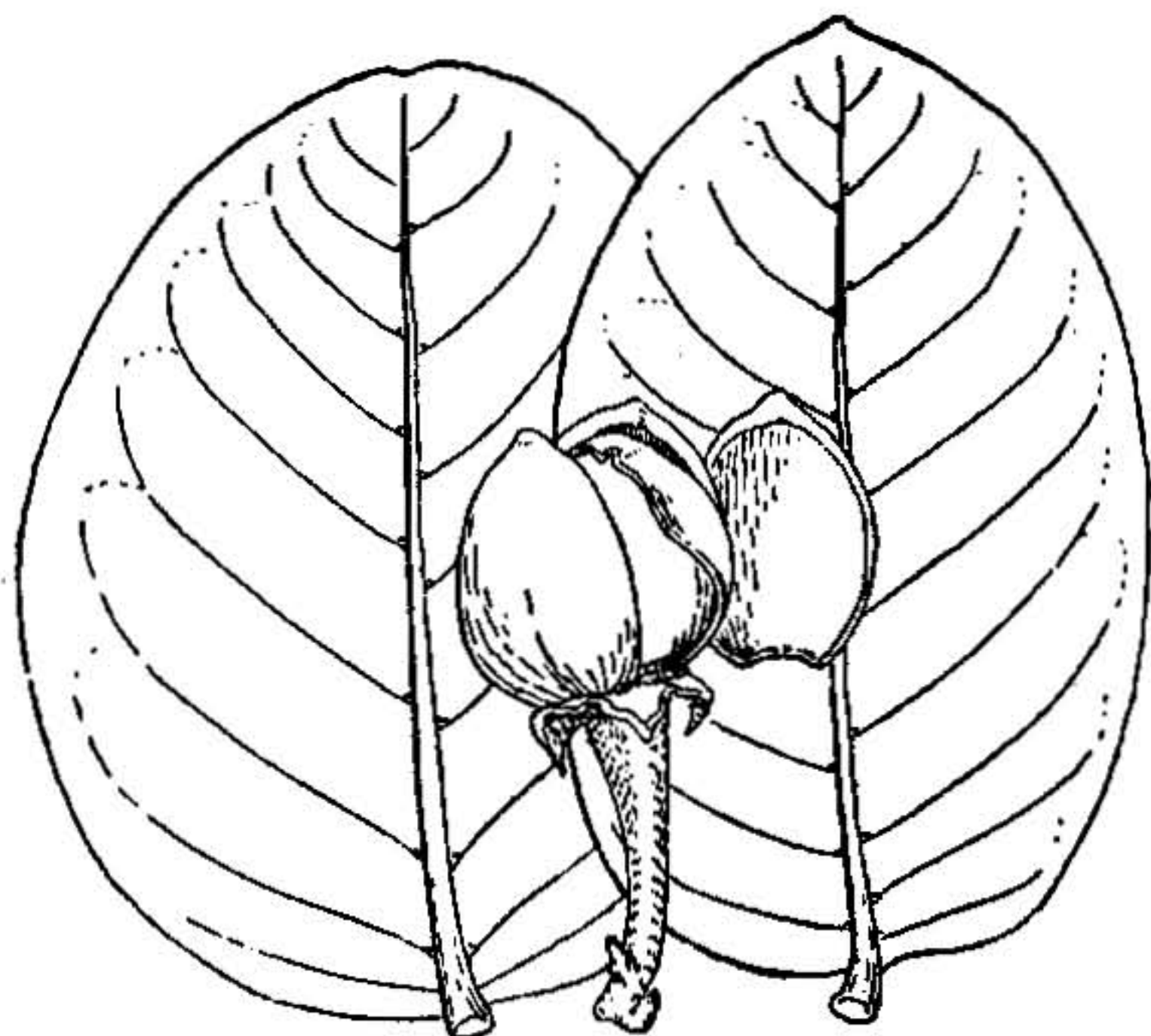


FIG. 37.—Leaves and flower of *Annona coriacea*.
Scale $\frac{1}{2}$.

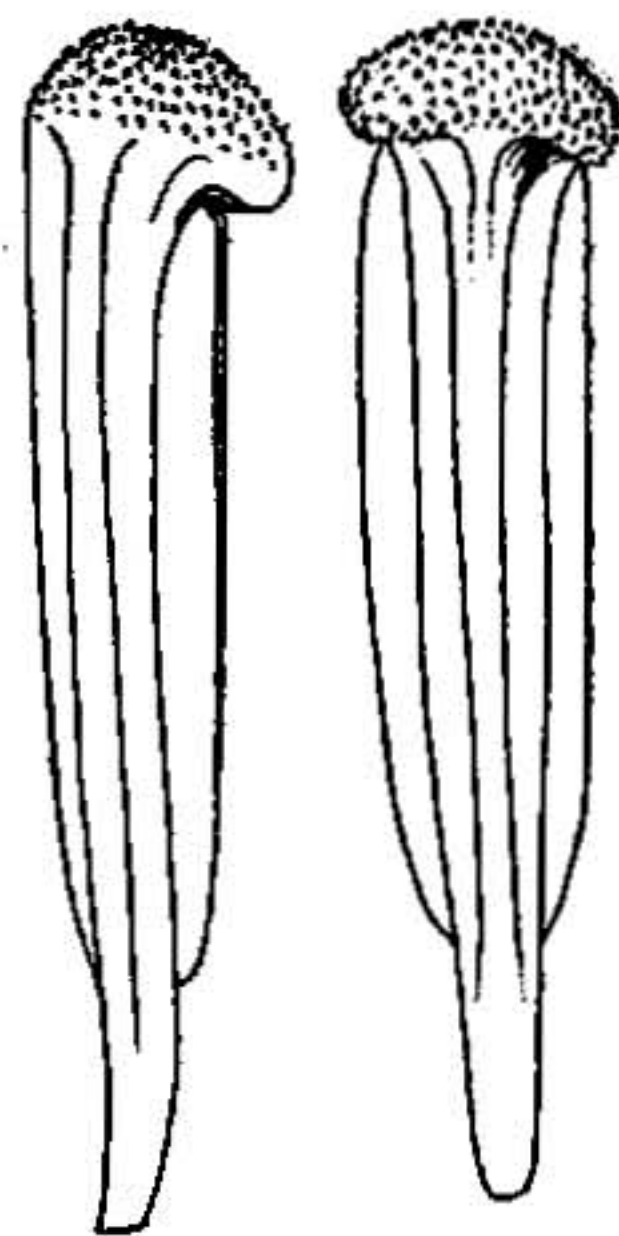


FIG. 38.—Stamens of
Annona salzmanni.
Scale 13.

Type in the De Candolle Herbarium, collected in the vicinity of Bahia, Brazil, on a dry sandy plain ("in sabulosis aridis, an culta? Arbor superne ramosissima, trunco crasso, altitudine mediocri."), in 1830, by Philipp Salzmänn (no. 5).¹

DISTRIBUTION: Dry sandy plains in the vicinity of Bahia and southward.

SPECIMENS EXAMINED: Type specimen as cited.

LOCAL NAMES: Araticú do campo; Araticú dos lhos ("araticu of the plains").

Annona salzmanni A. DC. bears a certain superficial resemblance to *A. coriacea* Mart. (fig. 37) in its coriaceous leaves and its thick-petaled flowers. It is, however, sharply distinct from the latter. Its leaves are devoid of the minute pits in the axils of the veins, and the lateral nerves together with the reticulated veins between them are remarkable in being impressed on both faces. The stamens of *A. salzmanni* (fig. 38) are

only 4 mm. long, while those of *A. coriacea* are 6 to 6.5 mm. long. The ovaries (fig. 39) are densely clothed with ascending, bright, ferrugineous hairs. It is strange that this quite distinct and valid species is absent from more recent collections of plants from its native region. Its fruit is quite unknown.

De Candolle was inclined to place this species close to *A. glabra* L. (*A. palustris* L.), but it differs from that in its carpels and inner petals. It can not



FIG. 39.—Ovaries of
Annona salzmanni.
After loss of styles.
Scale 13.

¹ Salzmänn, Philipp. An enthusiastic botanist and entomologist, in honor of whom De Candolle named the rubiaceous genus *Salzmannia* and to whom he dedicated the fourth volume of the *Prodromus*; born at Erfurt, February 27, 1781, died at Montpellier, May 11, 1851. See August Röse, *Bot. Zeit.* 11: 4. 1853.

be placed in the same section with *A. muricata* on account of the peculiar structure of its rigid coriaceous leaves, which are devoid of the peculiar pits in the axils of the lateral nerves, characteristic of the section *Euannonia*; and it is separated from *Annona purpurea* and its allies not only by its leaves but also by its inner petals, which are not imbricate and overlapping. The author has consequently been obliged to place it in a section apart, for which he proposes the name *Psammogenia*, since it comes forth from the sands of arid plains.

EXPLANATION OF PLATE 11.—Photograph of type in the De Candolle Herbarium, showing flower bud, flower from which the petals and stamens have been removed, with the tips of the calyx lobes broken off, a number of loose stamens, an inner petal, and two outer petals. All natural size. Negative by H. K. Sloat.

Annona purpurea Moc. & Sessé.

Annona purpurea Moc. & Sessé in Dunal, Monogr. Anon. 64. pl. 2. 1817.

Annona manihote H. B. K. Nov. Gen. & Sp. 5:59. 1821.

Section *Ulocarpus*. A small or medium-sized deciduous tree with spreading branches and very large short-petioled leaves; older branches brown, bearing prominent leaf scars; young branches clothed at first with fulvous or ferruginous tomentum, but soon glabrate; leaves membranaceous at first, conduplicate, their parenchyma more or less bullate, at length subcoriaceous and undulate, green and smooth above with the impressed midrib and lateral nerves (20 to 25 on each side) very prominent beneath, ferruginous-pubescent on both faces; petioles 5 to 8 mm. long and 3 to 4 mm. thick; blades oblong-elliptical or oblong-obovate to oblong-lanceolate, acuminate above, the apex usually acute, but sometimes obtuse or retuse, obtusely cuneate or rounded at the base, 20 to 30 cm. long and 10 to 14 cm. broad; flowers very large, solitary, extra-axillary, appearing at the same time as the new leaves, usually inclosed at first by an involucre composed of 2 sessile acuminate bracts, these with marcescent apex and persistent base resembling a second, or outer, calyx; peduncle very short and thick, at length woody; calyx 3-lobed, the lobes broadly ovate or deltoid, acute or obtuse at the apex, ferruginous-velvety on the outside; corolla composed of 6 petals in 2 series, increasing in size after anthesis, the 3 outer ovate or ovate-lanceolate, very thick, valvate, concave, usually acuminate but sometimes obtuse at the apex, ferruginous-velvety on the outside, stained with deep purple within; inner petals somewhat smaller and thinner, imbricate, ovate or subrotund, concave, forming a domelike covering over the essential parts, whitish on the outside, purple within; receptacle conoid or hemispherical, densely clothed with short, stiff, straight, light brown hairs; stamens numerous, about 5 or 6 mm. long, club-shaped, with the connectives expanded and swollen into brown velvety heads so closely crowded together as to form a continuous covering above the linear parallel brown pollen sacs; carpels 5 or 6 mm. long, with the ovary about 2.5 to 3 mm. long, sulcate on the inside, clothed with fine light brown sericeous hairs, surmounted by a prism-shaped style of equal length terminating in a capitate pale brown velvety stigma; fruit large, broadly ovoid or spheroid, 15 to 20 cm. in diameter, bearing numerous rigid pyramidal protuberances and clothed with brown feltlike tomentum, the protuberances grooved on the ventral side and usually terminating in a hook directed toward the peduncle; seeds large, obovate, more or less compressed and marginate, 28 to 30 mm. long, 14 to 18 mm. broad, and 9 mm. thick, with a smooth chestnut brown testa covered when fresh by a thin membranous closely adhering envelope (aril ?)

and imbedded in fragrant mango-flavored orange-colored fibrous pulp. (PLATES 12-14. FIGURE 40, a.)

Described by Mocifio & Sessé from a specimen without fruit, bearing flowers and young leaves; description published by Dunal as cited above, accompanied by a plate engraved by Moquin. "Hab. in Mexico," without definite locality.

DISTRIBUTION: State of Veracruz, Mexico, to Panama, and northern South America.

SPECIMENS EXAMINED:

MEXICO: Córdoba, Veracruz, *E. Kerber*, July, 1882 (Berlin Herb.), photograph of globose fruit covered with sharp hooked protuberances, *C. B. Waite* 1515; Omealca, Veracruz, seeds, *C. B. Waite*, S. P. I. no. 31891¹; Tehuantepec, seeds, *W. W. Miller*, S. P. I. no. 34050¹; Tapachula, Soconusco, State of Chiapas, photograph, *Guy N. Collins* 4007.

COSTA RICA: Nicoya, along roadsides, *Tonduz* 13932; Puerto Jesús, Nicoya, *Cook & Doyle* 745, with photograph 5814; El Coyolar, near Punta Arenas, alt. 150 meters, fruit, flowers, and leaves, *Wercklé*, S. P. I. no. 31929.¹

PANAMA: Matachín, on Panama Railway, *Hayes*, September 8, 1860; without definite locality, *Duchassaing*; Hospital grounds, Ancon, *Pittier* 3955; Forests of San Felix, eastern Chiriquí, *Pittier* 5749.

VENEZUELA: Above Dos Caminos, east of Carácas, alt. 850 meters, *Pittier* 6221.

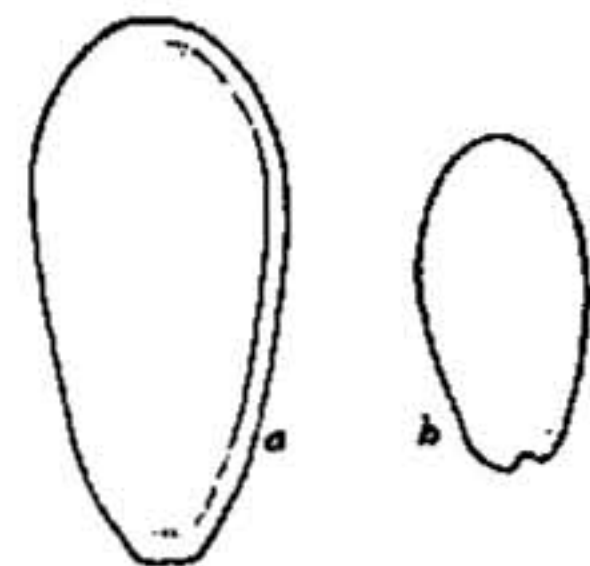


FIG. 40.—(a) Seed of *Annona purpurea* and (b) one of *A. muricata*. Natural size.

LOCAL NAMES: Cabeza de negro, or "negro-head" (Veracruz); Cabeza de ilama, or "old woman's head" (Veracruz and Oaxaca); Chincua, Ilama de Tehuantepec (Oaxaca); Soncoya, Soncolla, Sencuya (Central America); Toreta (Panama); Manirote (Venezuela).

Annona purpurea has hitherto been imperfectly known. At the time of its flowering it is almost devoid of leaves. The fruit was lacking in the type material and it has been confused, on account of its protuberances, with that of the soursop (*A. muricata*), the resemblance between the flowers of the two species adding to the confusion. Those of the present species, however, are easily distinguished by their very short, thick peduncle, and the fruit by its yellow fibrous pulp and large seeds (fig. 40). The common name "cabeza de ilama" ("old woman's head") applied to the fruit on the isthmus of Tehuantepec, is apt to cause it to be confused with that of *A. diversifolia*,² called "ilama" at Colima and Acapulco; but the latter species is easily distinguished by the persistent leaflike, amplexicaul bracts at the base of its long peduncle, its much smaller leaves rounded at the apex, the rose-tinted pulp of its fruit, the shape of the latter which resembles that of a pineapple cheese, and its hard, nutlike, subterete seeds.

The identity of *Annona manirote* H. B. K. with *A. purpurea* Moc. & Sessé was suspected by the writer, as the latter corresponds closely with the description of the leaves and fruit of the former. In the type material of *A. manirote* flowers were lacking. These, however, have been recently collected by Professor Henry Pittier above Dos Caminos, a short distance east of Caracas, at an elevation of 850 meters above sea level (pl. 13). Professor Pittier collected both old leaves of the preceding season, which had nearly all

¹ Collections of the Division of Seed and Plant Introduction, Bureau of Plant Industry, U. S. Department of Agriculture.

² *Annona diversifolia* Safford, Journ. Washington Acad. Sci. 2: 118. 1912.

fallen, and new leaves, which were just appearing with the flowers. The species is known in Venezuela by the common name "manirote." The following is an extract from Professor Pittier's field notes, dated May 24-25, 1913: "*Annona manirote*. Tree small, 3 meters high with depressed crown, nearly leafless at time of blooming, bearing only a few new leaves; flowers very large, yellowish green, having a strong, unpleasant, cestrum-like odor."

Alcoholic as well as dry herbarium material was brought home by Professor Pittier, and a photograph was secured of the fresh leaves and a mature flower with elongated petals. A careful study of these establishes the identity of *Annona manirote* H. B. K. with *A. purpurea* Moc. & Sessé, beyond a doubt.

EXPLANATION OF PLATES 12-14.—Pl. 12, photograph, by Collins, of specimen closely resembling Mociño and Sessé's type as shown in plate 2 of Dunal's monograph, with branches bearing prominent leaf scars and with young leaves and immature, solitary, extra-axillary flowers from the base of which the involucre is lacking. One flower with an outer and an inner petal removed shows the essential parts as crudely figured on Dunal's plate. Pl. 13, field photograph, by Pittier, of specimen growing in Venezuela, showing old branch with flower subtended by involucre, and new branch, bearing leaves. Pl. 14, fruit collected at Ancon, Isthmus of Panama, by Pittier (no. 3955); photograph by Crandall. Natural size.

Annona involucrata Baill.

Annona involucrata Baill. *Adansonia* 8: 265. 1868.

Annona prestoei Hemsl. in Hook. Icon. Pl. IV. 6: 2519, 2520. 1897.

Annona muricata Wercklé, *Tropenpfl.* 428. 1903, not L. Sp. Pl. 536. 1753.

Section *Ulocarpus*. A tree with the young branches yellowish or ferruginous-tomentose, soon glabrescent, becoming light brown and covered thickly with lenticels; leaves short-petioled, large, broadly elliptical to obovate-oblong or obovate-lanceolate, shortly and often abruptly acuminate above the apex, usually obtuse or retuse, but sometimes acute, rounded or subcuneate at the base, 28 to 30 cm. long, 15 to 17.5 cm. broad, at first membranaceous, at length subcoriaceous, the midrib and primary nerves (22 to 28 on each side) impressed above, prominent beneath, ferruginous-tomentose above at first, but at length glabrate, persistently ferruginous-tomentose beneath; petiole 5 to 10 mm. long, thick and grooved above, ferruginous-tomentose at first, at length glabrescent; flowers solitary, subsessile, extra-axillary, resembling those of *A. purpurea*, the young buds enveloped in an involucre of 2 imbricating bracts resembling bud scales, more or less persistent and suggesting a second or outer calyx; involucre, calyx, and outer petals densely and shortly ferruginous-tomentose; calyx lobes broadly ovate, 2.5 to 3 cm. long, the 3 outer petals valvate, very thick, ovate-lanceolate, usually acute or acuminate but sometimes obtuse at the apex, cordate at the base, 3.5 to 6.2 cm. long by 3 to 3.5 cm. broad; 3 inner petals imbricate or overlapping, thinner than the outer and suborbicular or broadly ovate and rounded at the apex; receptacle hemispherical, clothed with minute bristle-like straight hairs; stamens 6 mm. long, very numerous, similar to those of *A. purpurea*, the thickened truncate crowded connectives clothed with brown velvety puberulence composed of short straight hairs; carpels numerous, 6.5 mm. long, the ovaries sericeous-hirtellous and scored with a median groove on the inner or ventral side; style prism-shaped, terminating in a swollen glandular velvety stigma; fruit spheroid, 10 to 12.5 cm. in diameter, covered with rigid pyramidal protuberances, more or less 4-cornered, with a median groove or fissure on the side opposite the peduncle, very much as in *A. purpurea*, but with the apex not produced into a hook; seeds resembling those of *A. purpurea*, obovoid, compressed, marginate, the chestnut-brown testa roughened on its inner surface to conform with the

wrinkles of the endosperm; ripe pulp yellow or orange-colored, fibrous, and fragrant, like that of *A. purpurea*. (PLATES 15, 16.)

Type in the Botanical Museum of Copenhagen, collected at Tlatatla in the mountains of Veracruz, Mexico, July, 1841, by Liebmann (no. 25).

DISTRIBUTION: Mountains of Veracruz, Mexico, Guatemala, Salvador, and possibly Venezuela; in cultivation on the Island of Trinidad.

SPECIMENS EXAMINED:

GUATEMALA: Between Secanquim and Cahabón, mountains of Alta Verapaz, April 20, 1904, with young flower buds inclosed in involucre, *Cook* 87; Cucanhá, near Tukurú, Alta Verapaz, June 6, 1904, herbarium specimens and photographs of flowers, leaves, and young fruit, *Cook* 314, photographs 7463, 7464. (All U. S. Nat. Herb.)

SALVADOR: Without definite locality, but presumably near the city of San Salvador, *Renson* 271.

ISLAND OF TRINIDAD: Botanical Garden, as *H. prestoei* Hemsl. (Herb. John Donnell Smith).

LOCAL NAMES: Soncoya, Sincuya (southern Mexico and Guatemala); Matacuy (Alta Verapaz, Guatemala).

Annona involucrata is very closely allied to *A. purpurea*, of which it may possibly prove to be a broad-leaved variety. The types of both species are Mexican. It is distinguished principally in the short abrupt acumination of the leaves, with a small terminal point which is often retuse or at least obtuse, while the leaves of the typical *A. purpurea* are more gradually acuminate. The flowers of the two species can scarcely be distinguished from each other. In both of them there is considerable variation in the size and shape of the petals, and in both the young flower bud is inclosed at first in an envelope of imbricating bracts.

On carefully comparing a specimen of the leaves of *A. prestoei* Hemsl., in the herbarium of Capt. Donnell Smith, with the leaves of the present species, the author could not discover points of difference between them warranting their separation into distinct species. A comparison of Hemsley's figures above cited with the photographs presented in the present paper indicates that the two species are in all probability identical. Further investigation may show that they ought both to be referred to *A. purpurea* Moc. & Sessé.

Obtuse-pointed fruits collected in Costa Rica were received from Mr. Carlos Wercklé, who, in answer to questions relating to the hook-pointed fruits, said that he had never seen fruits of that character. The fruits referred to by him in a paper published in the *Tropenpflanzer*, cited above, must have been of the blunt-pointed form, and consequently they are here referred to the present species. Subsequently Mr. Wercklé forwarded hook-pointed fruits to the United States Department of Agriculture, stating that in his opinion the two forms are variations of the same species, and in a letter dated July 15, 1913, he writes: "There is absolutely no difference in the flowers and the leaves between the soncoyas. On some fruits the pyramids are more sharply pointed than on others, sometimes even on the same tree, and often more or less recurved, especially on young fruits." It is, therefore, quite possible that *Annona involucrata* Baill. together with *A. prestoei* Hemsl. will eventually have to be reduced to *A. purpurea* Moc. & Sessé, and it is also possible that the type of Hemsley's *A. prestoei*, growing in Trinidad, was introduced upon that island from Venezuela, in which case it is to be identified with *A. manrote* H. B. K., a species which also proves to be identical with *A. purpurea* Moc. & Sessé.

EXPLANATION OF PLATES 15, 16.—Pl. 15, leaf, flower, gynœcium, and immature fruit with involucre beneath the calyx, collected by Mr. O. F. Cook at Cucanhá, near Tukurú, Alta Verapaz, Guatemala. Natural size. Photograph by C. B. Doyle. Pl. 16, branch with old leaves and an extra-axillary sessile flower bud inclosed in an involucre. Natural size.

Annona paludosa Aubl.

Annona paludosa Aubl. Fl. Guian. 1:611. pl. 246. 1775.

Section Helogenia. A shrub 120 to 150 cm. high; young branches densely ferruginous-tomentose, at length glabrate and bearing numerous light brown lenticels; leaves shortly petiolate, oblong to elliptical-oblong, acute, rounded at the base, above sparsely pubescent, at length glabrescent, beneath clothed with persistent soft velvety ferruginous or cinnamon-colored tomentum;

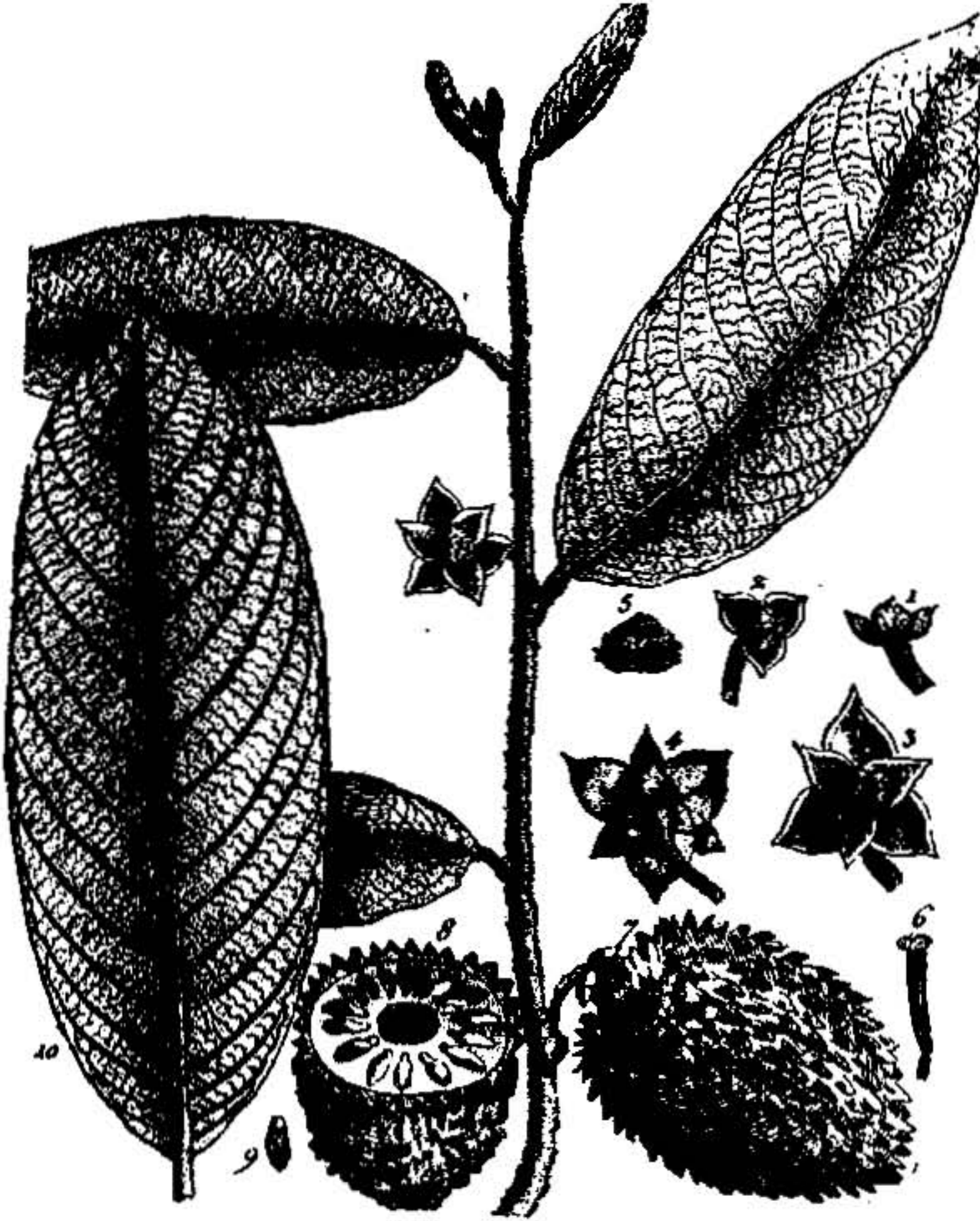


FIG. 41.—*Annona paludosa*. 1, calyx, lateral view; 2, calyx seen from above; 3, 4, flowers; 5, androecium and gynoecium; 6, stamen; 7, fruit, showing persistent calyx; 8, section of fruit; 9, seed; 10, leaf. Reproduced from Aublet at one-half original size.

midrib and lateral nerves (about 18 to 20 on each side) impressed above, prominent beneath, the latter with approximate diagonal veins between them; blade thin-membranaceous, punctate, with a tendency to curl inward in drying (as in *A. jenmanii* Safford). 16 to 20 cm. long and 6 to 7.5 cm. broad; petiole about 5 mm. long and 3 mm. thick, broadly grooved above and clothed with dense tomentum; peduncles solitary or in pairs, 10 to 15 mm. long, extra-axillary, usually opposite a leaf, clothed with tomentum and usually bearing a broad semi-amplexicaul acute bracteole above the middle and one at the base; flower buds depressed-globose, 20 to 25 mm.

broad and about 15 mm. high; calyx gamosepalous, subtriangular or 3-lobed, the lobes 10 mm. broad and scarcely 10 cm. high, sharply acuminate, clothed on the outside with ferruginous tomentum like that on the peduncle and more or less plicate; petals 6, the three outer ones thick and valvate, broadly ovate, acute, 15 to 18 mm. broad and 15 mm. high, concave, clothed on the outside with fine velvety rufous tomentum with a median ridge and parallel plications and within with fine grayish rufous tomentum; inner petals smaller and relatively much narrower than the outer and alternating with them, so as to close the cracks between them, connivent above the essential parts but with their margins thin and not meeting (neither valvate nor imbricate), about 6 mm. broad and 14 or 15 mm. high, concave, keeled on the outside and clothed both without and within with fine grayish tomentum; torus convex, clothed with

straight glossy translucent whitish hairs; stamens numerous, crowded, 2.8 to 3 mm. long; pollen sacs 2.1 mm. long, the pollen orange-colored in 2 columns of tetrads in each sac; connective minutely muriculate, swollen at the extremity into a depressed cap, apparently light brown and velvety, but as seen under the microscope muriculate with fine glossy points or short straight diaphanous hairs, carpels numerous, the ovary pale rufous-sericeous; styles linear-oblong, minutely granular on the sides, when mature terminating in a swollen, minutely tuberculate extremity; fruit ovoid, yellow, tomentose, about 6 mm. long and 4 cm. in diameter, muricate with slender acute fleshy points and usually bearing the persistent calyx; seeds small, about 8 mm. long and 4 mm. broad, smooth, ovoid, slightly compressed, with a conspicuous caruncle at the base; pulp soft and fleshy, edible, but with less flavor than that of *A. squamosa*. (PLATES 17, 18, B. FIGURES 14, 41-43.)

TYPE LOCALITY: "Habitat in pratis paludosis Courou & Timoutou," coast of French Guiana.

DISTRIBUTION: Known certainly only from French Guiana, in marshy situations at Kouroutou on the coast, west of Cayenne (type locality), but occurring also, according to Sagot, in the interior.

SPECIMENS EXAMINED:

FRENCH GUIANA: Without definite locality, *Leprieur* in 1840 (Herb. De Candolle, no. 11, with geminate flowers not quite mature); *Leprieur* in 1834 (Berlin Herb. ex Mus. Paris, no. 238), with immature flower bud.

LOCAL NAMES: Guimamé, according to Sagot; Corossol sauvage, according to Aublet (French Guiana).

Although *Annona paludosa* has a 6-petaled corolla it resembles *A. sericea*, in which there are normally but 3 petals. The latter, however, as Sagot has pointed out, sometimes has 6 petals in rainy seasons, as though making special provision for guarding its essential parts from moisture. The only figure of *A. paludosa* known to the author is the original illustration of Aublet (see fig. 41) which, like Dunal's figure of *A. sericea*, but poorly represents the flower and the essential parts. On this account a photograph of the species from its type locality is here presented (pl. 17). It is interesting to note that, though this specimen has geminate flowers, the smaller flower of the pair is abnormal, having only 2 calyx lobes, 2 outer petals, and probably 2 inner petals.

Though listed by Martius as occurring in Brazil, it is quite certain that he never saw a specimen from that country and that he gives a description of the plant entirely at second hand. His statement that the peduncles are solitary and without bracteoles is incorrect. In the original description of Aublet they are correctly described as solitary or two together and provided at the base and also near the middle with a "scale"; though Aublet also is mistaken in saying that they issue from a leaf axil. They are extra-axillary, as in most other species of *Annona*, and in the present specimen are opposite a leaf. It appears that the second or smaller flower issues from the basal scalelike bracteole of the first flower and bears no bracteole near the middle of the

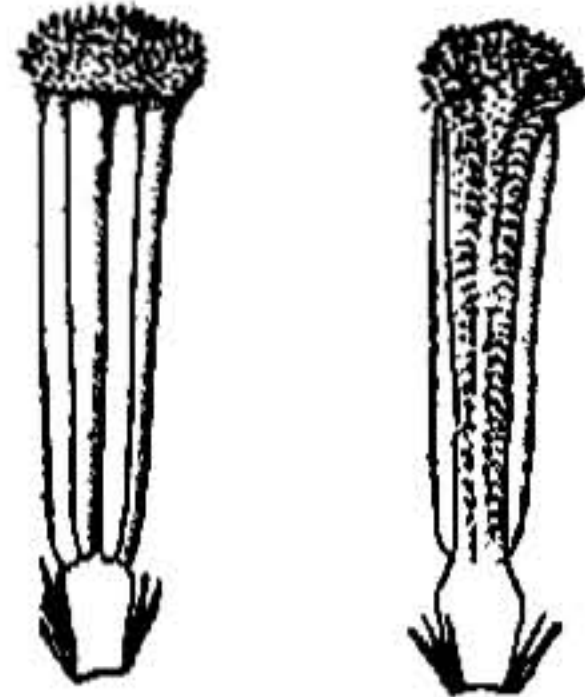


FIG. 42.—Stamens of *Annona paludosa*. Left hand, dorsal view, showing pollen sacs; right hand, ventral view. Scale 10.

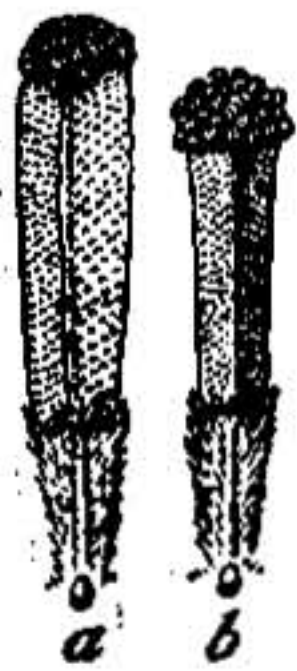


FIG. 43.—Carpels of *Annona paludosa*. a, Outer carpel; b, inner. Scale 13.

peduncle. The bracteole on the peduncle of the larger flower is scarcely perceptible in the photographs. The approximate lateral nerves and the parallel veins between the lateral nerves suggest the leaves of *A. purpurea* Moc. & Sessé, but the broad-clawed, imbricate inner petals of the latter separate that and its close allies from the present species, in which the inner petals are narrow and appear simply to play the part of weather strips.

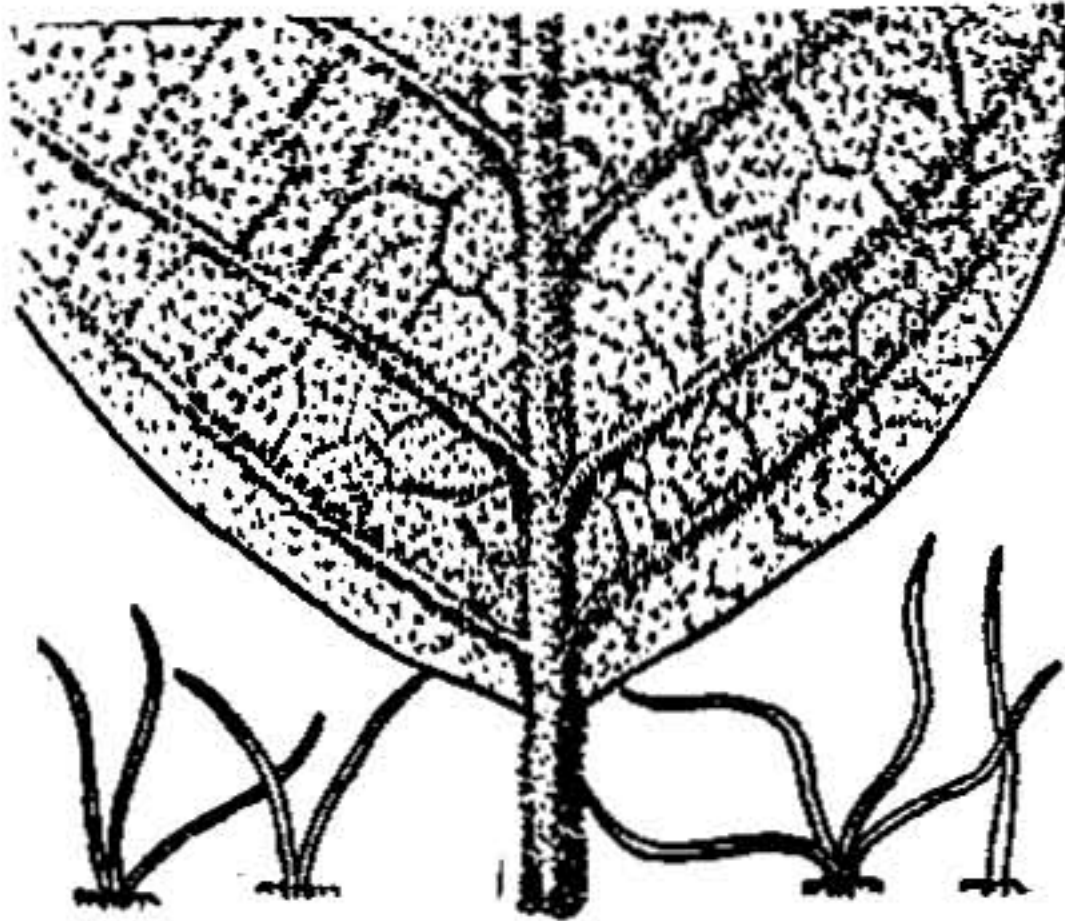


FIG. 44.—Base of leaf of *Annona jahni*. Also detached solitary and fascicled hairs. Leaf, natural size; hairs, scale 25.

lenticels; leaf scars lined with dense rufous pubescence; hairs solitary or fascicled in tufts of 2 to 4, not stellate; leaves yellowish green when fresh, membranaceous, pellucid-punctate, broadly obovate to obovate-oblong, acuminate, with the narrow apex acute or rounded, rounded or acutish at the base, 12.5 to 18 cm. long and 7 to 10 cm. broad, above pubescent at first, at length glabrate except along the impressed midrib and lateral nerves (10 to 14 on each side), beneath persistently rufous-pubescent, densely so on the prominent midrib, lateral nerves, and anastomosing veins; hairs fascicled or solitary; petiole 6 to 8 mm. long, grooved above, densely rufous-pubescent like the midrib; peduncles solitary, extra-axillary, 12 to 15 mm. long, issuing from the young branches, clothed with rufous hairs and bearing a small, broad, sessile or subamplexicaul, pubescent bracteole near the middle; calyx rufous-pubescent on the outside, quite glabrous within, gamosepalous, subtriangular, with the 3 lobes long-acuminate; corolla subglobose or broadly pyramidal in bud, about 22 mm. in diameter; petals 3, valvate, very thick, broadly ovate, somewhat cordate at the base, 20 mm. high and 18 mm. broad, clothed on the outside with fine olivaceous appressed pubescence scarcely apparent without a microscope, lined within with grayish tomentulum and bearing the imprints of the stamens, inner petals entirely absent; torus convex or dome-shaped, densely clothed with short erect straight yellowish white hairs; stamens numerous, 2.5 to 2.8 mm. long, the parallel pollen sacs filled with lemon yellow pollen grains in 2 rows of tetrads and capped by the expanded brown-velvety apex of the connective, muriculate under the microscope; gynæcium depressed-conoidal; carpels (including the styles) 2.6 to 2.8 mm. long, free, the ovary clothed with appressed

EXPLANATION OF PLATES 17, 18.—Pl. 17, photograph of *Annona paludosa*, Leprieur's specimen as cited. Natural size. Pl. 18, A, flower of *Annona cornifolia*, being a back view of specimen shown in plate 20; B, flower of *Annona paludosa*. A, scale 2; B, scale 2.5.

Annona jahni Safford, sp. nov.

Section Pilannona. A flat-crowned tree with spreading branches, 4 to 6 meters in height; young branches rufous-pubescent, at length glabrescent, the bark brown, longitudinally plicate, and bearing a few inconspicuous brown

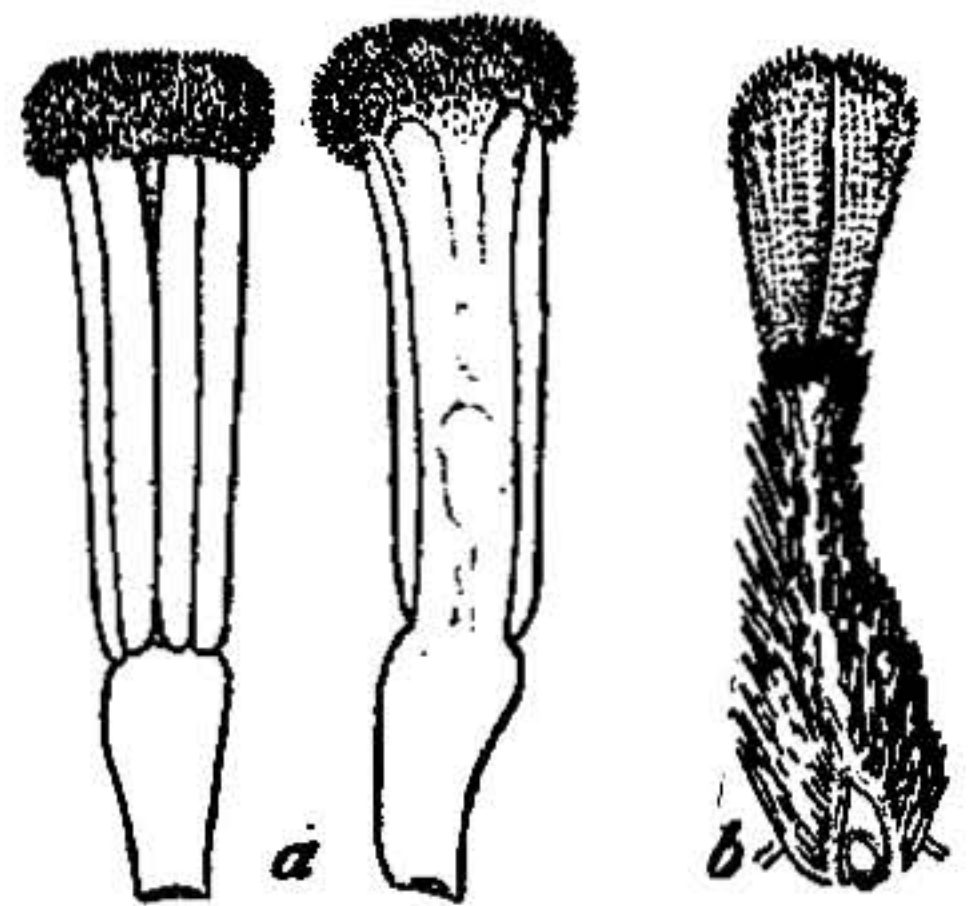


FIG. 45.—(a) Stamens and (b) carpel of *Annona jahni*. Scale 13.

pale fulvous or yellowish white hairs, tapering upward and surmounted by a fleshy truncated stigma about half its length, this grooved longitudinally on the ventral side and covered with minute short straight hairs and glandular tubercles; fruit ovoid, small, resembling the fruit of *Annona echinata*, that of the type material (immature) about 4.5 cm. long and 3 cm. in diameter, sometimes reaching 7 cm. in length with a diameter of 4 cm., muricate with numerous pyramidal protuberances spirally arranged, clothed with dense rufous or ferruginous pubescence, marked with a longitudinal groove on the side opposite the peduncle, as in *A. purpurea*, and terminating in a hooked point recurved toward the peduncle, the latter somewhat thickened and woody when mature and bearing the persistent triangular calyx; seeds (immature) 9 to 10 mm. long and 4 to 5 mm. broad, the testa brown and smooth but not polished, truncate at the apex and bearing at the base a conspicuous caruncle; pulp edible, sweet and pleasantly flavored. (PLATE 19. FIGURES 44, 45.)

Type in the U. S. National Herbarium, no. 692739, collected and photographed on the Hacienda Solorzano, Borburata Valley, a short distance southeast of Puerto Cabello, Venezuela, July 14, 1913, by H. Pittier (no. 6465).

This species is named in honor of Dr. Alfredo Jahn of Carácas, civil engineer and botanist, to whom Professor Pittier is indebted for many courtesies and for valuable botanical information received while on his recent mission to Venezuela.

SPECIMENS EXAMINED:

VENEZUELA: Hacienda Solorzano, near Puerto Cabello, Pittier 6465 (type).

COLOMBIA: In thickest forests, on margins of streams, Río Meta, at Ororué, Lehmann 8824 (Berlin Herb.).

DISTRIBUTION: Coast of Venezuela to Río Meta, Colombia.

LOCAL NAME: "Manirito," a diminutive form of "manirote," the local name of *A. purpurea*, applied to it on account of the resemblance of the fruits of the two species.

EXPLANATION OF PLATE 19.—Field photograph of the type. Fruit not yet mature. Natural size.

Annona cornifolia St. Hil.

Annona cornifolia St. Hil. Fl. Bras. Merid. 1: 33. 1825.

Section Gamopetalum. A low shrub or undershrub sometimes less than a foot in height, with simple or branching stems glabrous at the base and ferruginous-pubescent or tomentose on the upper part, especially near the apex; hairs simple, not stellate; branches axillary, slender, straight, ascending; leaves membranaceous, broadly ovate, or in the same specimen ovate and obovate and sometimes subrotund, obtuse or acutish at the base, acutish or sometimes obtuse at the apex, frequently mucronulate, the apex terminating in a minute rigid point, 5 to 10 cm. long and 2.5 to 6 cm. broad, above sparsely puberulent, at length glabrous or nearly so, beneath puberulent or pubescent and canescent, with the prominent midrib and lateral nerves more or less rufous-tomentose; petiole 3 or 4 mm. long, broadly grooved above, convex beneath, rufous-tomentose like the midrib; peduncles solitary or geminate, extra-axillary, often opposite a leaf, or apparently terminal by the abortion of the stem or branch beyond them, when geminate usually subtended at the common base by a sessile leaflike bract (the latter rufous-tomentose beneath on its midrib and lateral nerves), 1-flowered, usually incurved or nodding, thickened from the base to the apex, 2.5 to 6 cm. long, clothed with appressed ferruginous hairs and bearing a small ferruginous-tomentose or pubescent bracteole near the middle and one at the base, the hairs straight or floccose; calyx small, ferruginous-

villous on the outside, 3-lobed, the divisions ovate-acuminate with a midrib or median keel; corolla depressed-spherical in bud, bowl-shaped and about 2.5 cm. broad when expanded, gamopetalous, 6-lobed, with 3 narrow lobes corresponding to inner petals alternating with 3 broad lobes which overlap their edges, corolla lobes rufous-pubescent, much larger than the calyx divisions, the outer ones broadly ovate, acute, pale yellow or whitish, with a purple spot within near the base; inner lobes oblong-elliptical or obovate-oblong, much narrower than the outer and somewhat shorter, shortly acuminate at the apex and keeled on the back, pale yellow or whitish on the outside, spotted with purple or entirely purple within; torus consisting of an outer convex or hemispherical ring, and an inner cone bearing the gynoecium, the ring more or less pubescent between the bases of the thickly crowded stamens and surrounded by a fringe of

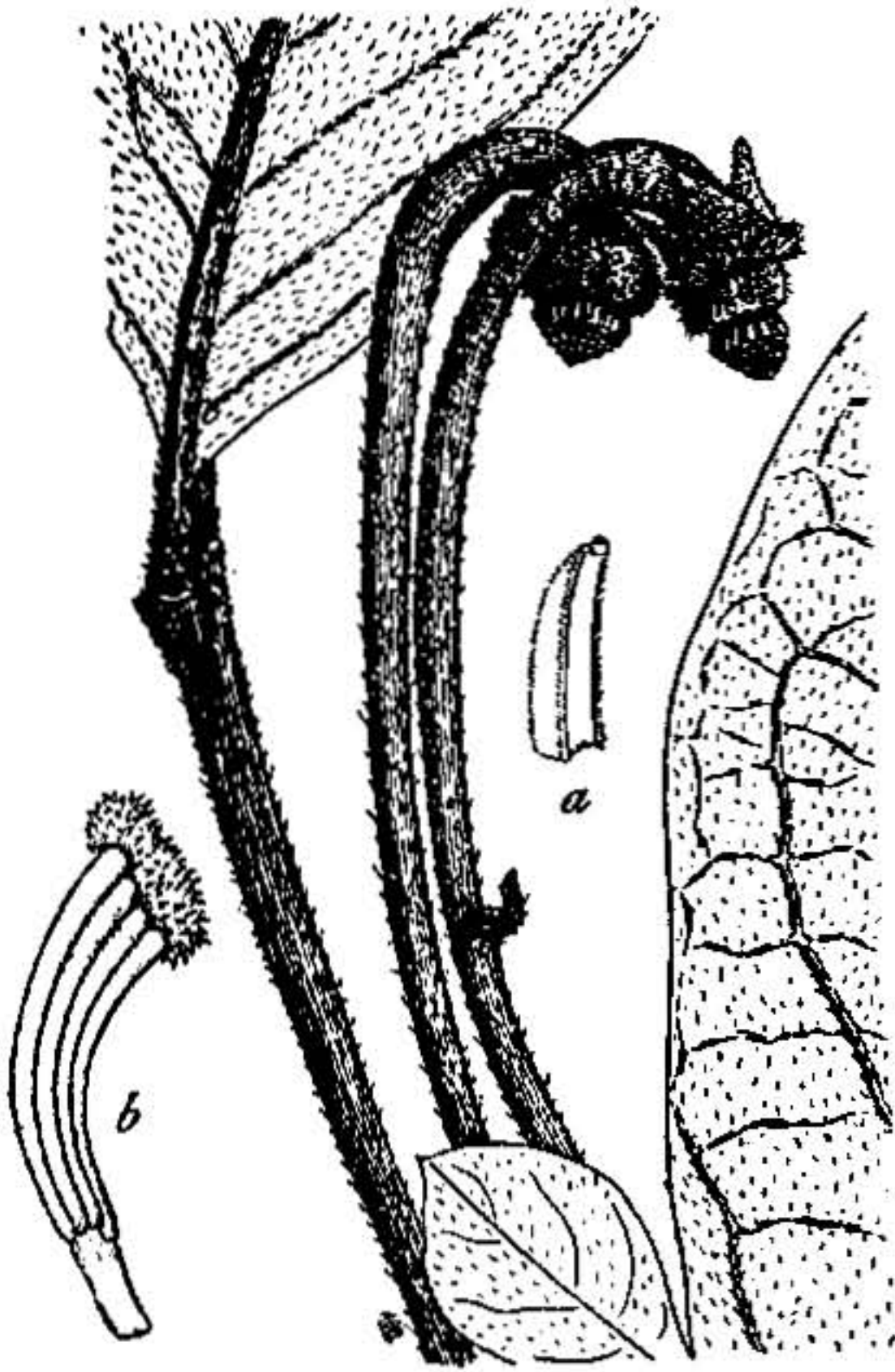


FIG. 46.—Geminate peduncles and other details of *Annona cornifolia*. *a*, Ovary; *b*, stamen. Main figure, scale 2; *a*, *b*, scale 13.

fulvous hairs; stamens pale yellow, 2 to 2.5 mm. long, with flat filaments scabrous with minute short appressed hairs, the connectives broadly expanded above the parallel sacs into an echinulate hood; carpels free, closely crowded into a cone-shaped gynoecium issuing from the center of the convex torus; ovaries prism-shaped, about 1 mm. long, 4-angled, slightly curved or straight, usually with a line of minute ascending hairs on each angle and a few similar hairs on the faces of the prism; styles about equal to the ovaries in length, fleshy, the outer ones on the periphery of the gynoecium swollen and subcylindrical, the inner ones quadrangular-prismatic, all of them becoming cemented together after pollination and very soon falling off, leaving the conoid mass of ovaries, the latter coalescing into a fleshy mass (syncarpium); fruit about the size of a horsechestnut or hen's egg, ovate-globose, obtuse, irregularly squamose and pubescent when immature, at length glabrate or glabrescent and reddish or orange-red, contain-

ing sweetish edible pulp. (PLATES 18, A, 20. FIGURE 46.)

Type material collected "in campis herbosis, prope urbem Sorocaba," Province of São Paulo, Brazil, December, 1819, by Augustin de St. Hilaire; also "in parte occidentali provinciae Minas Geraes dicta Certao de Rio de San Francisco, praecipue prope praedium S. Eligii et pagos Contendas et Formigas."

DISTRIBUTION: Brazil: Provinces of São Paulo and Minas Geraes, in grassy meadows.

SPECIMENS EXAMINED:

Brazil: "Campos près Sorocaba," *St. Hilaire* in 1828, with solitary flower borne at the apex of a simple stem (type collection, in Herb. De Candolle, attached tag numbered, 1261); Cuyabá, *Endlich* 4b (Berlin Herb.); Ipanema, *Sellow* 1475 (Berlin Herb.); Rio Janeiro, *Glaziou* 12408; Minas Geraes, *Claussen* (fig. 46), with geminate erect peduncles and abruptly recurved flowers (in Herb. De Candolle, received from De Lessert, 1842); without definite locality, *Riedel* 2173 (Berlin Herb.).

LOCAL NAMES: Araticú mirim, Cuyabá (according to Endlich); Araticú do campo, southern Brazil (according to St. Hilaire).

Annona cornifolia St. Hil. is closely related to *A. spinescens* Mart. which grows in the low regions subject to inundations called "alagadisso," on the river San Francisco, near Joazeiro, in the Province of Bahia. The latter differs, however, in having spinescent branches and obtuse leaves, these glaucous rather than hoary white beneath, with the midrib and nerves of the same color as the rest of the under surface and less pilose, the nerves not so nearly parallel, and in having the flowers somewhat larger. It is also very closely related to *Annona nutans* R. E. Fries.

EXPLANATION OF PLATE 20.—Photograph of specimen in the De Candolle Herbarium (from type collection).

Annona nutans R. E. Fries.

Annona nutans R. E. Fries, Bull. Herb. Boiss. II. 4: 1171. 1904.

Annona cornifolia Morong, Ann. N. Y. Acad. 7: 47. 1892, not *A. cornifolia* St. Hil.

Annona spinescens var. *nutans* R. E. Fries, Vet. Akad. Handl. Stockholm 34^b: 43. 1900.

Section Gamopetalum. A low shrub with slender erect stems and short straight ascending branches, rufous-pubescent at first, at length glabrate, longitudinally striate and pale brown with small inconspicuous pale brown lenticels; typical leaves broadly ovate to obovate or elliptical, rounded or obtuse and mucronulate at the apex, 3 to 5 cm. long and 2.5 to 3.2 cm. broad, membranaceous or subcoriaceous, quite glabrous above, glaucous and glabrous beneath except along the midrib and lateral nerves, these usually pale rufous or fulvous, clothed when young with scant straight appressed minute reddish hairs, at length glabrate; lateral nerves about 10 on each side; petiole about 2 mm. long, grooved above, appressed-pilose like the midrib when young, at length glabrate; leaves at the base of the branches sometimes emarginate or retuse at the apex, obtuse, rounded, or sometimes acute at the base; peduncles solitary or geminate, extra-axillary, usually opposite a leaf, or subterminal by the abortion of the stem or branch beyond them, with a ferruginous-tomentose scalelike bracteole at the base and a similar one near the middle, the latter sometimes reduced to a tuft of floccose hairs or even wanting; when geminate the pair sometimes subtended by a sessile suborbicular leaflike bract, straight or recurved near the extremity, 2.5 to 4 cm. long, at first clothed with appressed ferruginous hairs, at length glabrate; calyx gamosepalous, with the triangular lobes terminating in linear points, clothed on the outside with ferruginous silky hairs; corolla resembling that of *Annona cornifolia*, depressed-hemispherical in bud and about 1.5 cm. in diameter, finely ferruginous-pubescent on the outside, bowl-shaped when expanded and about 2.3 cm. in diameter, gamopetalous, 6-lobed, composed of 3 narrow lobes corresponding to inner petals, alternating with 3 broad lobes overlapping their edges, pale yellow, spotted with purple on the inside; torus convex, glabrous between the bases of the stamens; stamens 1.8 to 2.2 mm. long, the filaments flat, the connectives broadly expanded above the parallel pollen sacs, echinulate, with short diaphanous sharp-pointed hairs; carpels closely crowded into a cone-shaped gynoecium, the ovaries prism-shaped, 4-angled, 0.9 to 1 mm. long, straight or slightly curved at the apex, glabrous or with a line of minute ascending hairs on each angle; styles about equal in length to the ovaries, fleshy, quadrangular-prismatic in shape and terminating in ovoid or spheroid stigmas, the outer ones

on the circumference of the gynœcium velvety or clothed with fine glandular hairs, the inner ones less hairy or papillose, all of them cemented into a solid mass and becoming detached from the ovaries after pollination; fruit said to be irregularly ovoid or spheroid and orange-colored when ripe; pulp edible but inferior in flavor to that of the chirimoya (*A. cherimola*). (PLATE 21. FIGURE 17, *a, c, d*, p. 13.)

Type in the Regnell Herbarium, Stockholm, collected at Villa Morra, Asuncion, Paraguay, December 17, 1893, by Prof. J. Daniel Anisits, of Budapest (no. 52).

DISTRIBUTION: Paraguay, Asuncion and Pilcomayo River (Morong); also on sandy plains near Itacurubi (Hassler).

SPECIMENS EXAMINED:

PARAGUAY: Asuncion, *Morong* 149 (U. S. Nat. Herb., Herb. Phila. Acad. Sci.). San Bernardino, *Endlich* 4 (Berlin Herb.); Cordillero de Altos, *Fiebrig* 552 (Berlin Herb.); Estrella, near Río Apá, on termite hills, *Fiebrig* 4324; near Concepcion, *Hassler* 7622; Gran Chaco, left shore Paraguay River, *T. Rojas* 2439. Lake Ypacaral, *Hassler* 3586.

LOCAL NAMES: Araticú ñu, Araticu mī (Paraguay).

This species is closely allied to *Annona cornifolia*, in which the flowers are either solitary or geminate and usually recurved or nodding. Its chief leaves, however, are glabrous or very nearly so, while in *A. cornifolia* they are normally pubescent or even densely tomentose, especially on the lower surface.

EXPLANATION OF PLATE 21.—Photograph of *Morong* 149 (U. S. Nat. Herb.), showing geminate peduncles at the right. *a*, Three ovaries detached from the gynœcium of the upper flower of the pair; *b*, mass of styles with outer circle of velvety stigmas detached from gynœcium of solitary nodding flower shown in the upper left-hand corner. Branches at natural size; *a, b*, scale 6.

Annona acutiflora Mart.

Annona acutiflora Mart. Fl. Bras. 13¹: 10. 1841.

Section Atractanthus. A shrub or small tree 4 to 6 meters high with crowded slender subflexuose branches; bark dark gray, bearing numerous lenticels, that of the young branchlets clothed with appressed ferrugineous hairs; bud scales densely ferrugineous-villous; leaves oblong, elliptical, obovate-oblong, or lanceolate-oblong, normally acuminate or cuspidate at the apex, acute or acutish at the base (8 to 11 lateral nerves on each side), distichous, rather closely crowded, 5 to 13 cm. long, 2.5 to 5 cm. broad, the younger ones thinly membranaceous and soft, the older ones membranaceous, deep green, pellucid-punctulate, glossy above and glabrous, clothed beneath when young with appressed ferrugineous hairs, especially along the midrib and lateral nerves, these becoming more or less glabrate at length; petioles 4 to 6 mm. long; broadly grooved above in continuation of the impressed midrib, ferrugineous-hirtellous when young, at length glabrescent; inflorescence extra-axillary, inclosed when young by two acute triangular concave ferrugineous-hirsute persistent bracts; peduncles in clusters of 2 or 3 or sometimes solitary by the abortion of the younger buds, usually decurved, issuing from the basal bracts and bearing one or two bracteoles, these together with the peduncles and the calyx clothed with a ferrugineous,



FIG. 47.—Flower of *Annona acutiflora*. From Riedel specimen as cited. Scale 2.

almost strigillose-villous indument; indument of the outer petals finer, subsericeous, of a lighter chestnut brown or cinnamon color; flower buds ovate-conical or fusiform, acuminate at the apex and sometimes triangular-pyramidal with the apex more or less curved; calyx 3-parted, the lobes scarcely 4 mm. long, broadly ovate-triangular, acute or acuminate; petals closely united in bud, broadly spreading after anthesis, fleshy but thin, the outer ones united at the base (gamopetalous), 12 to 16 mm. long, concave at the base around the essential parts and narrowed into a long-acuminate apex, white within with a light red or purplish spot at the base; inner petals about half as long as the outer, ovate, acute, excavated at the base and more connivent above the essential parts at first, at length opening widely, white with a purplish spot at the base; torus raised, conoid, minutely puberulent between the bases of the stamens and bordered about the base with stiff ferrugineous hairs; stamens numerous, yellow (light brown or straw-colored when dry), with short flat filaments and the connective expanded above the pollen sacs into a swollen, brown, minutely papillose or velvety head; carpels numerous, closely crowded into a conoid gynoecium borne on the apex torus; ovaries densely pilose with ascending rufous or fulvous subulate hairs, linear-oblong, tipped with short prism-shaped styles terminating in depressed-capitate velvety stigmas with their surface covered with minute acutish papillose cells; young fruit ovate-conoid, rufous or fulvous-pubescent and tuberculate or verrucose from the swelling of the carpels composing it; ripe fruit not observed, but in all probability similar to that of *A. cherimola* in shape and appearance. (PLATE 22. FIGURES 21, p. 16; 47, 48.)

Type material in the Royal Botanical Museum at Munich, collected in the Province of Rio de Janeiro, Brazil; near Tijuca, by Schott; near Campinho, by Martius; also near Lagoa de Freitas (not far from the site of the present Botanical Gardens), by Luschnath.

DISTRIBUTION: Province of Rio de Janeiro, Brazil, growing in moist situations in forests and groves called "caa-apoam," and on sandy stretches along the coast called "restinga."

SPECIMENS EXAMINED:

BRAZIL: Province of Rio Janeiro: "In arenosis Rastinga dictis pr. Tijuca et Taipú, April, 1833, *Riedel* 1306 (U. S. Nat. Herb., no. 703459, ex Herb. Hort. Bot. Petrop.); without definite locality, *Riedel* (U. S. Nat. Herb., no. 703460, ex Herb. Hort. Bot. Petrop.); Rio Janeiro, *Gaudichaud* 802 (Herb. De Candolle, Berlin Herb.); *Glaziou* 18841 (Berlin Herb.); without definite locality, *Casaretto* (Herb. De Candolle ex Herb. Reg. Turini, 1857); without definite locality, *Sellow* 1256 (Berlin Herb.).

EXPLANATION OF PLATE 22.—Photograph of specimen in Herb. De Candolle, collected by Casaretto, showing unopened flower and leaves. Natural size.

Annona lutescens Safford, sp. nov.

Section Atta. A small tree with spreading branches; new branchlets densely fulvous-pubescent, at length glabrescent; leaves ovate to elliptical-oblong, acute



FIG. 48.—Immature fruit and stamens of *Annona acutiflora*. a, Stamens; b, flower from which petals, stamens, and styles have fallen; c, young fruit. a, Scale 16; b, c, scale 2.

or acuminate (the lower ones sometimes retuse), usually rounded at the base, conduplicate, membranaceous, punctate, 12 to 15 cm. long and 6 to 7.5 cm. broad,

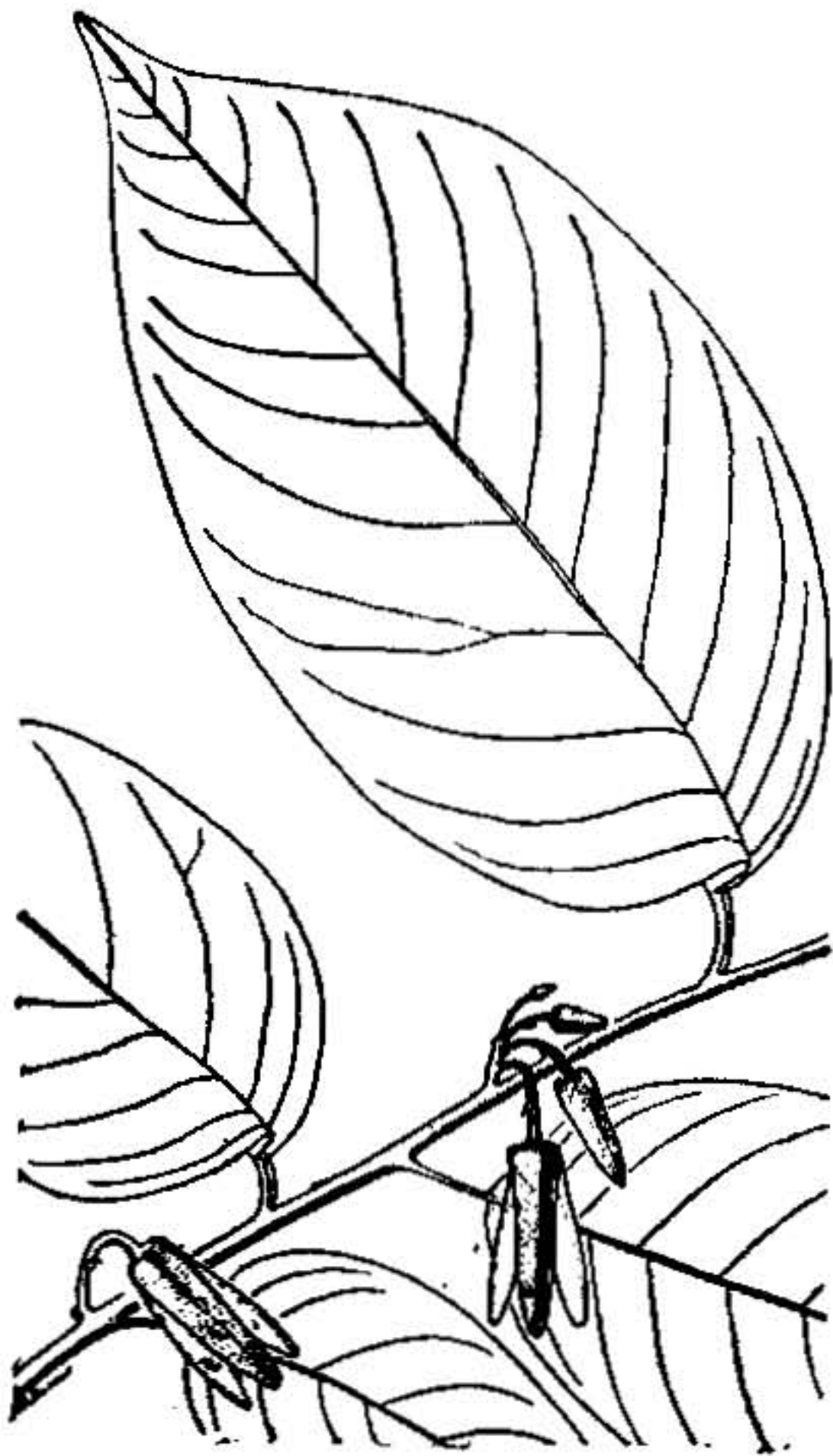


FIG. 49.—Inflorescence and leaves of *Annona lutescens*. From Goldman 1007, as cited. Scale $\frac{1}{2}$.

impress of stamen within, sericeous and keeled on the outside; stamens numerous, short and broad, about 1.1 mm. long,

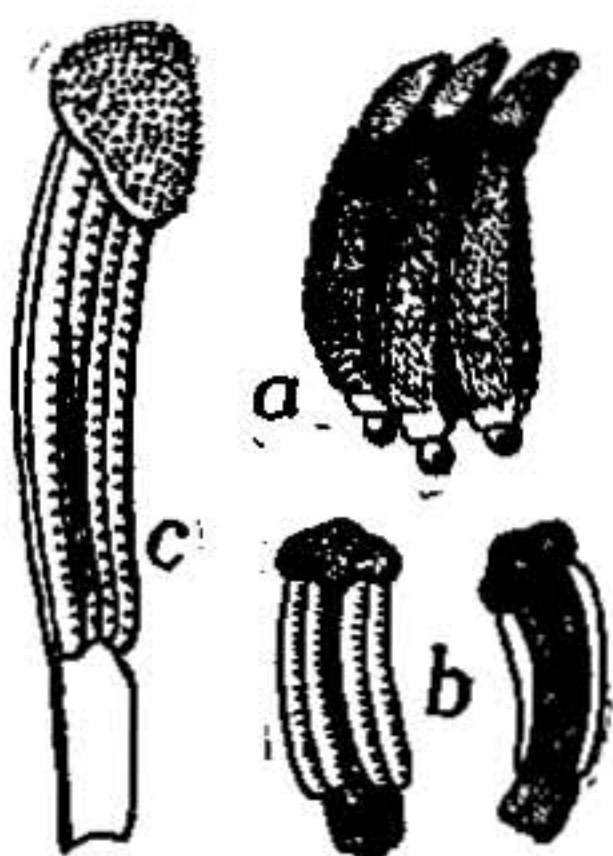


FIG. 51.—Floral details of *Annona lutescens* and *A. glabra*. a, Carpels with solitary ovules at base, and b, stamens of *A. lutescens*; c, stamen of *A. glabra*. All scale 13.

smooth and the areoles only faintly indicated, as in *A. glabra*; seeds dark brown, smooth and glossy, resembling those of *A. reticulata*; pulp sweetish but

at first densely fulvous-pubescent, at length glabrate except along the midrib and lateral nerves (10 to 14 on each side), these sparsely and persistently pubescent, as seen under the lens; petiole 10 to 14 mm. long, grooved above, the grooves filled with dense fulvous pubescence, at length glabrescent; flowers resembling those of *Annona reticulata* L. and *A. squamosa* L., the young buds obpyriform, fulvous-pubescent; inflorescence extra-axillary, often opposite a leaf, peduncles in clusters of 3 or 4, sometimes solitary, recurved or nodding, at first fulvous-pubescent, at length glabrate or sparsely appressed-pubescent, usually with an ovate acute pubescent bracteole at or below the middle and a second one at the base; calyx 3-parted, calyx lobes ovate-acuminate; outer petals linear-oblong, 22 to 24 mm. long, concave at the base, keeled within or triquetrous above; inner petals minute, squamiform, scarcely exceeding the stamens in length, ovate, acute, usually with

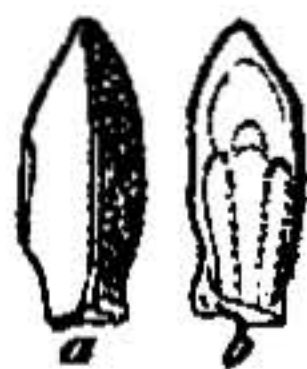


FIG. 50.—Inner petals of *Annona lutescens*. a, Outside face; b, inner face, with imprint of stamens. Scale 10.

with the brown connective expanded above the pale yellow pollen sacs into a broad truncate head; pollen grains in tetrads, yellowish white or cream-colored, arranged in 2 columns in each pollen sac; gynœcium conoid, composed of numerous closely crowded appressed carpels 1.1 to 1.3 mm. long; ovaries clothed with pale brown ascending hairs, with solitary basal ovule and terminal oblong or ovate fleshy glandular style similar to the styles of *A. reticulata* and *A. squamosa*, the lower portion of the ovaries more closely cemented together than in the typical forms of *A. squamosa* and *A. cherimola*, the styles constricted in the base and falling off in a mass soon after pollination; fruit broadly heart-shaped or conoid, 8 or 9 cm. in diameter, yellow when ripe, rounded at the apex, resembling that of *A. reticulata*, but with the surface quite

insipid, adhering to the seeds, tallow-like with minute hard granules. (PLATE 23. FIGURES 49, 50, 51, *a*, 52, *a*.)

Type in the U. S. National Herbarium, no. 850044, collected near Cahabon, Alta Verapaz, Guatemala, April 26, 1904, by O. F. Cook (no. 93).

DISTRIBUTION: Northern Guatemala and southern Mexico.

SPECIMENS EXAMINED:

GUATEMALA: Type specimen as cited with field photograph (U. S. Dept. Agr. Bur. Plant Ind. no. 7247.)

MEXICO: Chiapa, State of Chiapas, *Goldman* 1007.

LOCAL NAME: Anona amarilla (Alta Verapaz, Guatemala).

Annona lutescens is closely allied to *A. reticulata* L., from which it differs in its broader leaves (fig. 52) and its yellow fruit. *Annona reticulata*, commonly known as "bullock's heart," has long, narrow leaves (therefore figured by Plumier¹ as "*Annona foliis lanceolatis*") and its fruit turns red, at least on the sunny side, when mature. The present species, according to Mr. Cook, is recognized as distinct from the common *A. reticulata* by the natives of Alta Verapaz, who call it "anona amarilla." In general appearance the fruit resembles very closely the common alligator apple of tropical mangrove swamps (*A. glabra* L.), but the latter may easily be distinguished by its large flowers with 6 ovate valvate petals, its laurel-like leaves, its edible fruit, and its yellow or tan-colored seeds. The difference in the stamens of the two species may be seen in figure 51, which also shows three carpels of *A. lutescens*, with their hairy ovaries, basal solitary ovules, and terminal fleshy styles, these velvety like chamols skin on the surface, as seen under the microscope, instead of muriculate, as in the much larger stamen of *A. glabra*. The flowers of the present species are very similar to those of *A. reticulata* L., yet this is also true of the flowers of *A. squamosa* L. The three form a subdivision of the section *Atta* and are very closely allied, but undoubtedly distinct, as in the case of the two chirimoyas, *A. cherimola* Mill. and *A. longiflora* S. Wats.

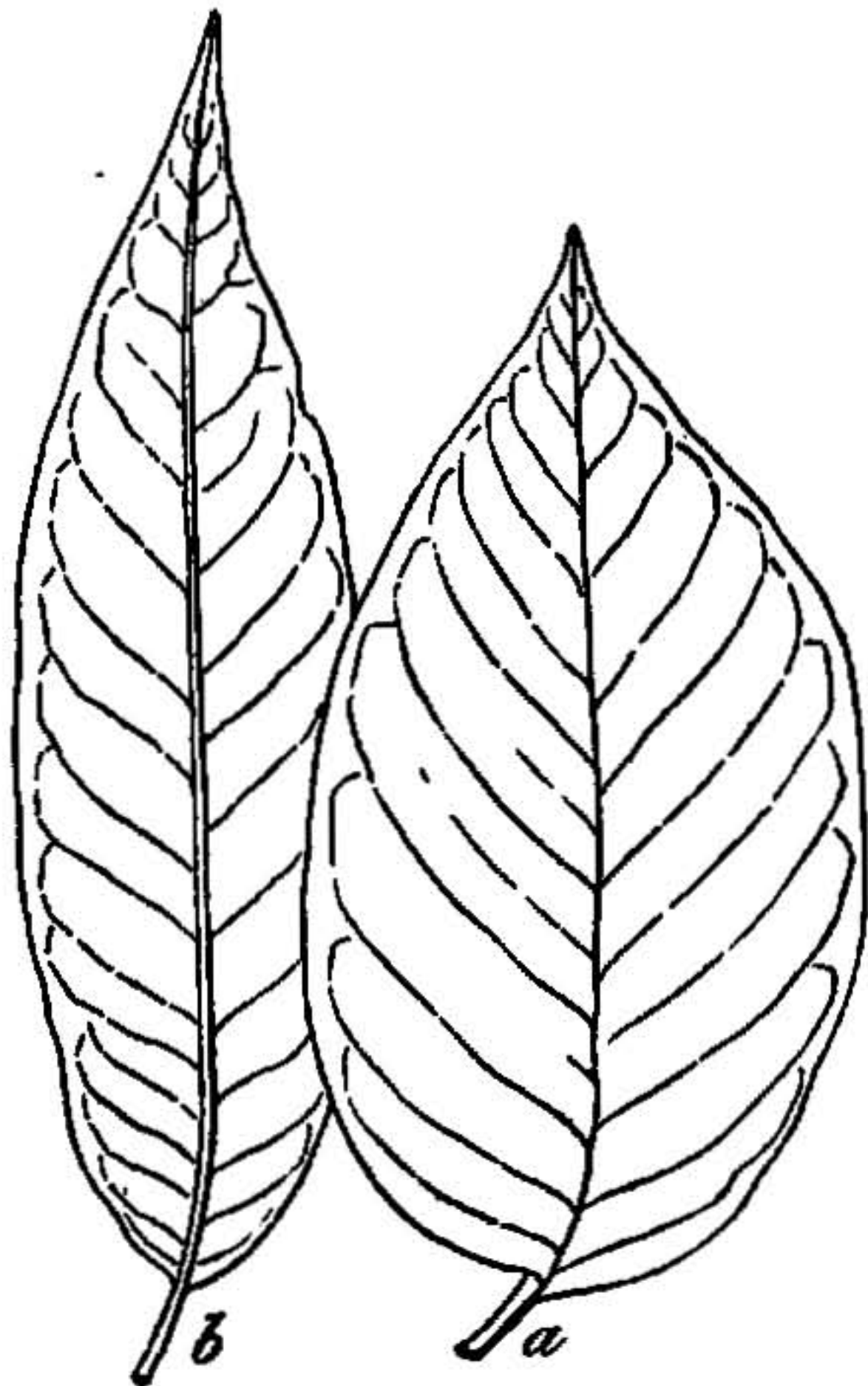


FIG. 52.—(a) Leaf of *Annona lutescens* and (b) one of *A. reticulata*. Scale $\frac{1}{2}$.

EXPLANATION OF PLATE 23.—From a field photograph of type material, showing fruit, seeds, extra-axillary clusters of unopened nodding flowers, and retuse lower leaf. Natural size.

Annona palmeri Safford, sp. nov.

Section *Atta*. A shrub 2 or 3 meters high, with 2-ranked approximate thin membranaceous leaves resembling those of *A. squamosa* in shape, and with very small obtuse-petaled flowers on long slender peduncles; branches very slender, at

¹ Nov. Pl. Amer. pl. 143. f. 2. 1755.

first sparsely appressed-pilose, soon glabrate, reddish brown, bearing numerous light-brown lenticels; petioles 5 or 6 mm. long, broadly channeled above, sparsely pubescent at first, soon glabrescent; blades oblong-lanceolate to ovate, the lowermost on the flowering branches small, elliptical and sometimes retuse, the uppermost longest, and relatively narrowest, 10 cm. long and 2.5 cm. broad, with 7 to 10 nerves on each side, those lower down 5 to 6 cm. long and 2.8 to 3 cm. broad, usually obtuse or obtusely acuminate but sometimes acutish at the apex, rounded or cuneate and sometimes slightly unequal at the base, above at first sparsely pubescent but soon quite glabrous or with a few whitish fine hairs along the impressed midrib, beneath at first sparsely appressed-pilose but soon glabrate or nearly so, the pale rufous midrib and lateral nerves prominent; peduncles extra-axillary, solitary, 1-flowered, 10 to 15 mm. long, sparsely



FIG. 53.—*Annona palmeri*. Leaves, flower, and fruit. Scale $\frac{1}{2}$. From type specimen.

pubescent, with a minute pubescent bracteole at about the middle and one at the base, persistently slender; flowers small, pyriform or obovoid in bud; calyx lobes broadly ovate or triangular, pubescent; outer petals obovate-oblong, 8 to 8.5 mm. long by 4 mm. broad, rounded at the apex, very thick, valvate, triquetrous, excavated at the base to receive the essential parts, puberulent on the outside; inner petals small, scarcely exceeding a stamen in length, perfectly formed (not aborted), elliptical or obovate, rounded at the apex, velvety on the outside, about 1 mm. long and 0.5 mm. broad; receptacle convex; stamens numerous, 1 mm. long with the two parallel straw-colored pollen sacs capped by the expanded brown velvety terminal head of the connective; carpels distinct, forming a depressed-pyramidal gynœcium; fruit subglobose or depressed-conoid, 2 to 2.5 cm. in diameter, composed of 12 to 20 carpels, these cohering in a solid mass, individually somewhat gibbous on the surface and marked with a terminal

point but not produced into a beak or tubercle; pulp scanty; seeds relatively large, unsymmetrically obovate, rounded at the apex and bearing a caruncle at the base, 8 to 10 mm. long and 7 mm. broad; testa thin, golden brown, or buff-colored, somewhat wrinkled by the rumination of the inclosed endosperm. (PLATE 24. FIGURES 53, 54.)

Type in the U. S. National Herbarium, no. 266450, collected near Acapulco, Mexico, in November, 1894, by Dr. Edward Palmer (no. 85). "A shrub 5 to 10 feet high with dull white flowers, growing in the river bottom near Acapulco."

DISTRIBUTION: Known only from the type locality.

SPECIMENS EXAMINED:

MEXICO: From the type collection in the U. S. National Herbarium and in the Gray Herbarium.

LOCAL NAME: Anonilla, or "dwarf anona" (Acapulco).

This species has very much the same habit of growth as *A. globiflora* Schlecht., the dwarf anona of eastern Mexico, but the head of the connective is broader than the two pollen sacs and the long, solitary peduncle is very different from that of *A. globiflora*. On account of the broad connective and the perfectly formed inner petals, the writer provisionally assigns *A. palmeri* to the section *Atta*, which includes *A. squamosa* and its allies. It has, however, the habit of certain species of *Rollinia*, and its short, round-pointed, thick petals, together with its *Rollinia*-like seeds may indicate that it is a link between the genera *Annona* and *Rollinia*.

EXPLANATION OF PLATE 24.—Photograph of the type in the U. S. National Herbarium, showing a single flower, a dry fruit, and two seeds. Natural size.

Annona longiflora S. Wats.

Anona longiflora S. Wats. Proc. Amer. Acad. 22:397. 1887.

Section *Atta*. A shrub 3 to 10 feet high, the young branches, peduncles, and petioles densely soft-pubescent; leaves elliptical to ovate or obovate-elliptical, usually rounded but sometimes acute at the base, rounded or obtuse and often minutely apiculate or mucronulate at the apex, bright green above, glaucous green beneath (when dry), 5 to 14 cm. long by 3.5 to 8 cm. broad, densely and softly pubescent when fresh, at length becoming nearly glabrous above and glabrescent or sparsely pubescent beneath except on the midrib and lateral nerves; flowers

resembling those of *A. cherimola* but larger, short-peduncled, pubescent, densely so at the base; calyx divisions deltoid-ovate, 5 mm. long, clothed on the outside with fine long soft hairs; outer petals linear-oblong or oblong-lanceolate, 4 to 5 cm. long and 7 to 9 cm. broad, coriaceous, swollen at the base and concave about the essential parts, whitish or cream-colored with a dark purple or blackish spot at the base; inner petals minute (sometimes wanting), finely pubescent, ovate, obtuse, 2 to 3 mm. long; torus hemispherical, clothed with fine straight hairs between the filaments; stamens 2.2 to 2.7 mm. long, with the connective terminating in an expanded cap above the parallel pollen sacs, its surface finely granular; carpels 2.5 to 3 mm. long, the ovaries 1.5 to 2 mm. long, covered with rufous ascending hairs, the styles 1 to 1.5 mm. long, minutely puberulent (under the microscope), the stigmatic extremity tapering to a point; fruit conoid or globose-ovate, its surface either reticulated with flat areoles or bearing protuberances like those on certain forms of the fruit of *Annona cherimola* L.; seeds coffee-colored, obovoid, cuneate, truncate or obpyramidal, about 15 mm. long and 10 mm. broad, with a smooth thick

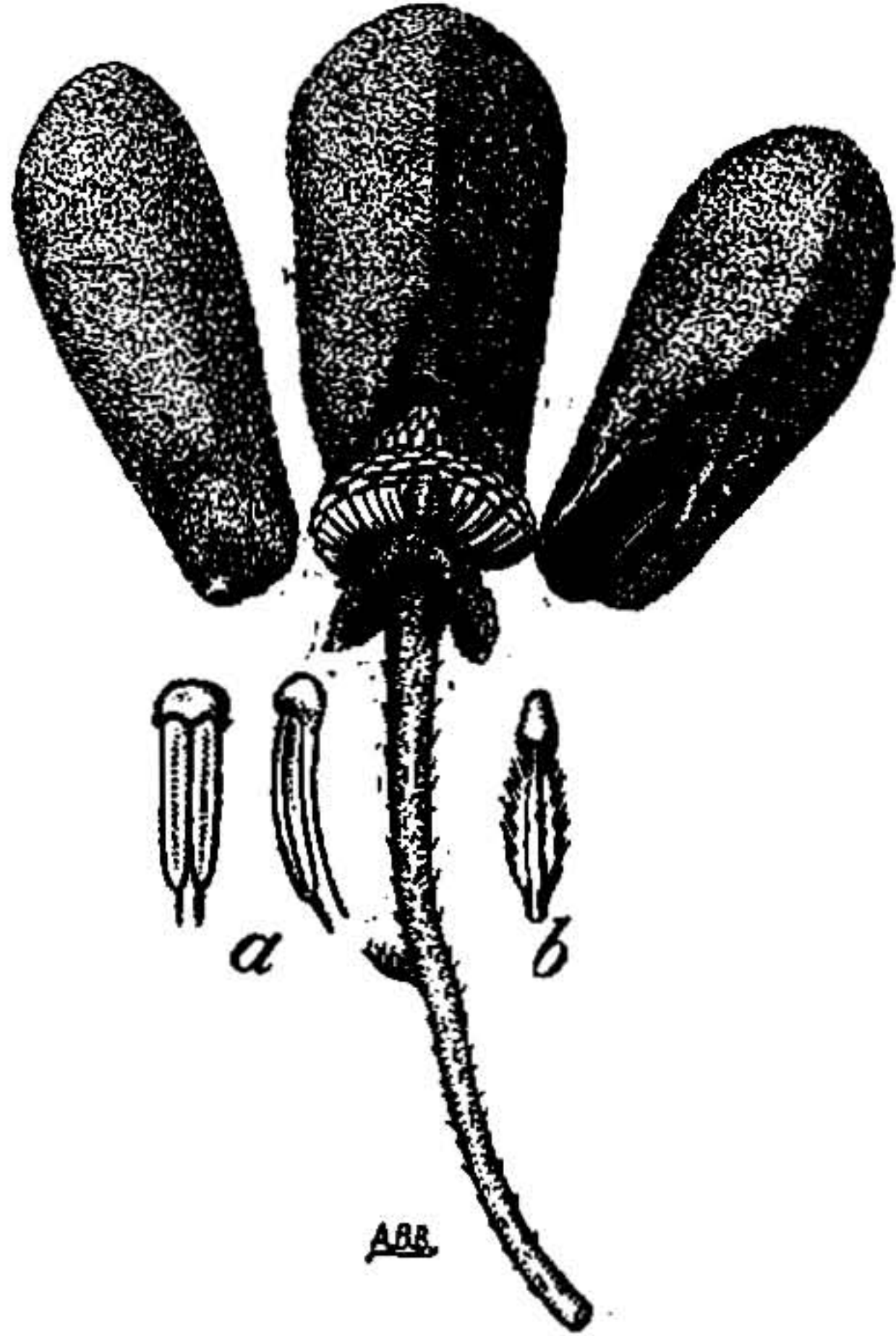


FIG. 54.—Flower of *Annona palmeri*. a, Stamens; b, carpel. From type specimen. Flower, scale 4; a, b, scale 13.

testa, resembling the nuts of *Pinus cembra* but much larger, without a pronounced basal caruncle. (PLATE 25. FIGURES 55, 56.)

Type in the Gray Herbarium, collected at Rio Blanco, near Guadalajara, State of Jalisco, Mexico, June, 1886, by Dr. Edward Palmer (no. 55).

DISTRIBUTION: State of Jalisco, Mexico.

· SPECIMENS EXAMINED:

MEXICO: State of Jalisco, Rio Blanco, *Palmer* 55, type (with smooth fruit) in Gray Herb., duplicate (with umbonate fruit) in U. S. Nat. Herb., no. 2572); bluffs of the Rio Grande de Santiago, *Pringle* 2480; bluffs of the Barranca de Guadalajara, "a shrub 5 to 10 feet high," *Pringle* 9681 (with mature seeds); on the road between Bolaños and Guadalajara, *Rose* 3058; near Tequila, *Rose & Hough* 4741.

LOCAL NAMES: Chirimoya de la barranca (Guadalajara, Jalisco); Chirimoya cimarrona (Tequila, Jalisco).



FIG. 55.—*Annona longiflora*. Leaves, flower, and fruit. Scale $\frac{1}{2}$. From type material in U. S. National Museum.

Annona longiflora is very closely allied to *A. cherimola* Mill., but is easily distinguished from that species by its longer flowers with shorter peduncles and loose floccose hairs about the base of the corolla (fig. 56), by its leaves, which are at length glabrate instead of persistently pubescent between the lateral nerves, and by its peculiar seeds, which resemble large pine nuts rather than the seeds of an *Annona*. It was originally described as a shrub 3 feet high; but specimens collected from the type locality by Mr. C. G. Pringle grew to the height of 10 feet. About the base of the young branchlets, where they issue from the bud, is a collar of soft plushlike pubescence. As in many other species of the Annonaceae, the lowermost leaves of the flowering branchlets are smaller than the succeeding ones, in this species often suborbicular; the peduncles are extra-axillary, usually issuing from near the base of a branchlet and often opposite a small suborbicular leaf. The stamens and carpels are considerably larger than those of *A. cherimola*; the outer petals are strap-shaped rather than triquetrous, as in the latter species,

though they usually have a raised median line or keel on the inner surface. The minute inner petals scarcely exceed the stamens in length and might easily escape observation.

In the type collection the fruits were immature. They were of two distinct forms analogous to the umbonate and smooth forms of *Annona cherimola* and of *A. diversifolia*. That in the Gray Herbarium is globose-ovate and "covered with flat reticulations," as described by Doctor Watson. In the National Herbarium, however, the fruit of the type collection is conoid and bears numerous

umbonate protuberances, as shown in figure 55. Mature seeds collected by Pringle in the Barranca of Guadalajara in 1902 are very different from those of *Annona cherimola*, being truncate or obpyramidal in form without a caruncle at the base, and having the testa quite smooth and nutlike, thicker than those of the common edible custard apples and similar in texture to the seeds of *Annona diversifolia*. They differ so much from those of all other species of *Annona* that they alone would be sufficient to identify this species.

According to Doctor Palmer's notes, the fruit is edible either raw or cooked. A sweetmeat is made by boiling it with sugar, together with the fruit of the *tefocote* (*Crataegus mexicana*).

EXPLANATION OF PLATE 25.—From a photograph of a specimen collected by Rose and Hough in the Barranca of Guadalajara, State of Jalisco, Mexico (no. 4827), together with seeds from the same locality collected by Pringle in 1902. Natural size.

Annona macrophyllata Donn. Smith.

Annona macrophyllata Donn. Smith, Bot. Gaz. 49: 453. 1910.

Section Ilama. A shrub 3 or 4 meters high with pale green or glaucous foliage; leaves small, subsessile, membranaceous, glabrous, oblong-elliptical or obovate-oblong, 4 to 5.5 cm. long and 2 to 3 cm. broad, rounded or at least obtuse at the apex and rounded or retuse at the base, with 7 to 13 prominent lateral nerves on each side the midrib, minutely reticulate and punctulate with pellucid dots between the nerves; petioles 2 to 3 mm. long; peduncles solitary, 1-flowered, glabrous, 17 to 27 mm. long, issuing from a pair of leaflike cordate-orbicular bracts, or prophylla, at the base of short branchlets and bearing near the middle a minute lanceolate bracteole tipped with a floccose tuft of silky hairs; basal bracts subopposite, unequal, 16 to 24 mm. in diameter, at first clothed with ferrugineous-silky hairs, at length glabrescent, but ciliate along the margin and at the base; calyx lobes ovate, 3 to 4 mm. long, ferrugineous-villous on the outside; outer petals oblong or ovate-oblong, obtuse or rounded at the apex, thick and fleshy, glabrescent on the outside, valvate, excavated at the base to include the essential parts, cinereous-velvety within, 21 mm. long and 8 mm. broad; inner petals minute, 2.5 mm. long and 1 mm. broad, pubescent on the outside and bearing the rudiments of two pollen sacs; receptacle convex or hemispherical, clothed with whitish silky hairs between the bases of the filaments; stamens numerous, crowded, 2.5 mm. long, puberulent, with the connective expanding above the pollen sacs into a broad puberulent head; carpels 2 mm. long, the ovary clothed with short whitish hairs and bearing a tapering amber-colored glandular style; fruit not observed. (PLATE 26.)

Type in the U. S. National Herbarium, no. 57958, ex Herb. Donnell Smith, collected near Viscal, 13 miles north of Guatemala City, 1,110 meters elevation, June 5, 1909, by Charles C. Deam (no. 6191).

DISTRIBUTION: Guatemala and southern Mexico.

SPECIMENS EXAMINED:

MEXICO: Tapachula, State of Chiapas, May 7, 1902, Cook & Collins (photograph no. 4005, U. S. Dept. Agr. Bur. Plant Ind.).

GUATEMALA: Type specimen as cited.

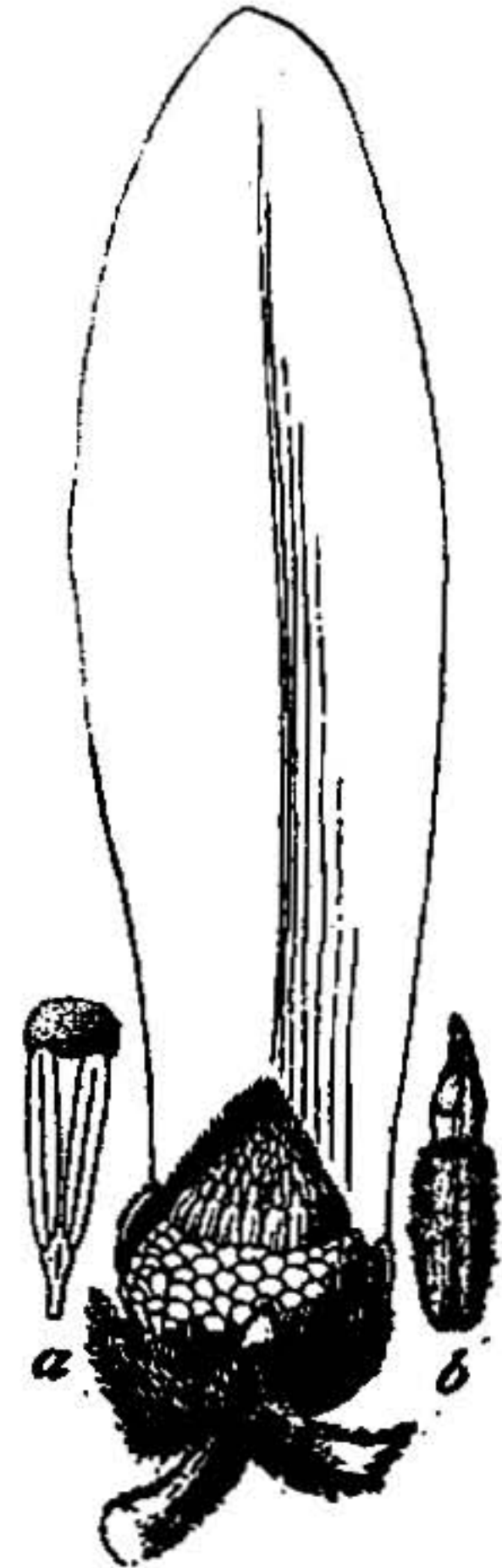


FIG. 56.—Flower of *Annona longiflora*. a, Stamen; b, carpel. Flower, scale 3; a, b, scale 13.

Annona macrophyllata Donn. Smith is very closely allied to *A. diversifolia* Safford,¹ the "ilama" of Colima and Acapulco (figs. 27, 28, pp. 19, 20); but it differs in its shorter-petioled, smaller leaves, its oblong flowers and thicker peduncles, and its persistently ciliate, smaller bracts or prophylla.

Mr. O. F. Cook, of the Bureau of Plant Industry, U. S. Department of Agriculture, while on a mission of agricultural exploration, found this species near Tapachula, in the State of Chiapas, southern Mexico, in 1902, 7 years before the type specimen described by Capt. Donnell Smith was collected, and describes it in his field notes as follows:

"May 8, 1902. There is an Anona with glaucous leaves not infrequent at Tapachula, State of Chiapas. The smaller leaves or bracts are, like the bud scales, clothed on the back with long, silky, brown hairs. The mature petals are greenish at the base and become yellow in the distal half; along the margins and on the inside they are tinged and mottled with pink and deep red like the flesh of a peach. The clustered apices [connective heads] of the stamens are dull pinkish when fresh. The pollen lies in the anthers in chains [of tetrads], two chains in each of the two sacs. The stigmas have a joint or collar at the base and are bathed in a transparent fluid [at the time of pollination]. The petals turn dark brown within a few minutes after being placed in alcohol."

EXPLANATION OF PLATE 26.—Photograph taken in the field, at Tapachula, State of Chiapas, Mexico, near the Guatemala boundary, May 7, 1902, by Mr. Guy N. Collins.

Annona bullata A. Rich.

Annona bullata A. Rich. (in part) Ess. Fl. Cuba 31. 1845. Same in Sagra, Hist. Cuba 10:13. pl. 5. 1845.

Section Saxigena. A shrub or tree; new branches ferruginous-subtomentose, at length glabrate; older branches glabrous, grayish or brownish, longitudinally plicate-striate and bearing numerous inconspicuous brownish lenticels;

leaves ovate to oblong-elliptical, acutish, obtuse or rounded, occasionally retuse, often mucronulate at the apex, obtuse or rounded at the base, 5 to 9 cm. long, 2.5 to 4.5 cm. broad, upper surface with the midrib, nerves (12 to 14 on each side), and reticulating veins impressed, the small areoles formed by the last having a gibbous or bullate appearance, when young pubescent with short grayish or pale rufous hairs, at length glabrescent; under surface with the venation elevated and ferruginous-pubescent, the ultimate areoles concave, olive green or grayish; petiole 4 to 6 mm. long, ferruginous or fulvous-tomentose, grooved above in continuation of the impressed midrib; peduncles solitary, extra-axillary, often issuing from very near the base of a new branchlet opposite a small leaf (not "subterminal" as described, in the specimens examined by me) at least 3 times the length of the petioles (15 to 18 mm. long), bibracteolate, the bracteoles squamæform, ferruginous or rufous-tomentose, alternate, one at the base, the other near the middle of the peduncle; flower buds oblong-pyramidal and subacute; flowers yellowish green when fresh, long and slender, resembling those of *A. cherimola* but with the outer linear petals when mature narrower and not



FIG. 57.—Flower of *Annona bullata*. One petal removed. Scale 4.

¹ Journ. Washington Acad. Sci. 2: 118. 1912.

triquetrous or keeled within along the distal portion, concave at the base to receive the essential parts, 25 to 30 mm. long and 4 mm. broad, rufous or fulvous-tomentose on the outside, grayish tomentulose within and pale rufous-tomentose at the base; inner petals minute, not exceeding the stamens in length, rufous-tomentulose; calyx gamosepalous, small, 3-parted, densely ferrugineous-tomentose on the outside, the lobes broadly triangular and obtusely acuminate or cuspidate at the apex; stamens numerous, 1.2 to 1.4 mm. long, covering the lower half of the ovoid torus, appressed, subarcuate; filaments broad and flat, 0.45 mm. long and 0.25 mm. broad; pollen sacs linear, 0.8 mm. long (mature specimens observed), pale straw-colored, parallel and almost contiguous; connective a continuation of the basal filament, broad and flat, terminating in a slightly swollen obtuse velvety straw-colored apex above the pollen sacs but not expanding beyond them as in *A. cherimola* and its close allies; carpels numerous, crowded, distinct, borne on the upper half of the torus, very similar to those of *A. cherimola* and its allies; ovaries about 0.8 mm. long, clothed with long appressed whitish sericeous hairs; styles ovoid or oblong, glandular-velvety with a median groove on the ventral side; fruit spheroid-cordiform or oblate, small, its component carpels terminating in pointed protuberances, very much as in umbonate forms of cherimoya fruit, and clothed with a pale rufous or fulvous velvety indument; seeds relatively large, ovoid or oblong, 10 to 14 mm. long, 7 to 9 broad, more or less triquetrous, with a smooth glossy golden brown testa more or less irregularly pitted and a ruminant endosperm as in allied species. (PLATES 27, 28. FIGURES 30, 32, pp. 20, 21; 57, 58.)

Type material in the Delessert Herbarium, collected at Arcos de Canasí, on the north coast of Cuba, between Habana and Matanzas.

DISTRIBUTION: Island of Cuba, Provinces of La Habana, Matanzas, and Santa Clara.

SPECIMENS EXAMINED:

CUBA: Province of Havana, (definite locality not stated,) 1831, *Ramon de la Sagra* 556 (type collection), in Herb. De Candolle, ex Herb. Delessert); Province of Matanzas, without definite locality, 1865, *Wright* 327 (U. S. Nat. Herb.); Province of Santa Clara, palm barren, Santa Clara, 1912, *Britton & Cowell* 13329 (U. S. Nat. Herb.).

The specimens collected by Ramon de la Sagra included only immature flowers ("in alabastro unico a me observato." A. Richard). These were nearly all detached from the branches, from which the leaves had also separated, as seen in the specimens in the De Candolle Herbarium as cited. The leaves agree in shape and texture with the specimens collected by Wright in the Province of Matanzas, here figured, except that several of the latter are more distinctly mucronulate than any of the leaves of the type. The normally shaped ones, growing on the upper portions of the branches, shown in figure 30 (p. 20), are distinctly oblong, and not suborbicular as in the closely allied *A. crassivenia* of Almacigos (fig. 31, p. 20), which has hitherto been confused with this species. From the camera lucida drawings of the essential parts (fig. 58) it will be seen that the mature stamens of *Annona bullata* are broader, thinner, and flatter, the hairy carpels more slender, and the (ovoid) terminal

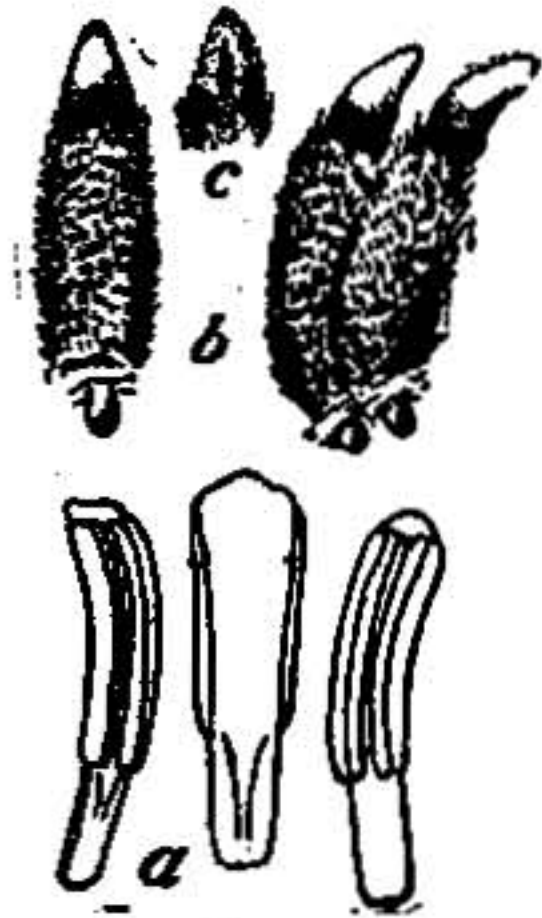


FIG. 58.—Essential parts of flower of *Annona bullata*. a, Stamens; b, carpel; c, ventral view of style, showing median groove. Scale 13.

styles more pointed than Richard's figures of the corresponding organs would indicate, while plate 27 shows that the flowers are not subterminal as originally described, but issue normally from the base of the branchlets, and that the mature petals are almost flat and rounded at the apex, instead of subtriquetrous and subacute. The indument of the peduncle and calyx is ferrugineous or deep cinnamon color, while that of the outer petals is composed of much finer hairs and is pale rufous or fulvous.

Richard is quite right in recognizing the relation of this species to *Annona cherimola*, but, for the reasons assigned in describing the section *Saxigena*, it seems advisable to place this and *A. crassivenia* in a special section.

This species, on account of the aromatic properties of the wood, is called "laurel." The leaves are eaten by horses and cattle and the fruit by pigs. The latter is described as hard and sour and unfit for the table. The pubescence of its surface is fulvous rather than ferrugineous. Its seeds are remarkable for the bright golden, smooth, waxlike surface of their thin testa. They are inclosed when fresh by a thin membranous aril and are surrounded by scant pulp.

EXPLANATION OF PLATES 27, 28.—Pl. 27, photograph of Britton & Cowell's no. 13329, U. S. Nat. Herb. Natural size. Pl. 28, photograph of Wright's no. 327, U. S. Nat. Herb., exactly similar to type specimens collected by Ramon de la Sagra in Herb. De Candolle.

Annona crassivenia Safford, sp. nov.

Annona bullata Griseb. Cat. Pl. Cub. 2. 1866, not A. Rich.

Section *Saxigena*. A small tree; branches slender, densely ferrugineous-tomentose when young, at length glabrate, grayish brown, longitudinally plicate-striate and bearing inconspicuous brownish lenticels; leaves orbicular or broadly ovate, rounded or retuse at the apex and rounded at the base, 5.5 to 7.8 cm. long and 4.5 to 7 cm. broad, when young pubescent above and clothed beneath with thick ferrugineous tomentum, at length sparsely pubescent or glabrate above, the midrib and lateral nerves impressed and persistently ferrugineous-tomentose beneath, with remarkable raised subparallel veins between the prominent lateral nerves and midrib inclosing concave reticulate areoles; lateral nerves 9 to 11 on each side; petioles 4 to 5 mm. long, grooved above, densely and persistently ferrugineous-tomentose; peduncles solitary, extra-axillary on the young branchlets, 10 to 13 mm. long, persistently ferrugineous-tomentose

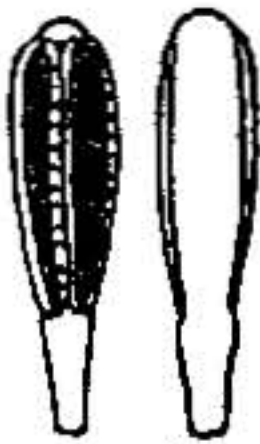


FIG. 59.—Stamens of *Annona crassivenia*. Showing pollen sacs after dehiscence. Scale 13.

and bearing a tomentose bracteole at the base; flowers resembling those of *Annona cherimola*, "dull greenish" when fresh; calyx small, about 4 mm. in diameter, gamosepalous, subtriangular, with the points obtusely acuminate or cuspidate; petals 6, the outer linear, tapering gradually toward the subacute apex, 24 mm. long and 4 mm. broad at the base, triquetrous or keeled within along the median line to the apex, hollowed at the base to receive the essential parts, clothed on the outside with a pale rufous or fulvous tomentum, lighter colored and finer than that of the calyx, grayish-tomentulose within; inner petals minute, not exceeding the stamens in length, rufous-tomentulose and keeled on the outside; torus convex; stamens numerous, about 1.3 mm. long; filaments brown, tapering to the base; pollen sacs 0.85 mm. long, contiguous, whitish, surmounted by the rounded apex of the connective, the latter not equal to the two pollen sacs in breadth; carpels numerous, closely crowded into a pyramidal gynoecium, the ovaries about equal in length to the pollen sacs and densely clothed with long straight white ascending hairs; style ovoid or oblong, tapering to an obtuse stigmatic point with a median ventral suture;

fruit broadly ovoid or subglobose, 4.3 cm. long and 4.1 cm. broad in the (immature) type specimen, its surface ferrugineous-tomentose or cinnamon-colored, the carpels terminating in low obtuse protuberances; seeds numerous (in type specimen), very closely crowded, obovate or oblong, compressed, about 11 mm. long and 6 mm. broad, with a thin tan-colored testa. (PLATES 29, 30. FIGURE 59.)

Type in the Gray Herbarium, collected at Los Almacigos, Province of Pinar del Rio, near the western extremity of the island of Cuba, July 26, 1862, by C. Wright (no. 1845); duplicates in the Göttingen Herbarium and the De Candolle Herbarium.

DISTRIBUTION: Province of Pinar del Rio, Cuba.

SPECIMENS EXAMINED:

CUBA: Type specimen as cited and duplicate of type in Herb. De Candolle; near Herradura, *Van Hermann* in Herb. Fr. Leon, Habana, Cuba (tracings of leaves and fruit).

Annona crassivenia is closely related to *A. bullata* A. Rich., but differs from it as set forth in the discussion under that species. The latter has the upper normal leaves ovate or ovate-oblong and often mucronulate as shown in figure 30, while the leaves of the present species are normally orbicular or nearly so, with thicker and denser reticulations between the secondary nerves, as shown in figure 31. The flowers of both species resemble those of the section *Atta*, but differ from them in having the terminal point of the stamen-connectives less broadly expanded, approaching more closely to the form of the connectives of the group *Annonellae*.

EXPLANATION OF PLATES 29, 30.—Pl. 29, photograph of type, showing remarkable venation of lower surface of the leaves. Pl. 30, leaves and bud of duplicate of type in De Candolle Herbarium, and fruit of type in Gray Herbarium. All natural size.

Annona cascarilloides
Wright.

Annona cascarilloides C.
Wright in Griseb. Cat.
Pl. Cub. 2. 1866.

Section *Annonula*. A branching shrub 2 meters high; young branchlets, petioles, and peduncles ferrugineous, appressed-hirtellous; leaves small, subsessile, approximate, oblong-linear, mucronulate, obtuse at the apex, obtuse or acute at the base, the margins revolute, glabrous above, the midrib deeply impressed, sparsely pubescent beneath with scattered ferrugineous hairs, at length glaucous and glabrescent with the prominent midrib densely covered with persistent appressed bright ferrugineous or cinnamon-colored hairs like those on the young branchlets and petioles, 37 to 25 mm. long and 8 to 6 mm. broad; lateral nerves

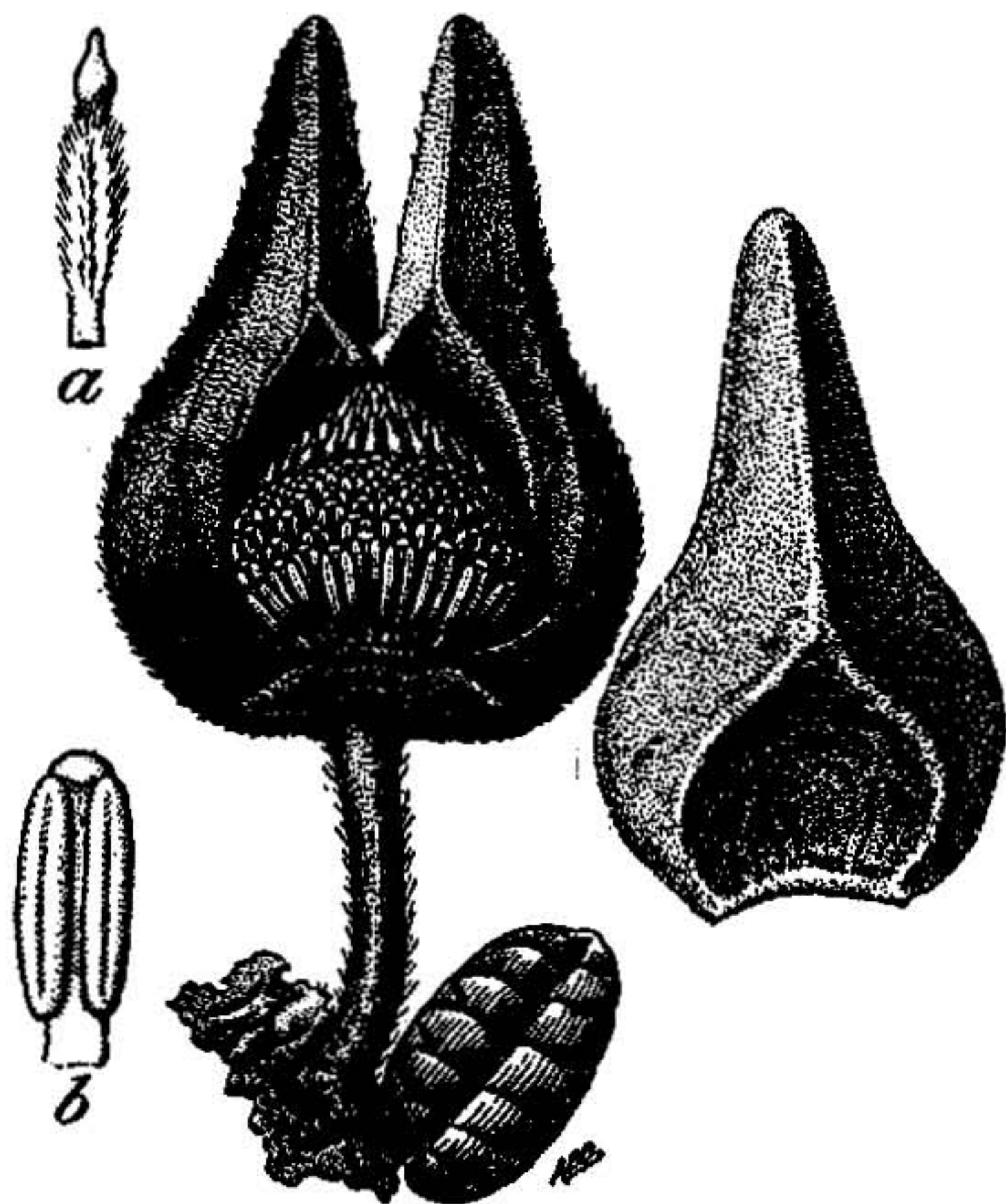


FIG. 60.—Flower of *Annona cascarilloides*. One petal removed. *a*, Carpel; *b*, stamen. Flower, scale 4; *a*, *b*, scale 13.

13 to 15 on each side, almost at right angles to the midrib, forking dichotomously before reaching the margin; peduncles solitary, subterminal on short lateral branchlets, 5 to 7 mm. long; flower buds obclavate or obpyriform; calyx lobes triangular, 2.4 mm. long and 2.4 mm. broad at the base, clothed with ferruginous appressed hairs on the outside; outer petals thick, valvate, broadly ovate and long-acuminate, hollowed at the base to cover the essential parts, the long tapering distal portion triquetrous and terminating in a rounded or acutish apex, ferruginous-puberulent on the outside, glabrous within, 12 to 20 mm. long and 6 to 7 mm. broad at the base; inner petals entirely absent in flowers of type material; torus convex, glabrous between the bases of the filaments; stamens numerous, 1.6 mm. long, the two linear pollen sacs contiguous, the apex of



FIG. 61.—Leaf of *Annona cascarilloides*. Lower surface. Natural size.

the connective above them not broadly expanded but similar in form to that of the stamens in the section *Annonella*; carpels equal in length to the stamens, closely appressed to form a conical gynœcium; ovaries covered with appressed pale rufous hairs and bearing at their apex a fleshy tapering style; fruit spheroid, 3 to 3.5 cm. in diameter, glabrescent, thin-skinned, neither squamose nor tuberculate, but the areoles corresponding to the individual carpels gibbous (in the dry fruit); mature peduncle slender, the calyx persistent; seeds obovate-oblong, laterally somewhat compressed and marginate on one side, 12 to 16 mm. long and 8 mm. broad (in type specimen), the thin testa more or less wrinkled and glossy brown as though varnished; pulp soft. (PLATE 31. FIGURES 60, 61.)

Type in the Göttingen Herbarium, collected at Paredones de San José, in the Province of Pinar del Rio, near the western extremity of the island of Cuba, in flower, June 10, in fruit, August 14, 1862, by C. Wright (no. 1848). Duplicates in the Gray and De Candolle herbaria.

DISTRIBUTION: Western Cuba.

SPECIMENS EXAMINED:

CUBA: Province of Pinar del Rio, Paredones de San José, C. Wright 1848 (type collection, Gray and De Candolle herbaria).

LOCAL NAMES: Anoncillo de Paredon; Anoncillo de Sabana (Province of Pinar del Rio).

Annona cascarilloides owes its specific name to the resemblance of the venation of its leaves (fig. 61) to that of the leaves of certain species of the genus *Cascarilla*. The flowers were said in the original description to resemble those of the genus *Rollinia*, but this statement is quite misleading (see fig. 60). They appear to be intermediate in form between the flowers of *Annona cherimola* and those of *A. globiflora*. In their swollen base and slender apex they are not unlike the flowers of *A. acutiflora* Mart. of Brazil, but the latter have conspicuous inner petals, and these are quite lacking in the specimens of *A. cascarilloides* examined. The fruit, which is about as large as a plum, is devoid of protuberances or stigmatic scars.

EXPLANATION OF PLATE 31.—Photograph of type material in the De Candolle Herbarium, showing leaves, flowers, and fruit, the latter distorted by compression. Natural size.

Annona sclerophylla Safford, sp. nov.

Section *Annonula*. A shrub 2 or 3 meters high with short crowded branchlets and rigid approximate aromatic leaves; young branchlets and peduncles densely and shortly ferruginous-tomentose; leaves thick-petioled, at first coriaceous, at length rigid, oblong-linear with the midrib deeply impressed above

and prominent beneath and the margins revolute, usually rounded and often apiculate at the apex, commonly rounded at the base, 3 to 5.5 cm. long, 8 to 11 mm. broad, glabrous and glossy above with the surface convex on each side of the midrib and covered with areoles formed by the reticulate veins between the lateral nerves, these 16 to 18 on each side, at right angles to the midrib and decurved toward the petiole; lower surface densely and persistently fulvous-tomentulose, the feltlike indument more or less concealing the venation on each side the prominent midrib, the latter at length glabrescent and longitudinally striate, never ferrugineous-hirtellous as in *Annona cascarilloides*; petioles 3.5 mm. long, 1.5 to 2 mm. thick, grooved above and persistently rufous-tomentulose; peduncles extra-axillary, often subterminal on short lateral branches, solitary, 1-flowered, 5 to 13 mm. long, minutely ferrugineous-tomentulose and bearing one or two small ovate bracteoles near the base; flower buds (young ones only observed) rufous-tomentulose or fulvous-tomentulose, oblong-pyramidal, obtuse or rounded at the apex, little swollen at the base, 6 to 9 mm. long; calyx cup-shaped, gamosepalous, 3-lobed, the lobes broadly ovate, acute or obtuse, clothed on the outside with ferrugineous tomentum like that of the peduncle; petals 3, valvate, thick, triquetrous, clothed on the outside with rufous or fulvous tomentum, excavated at the base to receive the essential parts, the cavity lined with fine tomentum; torus convex; stamens numerous (those of immature flowers only observed) 1 mm. long, their connectives terminating in a somewhat expanded apex above the pollen sacs, but not broadly capitate or hooded as in the section *Atta*; carpels about equal in length to the stamens, closely crowded to form a cone-shaped gynoecium; ovary clothed with appressed rufous hairs; style fleshy, slender, tapering; fruit not observed. (PLATE 32, FIGURES 33, p. 21; 62.)

Type in the Herbarium of the New York Botanical Garden, collected on the "Loma Menquira" (Mayari?), a short distance south of the Bay of Nipe, Province of Oriente, near the eastern extremity of Cuba, February 2, 1910, by J. A. Shafer (no. 3706).

DISTRIBUTION: Known only from the type locality.

SPECIMENS EXAMINED:

CUBA: Type material as cited.

This species was found growing in the form of a much branching shrub, about 8 feet high, at an elevation of about 680 to 1,000 meters above sea level in thin soil. The aromatic, brittle leaves have very much the flavor of nutmeg and bear a resemblance to those of *Annona cascarilloides* of western Cuba. However, they are covered beneath with persistent fulvous feltlike tomentum and are devoid of the bright-ferrugineous hairs which occur on the midrib and lower surface in the latter species, while the lateral nerves are peculiar and differ from those of all other known species of the genus in curving backward or downward toward the petiole, as shown in figure 33.

EXPLANATION OF PLATE 32.—Photograph of the type specimen. Natural size.



FIG. 62.—Flower of *Annona solerophylla*. Bud with one petal removed. a, Stamens; b, carpel. From type specimen. Flower, scale 4; a, b, scale 13.

Annona globiflora Schlecht.

Annona globiflora Schlecht. Linnæa 10: 235. 1836.

Annona fruticosa Moc. & Sessé, Fl. Mex. ed. 2. 134. 1894.

Section Annonella. A shrub 1 to 2 meters high with a spreading bushy habit of growth; leaves thin-membranaceous, punctate, deep green above, paler beneath; new branchlets rufous-pilose, at length glabrate, and finally plicate-striate, brown, dotted with very small inconspicuous pale brown lenticels; leaves oblong-lanceolate to oblong-elliptical, 4 to 9 cm. long and 15 to 20 mm. broad, with 7 to 9 lateral nerves on each side, usually obtuse or rounded but sometimes acute at the apex, acute at the base, the leaves near the base of the branchlets smaller and relatively broader than the others, sometimes ovate or even orbicular, as in many other Annonaceae, the margins slightly revolute,

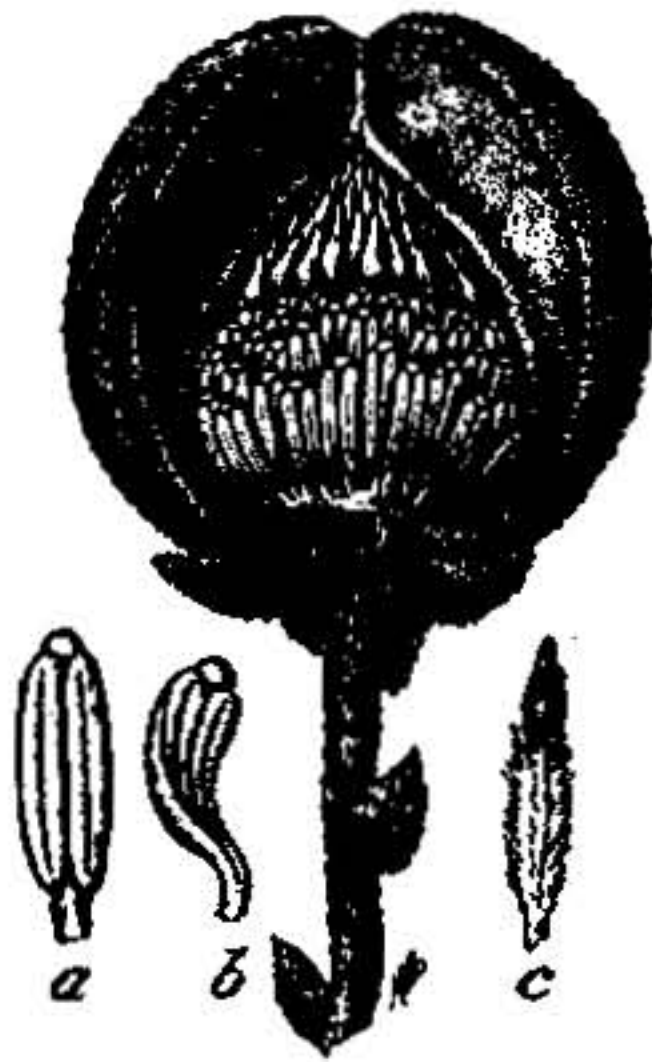


FIG. 63.—Flower of *Annona globiflora*. Bud with one petal removed. a, b, Stamens; c, carpel. Flower, scale 4; a, b, c, scale 13.

glabrate above and sparsely puberulent beneath; petioles about 3 mm. long, clothed like the midrib beneath and the peduncles with appressed ferrugineous hairs scarcely apparent to the naked eye; peduncles in pairs or solitary, extra-axillary, often opposite a leaf, 1-flowered, 4 to 5 mm. long, with two small hirtellous bracteoles, one at the base and one near the middle; flower buds globose, 7 to 8 mm. in diameter; calyx lobes triangular, hirtellous with appressed ferrugineous hairs on the outside; torus convex or subconoid; stamens numerous, 1.5 mm. long, the connective thickened at the apex, but not dilated into a hoodlike covering above the pollen sacs; carpels almost equal to the stamens in length, the ovaries appressed-pilose, surmounted by taper-pointed velvety styles with a median ventral stigmatic groove, becoming suffused with a viscous fluid at the time of pollination and soon afterwards dropping off in a coherent mass; fruit small, spheroid or broadly conoid, 3 or 4 cm. in diameter, its surface

muricate, or mamillate with stout salient nipple-like points, the integument glabrous and minutely granular, no distinct lines marking the areoles formed by the individual carpels; seeds unsymmetrically obovate, somewhat compressed and marginate, about 12 mm. long and 6 mm. broad, with a swollen caruncle at base and with a golden brown thin glossy testa more or less wrinkled by the inclosed ruminant albumen; pulp scanty, edible. (PLATE 33. FIGURE 63.)

Type collected near the Hacienda de la Laguna, a short distance south of Jalapa, State of Veracruz, Mexico, August 29, 1828, by J. Schiede (no. 298).

DISTRIBUTION: Mexico, eastern subtropical region of the States of San Luis Potosí, Tamaulipas, and Veracruz.

SPECIMENS EXAMINED:

MEXICO:

VERACRUZ: Type specimen, as cited; Zacuapan, *Purpus*, 2443.

SAN LUIS POTOSI: Las Canoas, *Pringle* 3796; *Palmer* 224.

TAMAULIPAS: Victoria, *Nelson* 6666 (in fruit); *Palmer* 55 (in flower), 439.

LOCAL NAMES: Anonita de papagayos (Espinal); Anonilla (Veracruz); Chirimoya cimarrona (Huasteca region of San Luis Potosí and Tamaulipas).

In its low bushy habit this species is quite distinct from all other Mexican Annonas. Its closest allies are the recently discovered *Annona bicolor* Urban

and *A. rosei* Safford of the island of Hispaniola, from both of which it differs decidedly in the character of its leaves. These resemble those of the South American *Rollinia emarginata* in their texture and venation. The small globose flowers are no larger than chick-peas (*garbanzos*). In the type specimens, as described by Schlechtendal, more or less imperfect minute inner petals were present, but in the specimens examined by the present writer no inner petals were observed. It is quite probable, however, that they are sometimes present, as in *Annona rosei*.

Annona globiflora was first collected the latter part of the 18th century near the village of Espinal, in the State of Veracruz, by Mociño, and it was described under the name *Annona fruticosa* in Mociño & Sesse's *Flora Mexicana*. This work, however, remained in manuscript for nearly a century, and the description was not published until 1894, as above cited. The name *Annona globiflora*, very appropriately applied to it by Schlechtendal in 1836, must therefore take precedence. Mociño states that the muricate fruit is about as large as a plum, and translates the common name "anonita de papagayos" as "little custard apple of the parrots."

EXPLANATION OF PLATE 33.—Photograph of leaves, flowers, and fruit collected near Victoria, in the State of Tamaulipas, Mexico, the flowers by Dr. Edward Palmer, the fruit by E. W. Nelson.



FIG. 64.—Flower of *Annona bicolor*. Bud with one petal removed. From duplicate type in U. S. National Herbarium. Scale 2.

Annona bicolor Urban.

Annona bicolor Urban, Symb. Antill. 7: 223. 1912.

Annona axilliflora Spreng. Syst. Veg. 2: 642. 1825, not *A.?* *axilliflora* DC. Prodr. 1: 86. 1824.

Section Annonella. A shrub or small tree; young branches slender, minutely subappressed-pilose or hirtellous, at length glabrate, terete, densely plicate-striate when dry, grayish brown, conspicuously dotted with pale grayish lentils; leaves with petioles 3 to 7 mm. long, variable in shape, those at the base of the branchlets, as in many other Annonaceae, smaller and relatively broader than the succeeding ones, orbicular or suborbicular, rounded or emarginate at the apex, 1.5 to 3 cm. long by 1.5 to 2.5 cm. broad, the succeeding ones ovate to ovate-elliptical, rounded or obtuse at the base and often abruptly decurrent on the petiole, 3 to 7 cm. long by 2 to 5 cm. broad, in veneration glabrous above and ferruginous-tomentulose beneath, at length glabrescent beneath with the nerves minutely fulvous-pilose or hirtellous, on both faces reticulate between the nerves, beneath pale greenish gray and densely clothed with very minute tomentulum (as seen beneath the microscope); flowers very small, in pairs or solitary, on short hirtellous peduncles not

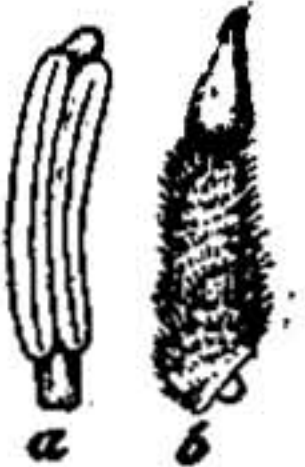


FIG. 65.—(a) Stamen and (b) carpel of *Annona bicolor*. Scale 13.

exceeding the petioles in length, issuing from the base of the young branchlets and subtended by two minute triangular pilose bracteoles; flower buds subglobose-triangular, often obtusely acuminate, 5 to 6 mm. in diameter; calyx lobes broadly triangular, soon reflexed, 1.5 mm. long, ferruginous-hirtellous; petals 3, fleshy, semiorbicular-triangular, sometimes obtusely acuminate at the apex, 5 mm. long and about 5 mm. broad, clothed on the outside with short appressed rufous hairs; stamens numerous, in 3 or 4 series, 1.2 to 1.4 mm. long, the linear pollen sacs borne on the back of a thick, fleshy connective, this obtuse or rounded at the apex, but not expanding into a hoodlike cap above the pollen sacs; carpels numerous, forming a broadly pyramidal gynœcium; ovaries

minutely rufous-pilose, with a single ovule at the base and a fleshy taper-pointed style at the apex; fruit (hitherto undescribed) subglobose or very broadly ovate and depressed at the base, with an axial length of 3.5 to 4 cm. and a diameter of 4 to 4.5 cm., glabrous, with the component carpels somewhat gibbous but not outlined by distinct areoles; seeds remarkable for their smooth polished black or dark brown testa, unsymmetrically obovate-oblong, often apiculate, distinctly marginate, and with a swollen caruncle at the base, somewhat compressed, 12 to 16 mm. long and 8 to 9 mm. broad. (PLATE 34. FIGURES 64, 65.)

Type in the herbarium of the Royal Botanical Museum, Berlin (without fruit) collected near Barahona, south coast of Santo Domingo, near the Haitian frontier, in April, 1911, by Rev. Miguel Fuertes (no. 258).

DISTRIBUTION: Santo Domingo.

SPECIMENS EXAMINED:

SANTO DOMINGO: Duplicate of type; same locality and collector, fruits, September, 1912 (both U. S. Nat. Herb.).

LOCAL NAME: Guanabanita (Barahona, Santo Domingo).

The closest ally of *Annona bicolor* is *Annona globiflora* Schlecht. of eastern Mexico. From this species it differs in its thicker, broader, coriaceous leaves, its smoother black-seeded fruits, and its pointed flower buds. A specimen of the type collection in the United States National Herbarium bearing the label "*Annona axilliflora* Spr.?" was recognized as a new species by the writer, who communicated the fact to Professor Urban, asking that Father Fuertes be requested to secure fruit from the type specimen, in order that the description of the species might be completed. Professor Urban replied that he had already "published the new *Annona* of Santo Domingo as *A. bicolor* in *Symb. Antill.* VII. (June, 1912), p. 223.—Fuertes no. 258," and added that he had not seen fruits. Fruits of the type plant were afterwards received by the writer directly from Padre Fuertes, who described them as of a green color on the exterior when fresh and cream color in the interior. "The fruit," he added, "smells like some of the other Anonaceae and keeps the characteristic odor of the family. The leaves and wood are fragrant, and I do not doubt but that they would yield a good [aromatic] extract."

The species was previously collected in 1819 to 1820 by Carlos Bertero on the island of Hispaniola, and was referred by Sprengel to *Annona axilliflora* DC., but the latter is a Guiana plant with much longer peduncles, as Professor Urban has already pointed out. From figure 64, showing a flower bud with one petal removed, and figure 65, showing a stamen and carpel, it will be seen at a glance that the present species is closely allied to the Mexican *A. globiflora* Schlecht., the type of the section *Annonella*. The recent discovery by Dr. J. N. Rose of another species of this section on the island of Santo Domingo, not very far from the type locality of *A. bicolor* is interesting.

EXPLANATION OF PLATE 34.—Photograph of duplicate of type in U. S. National Herbarium, together with fruit and seeds. Natural size.

Annona rosei Safford, sp. nov.

Section *Annonella*. A shrub or small tree, 2 to 6 meters high, with straight erect stems, slender ascending branches, and willow-like foliage; young branches subappressed ferruginous pilose, at length becoming reddish brown or grayish, plicate-striate, bearing many conspicuous whitish lenticels; leaves oblong-lanceolate, the margins revolute, obtuse or rounded at the base and gradually tapering to a very acute apex; those at the base of branchlets frequently rounded or retuse at the apex and shorter than the succeeding ones; nor-

mal leaves 5 to 9 cm. long by 1.6 to 2 cm. broad with 12 to 18 lateral nerves on each side forming an acute angle with the midrib and curving gently upward, membranaceous, the parenchyma reticulate, punctulate, deep green and glabrous above with the midrib impressed, dull green and sparsely pubescent beneath, with the prominent midrib and lateral nerves ferruginous-hirtellous; petioles grooved above, 3 to 4 mm. long, clothed like the new branchlets with sub-appressed ferruginous hairs; peduncles solitary, extra-axillary, short and slender, nodding or recurved, about 4 mm. long, minutely appressed ferruginous hirtellous, with a small ovate bracteole below the middle and a second at the base, these like the calyx appressed ferruginous hirtellous; flower buds broadly ovate-conoid, rounded at the apex, 9 to 10 mm. in diameter, and 9 mm. high; calyx small, ferruginous-hirtellous, with 3 broadly ovate lobes, at first appressed, at length recurved at the apex; outer petals very thick, valvate, triquetrous, hollowed at the base to receive the essential parts, finely ferruginous-pubescent on the outside, 9 mm. long and 7.5 mm. broad; inner petals normally scalelike, not exceeding the stamens in length; not infrequently one of them abnormally enlarged, thrusting itself between two of the outer petals and ferruginous-pubescent on the outside like them; torus convex, clothed with whitish hairs between the bases of the filaments; stamens numerous, 2 mm. long, in 3 or 4 series, with the fleshy incurved connective terminating in an obtuse apex less than the two pollen sacs in width, not expanded into a hoodlike covering above the pollen sacs; carpels distinct, about equal to the stamens in length, crowded into a conical gynoecium, the ovary with appressed whitish or pale rufous hairs on each side and at the base, the median portion more or less glabrous and minutely granular as seen under the microscope in fresh specimens); styles tapering to a fleshy point, with a median groove on the ventral side; fruit not observed. (PLATES 35-37. FIGURE 66.)

Type in the United States National Herbarium, no. 703452, collected at Azua, southern coast of Santo Domingo, March 20, 1913, by Dr. J. N. Rose (no. 4038). Growing in dry, rocky situations, associated with Cactaceae and other xerophilous plants.

DISTRIBUTION: Known only from the type locality.

According to Doctor Rose's field notes, *Annona rosei* is a bush or small tree from 6 to 20 feet in height. It was found mostly on the banks of a stream and adjacent low hills, in association with Agaves, Opuntias, and Acacias, the exact type locality being about 3 miles above the town of Azua along the little stream which is the source of its water supply. Azua is located in a great cactus desert on the leeward or southern side of the island and is probably one of the driest parts of Santo Domingo, the annual rainfall of the region being about 8 inches. Doctor Rose spent about ten days at Azua, collecting in all directions and looking out especially for Annonaceae, but the present species was seen only on this one occasion; not many individuals were observed, and these were included within the radius of a mile. Fortunately it was in bloom, and Doctor Rose collected fully developed flowers which were preserved in formalin. Though normally having three fleshy thick outer petals and three small scalelike inner ones, both the dry herbarium material and the flowers in formalin

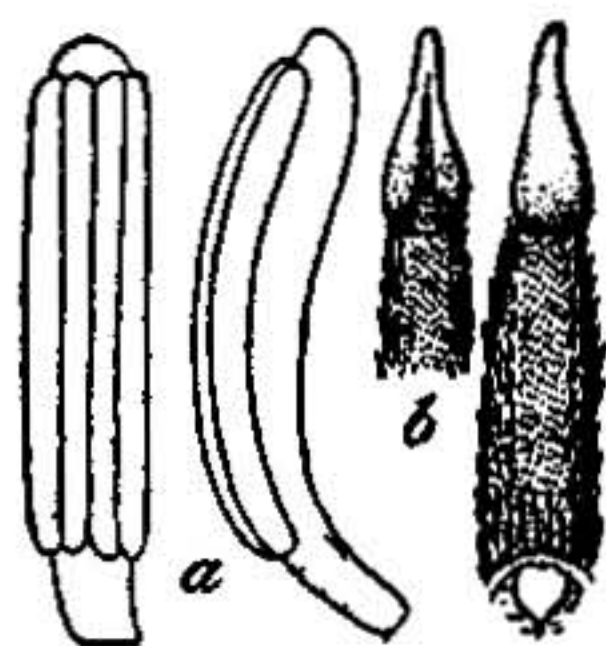


FIG. 66.—Essential parts of flower of *Annona rosei*. a, Stamens; b, carpels. Scale 13.

include specimens in which one of the inner petals is abnormally enlarged and is wedged between two of the outer petals, as shown in plate 36.

EXPLANATION OF PLATES 35-37.—Pl. 35, photograph of type plant taken in the field by P. G. Russell, of the U. S. National Herbarium. Pl. 36, flowers. *a*, Unopened bud; *b*, nearly mature normal bud with one petal removed, showing details; *c*, bud, showing abnormally enlarged inner petal forcing itself between two outer petals; *a*, *b*, *c*, scale 5. Pl. 37, branches, leaves, and solitary flowers. Natural size.

PLANTS ORIGINALLY DESCRIBED UNDER ANNONA BUT GENER- ICALLY DISTINCT.

ROLLINIA, DUGUETIA, AND RAIMONDIA, GENERA ALREADY ESTABLISHED.

Among the plants originally described under the generic name *Annona* several were found to differ so radically from the type of that genus that it became necessary to place them in distinct genera. Among the related genera are *Rollinia* and *Duguetia*, established in 1825 by Augustin de St. Hilaire, and *Raimondia*, recently established by the present author.

ROLLINIA St. Hil.

Rollinia was named in honor of the French historian Charles Rollin. Its type is *Rollinia longifolia* St. Hil.,¹ discovered by St. Hilaire on the Lagoa de Fretas, near Rio de Janeiro (pl. 38). The plants included in this genus do not differ from those of *Annona* in their essential parts nor in their fruits, but they have a peculiar gamopetalous corolla, the parts of which corresponding to the outer petals of the *Annonas* are developed into three obtuse wings or spurs, which leave only a very small opening above the essential parts. This genus includes the following species, originally referred to *Annona*.

Rollinia mucosa (Jacq.) Baill.

Annona mucosa Jacq. Obs. Bot. 16. 1764. excl. syn. Rumph.

Annona obtusiflora De Tussac, Fl. Antill. 1: 191. pl. 28. 1808.

Rollinia sieberi A. DC. Mém. Soc. Phys. Hist. Nat. Genève 5: 199. 1832.

Rollinia mucosa Baill. Adansonia 8: 268. 1868.

A small tree with the habit of *Annona reticulata* L.; young branches puberulous, at length glabrate, dark brown, longitudinally plicate with inconspicuous lighter brown lenticels; leaves ovate-oblong, acute or acuminate at the apex or sometimes obtuse, rounded or acute at the base, usually 12.5 to 15 cm. long and 5 to 6.5 cm. broad, at first sparsely pubescent above and fulvous sericeous pilose beneath, at length glabrate above except along the impressed midrib and lateral nerves (about 14 on each side), these pilose above and more densely so beneath with appressed rufous hairs; petioles 5 to 10 mm. long, grooved above, clothed with rufous hairs when young, at length glabrate or nearly so; smaller and relatively broader obtuse ovate leaves near the base of the flowering branches; peduncles solitary, extra-axillary, usually opposite a leaf, 1-flowered, 2 to 3 cm. long, clothed with minute appressed rufous hairs

¹ Fl. Bras. Merid. 1: 29. pl. 5. 1825.

and bearing 2 ovate bracteoles, one at the base, the other near the middle; calyx 3-lobed, the divisions subtriangular or broadly ovate, acute or acuminate, clothed with minute fulvous hairs; corolla gamopetalous, composed of 3 large lobes corresponding to the outer petals of an *Annona* flower and 3 minute lobes alternating with them, corresponding to the inner petals and opposite the calyx lobes; outer lobes widely diverging but not curved backward, about 15 mm. long, hollow and sacklike and closed nearly to the base, leaving only a narrow opening above the essential parts, the edges slightly overlapping the margins of the minute inner lobes; outer surface of the corolla densely fulvous-tomentulose; torus convex, covered with long fulvous hairs; stamens numerous, crowded, 1.1 mm. long, resembling those of an *Annona*, with the connective expanded at the apex into a flat process covering the two parallel pollen sacs, the latter dehiscing extrorsely by a median fissure; carpels numerous, about 1 mm. long, distinct but closely crowded into a convex gynœcium, the 1-ovuled ovaries covered with straight ascending hairs and terminating in an abruptly expanded flat style; fruit (syncarpium) resembling that of an *Annona*, subglobose, large, areolate, the areoles gibbous or wartlike, but not muricate nor papillose, more or less hexagonal in shape with the dividing lines raised; pulp fleshy, white or whitish, mucilaginous, sweet, edible; seeds obovoid, 18 to 20 mm. long by 12 to 14 mm. broad, somewhat compressed and with a caruncle at the base; testa thin, brown; endosperm wrinkled like that of other Annonaceae. (PLATE 39. FIGURE 67.)

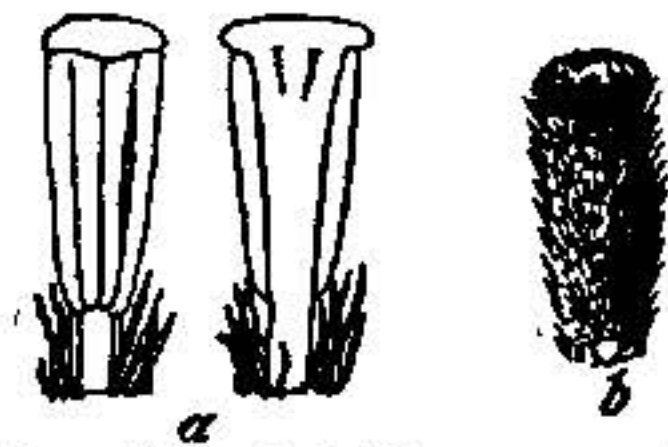


FIG. 67.—(a) Stamens and (b) carpel of *Rollinia mucosa*. Scale 13.

TYPE LOCALITY: Martinique.

DISTRIBUTION: Growing spontaneously and rarely cultivated in the West Indies, Tropical Mexico, and very probably northern South America.

SPECIMENS EXAMINED:

MARTINIQUE: Hauteurs du Prêcheur et du Fond Canonville, 1881, *Père Duss* 1045 (U. S. Nat. Herb.).

GUADELOUPE: Camp Jacob, "petit arbre, rare, cultivaté çà et là pour ses fruits, fl. en février, mars, et avril," *Père Duss* 3059 (U. S. Nat. Herb., with flower and fruit).

ISLAND OF TRINIDAD: Without definite locality, Herb. Bot. Gardens Trinidad, no. 2774 (two sheets in Herb. John Donnell Smith).

PORTO RICO: Prope Adjuntas, in sylva montis Galsa, *Sintenis* 4170.

LOCAL NAMES: Cachiman morveux, Cachiman montague (French Antilles); Anona babosa, Zambo (tropical Mexico).

Rollinia mucosa is a species with large edible fruit, but this not equal in flavor to that of the chirimoya or sugar apple. It was first described by Jacquin from specimens of plants growing wild and sometimes cultivated on the Island of Martinique; and afterwards, under the name of *Anona obtusiflora*, by Tussac from a specimen growing in an orchard at the western extremity of the Island of Hayti. It is possible that more than one species is included by authors under this specific name and that wild plants with smaller flowers and inedible fruit have been erroneously referred to the species. The accompanying figure shows that the lobes of the corolla are widely diverging but with an upward curve. Other closely related species in Central America, with geminate instead of solitary flowers, decurved corolla lobes, and small fruit with seeds very much smaller than those of *A. mucosa* have been referred to the latter

EXPLANATION OF PLATES 38, 39.—Pl. 38, type specimen. Reproduced from St. Hilaire. Pl. 39, flower, fruit, and seed. Drawing by Theodore Bolton from *Père Duss* 3059, as cited. Natural size.

species or to its synonym *R. sieberi* A. DC. It is fortunate that the type localities of the plants described under the names *Anona mucosa*, *A. obtusiflora*, and *Rollinia sieberi*, all of them West Indian, are definitely known, so that specimens from the same localities can be carefully compared. It must be borne in mind that the fruits of *Rollinia* are even more important than the flowers and leaves in the identification of species, as in the case of *Anona reticulata* and *A. squamosa*, species which can be distinguished from each other only with difficulty without specimens of the fruit.

Very closely related to *Rollinia mucosa* are *R. orthopetala* A. DC., from British Guiana, and *R. pulchrinervia* A. DC., from French Guiana. Delicious fruits grown at Miami, Florida, from seed received from Pará, Brazil, have been transmitted to Mr. David Fairchild, of the Bureau of Plant Industry, at Washington, under the name *R. orthopetala*. But the flowers of *R. orthopetala* (which have never been figured) are described as having their corolla lobes erect and incurved, while those of the Miami plants have their lobes widely diverging and decurved toward the peduncle, agreeing in this respect with the

description of the flowers of *R. pulchrinervia*, which is said in the original description to be very closely allied to *R. orthopetala*, as both of them are also said to be to *R. sieberi* of Trinidad.

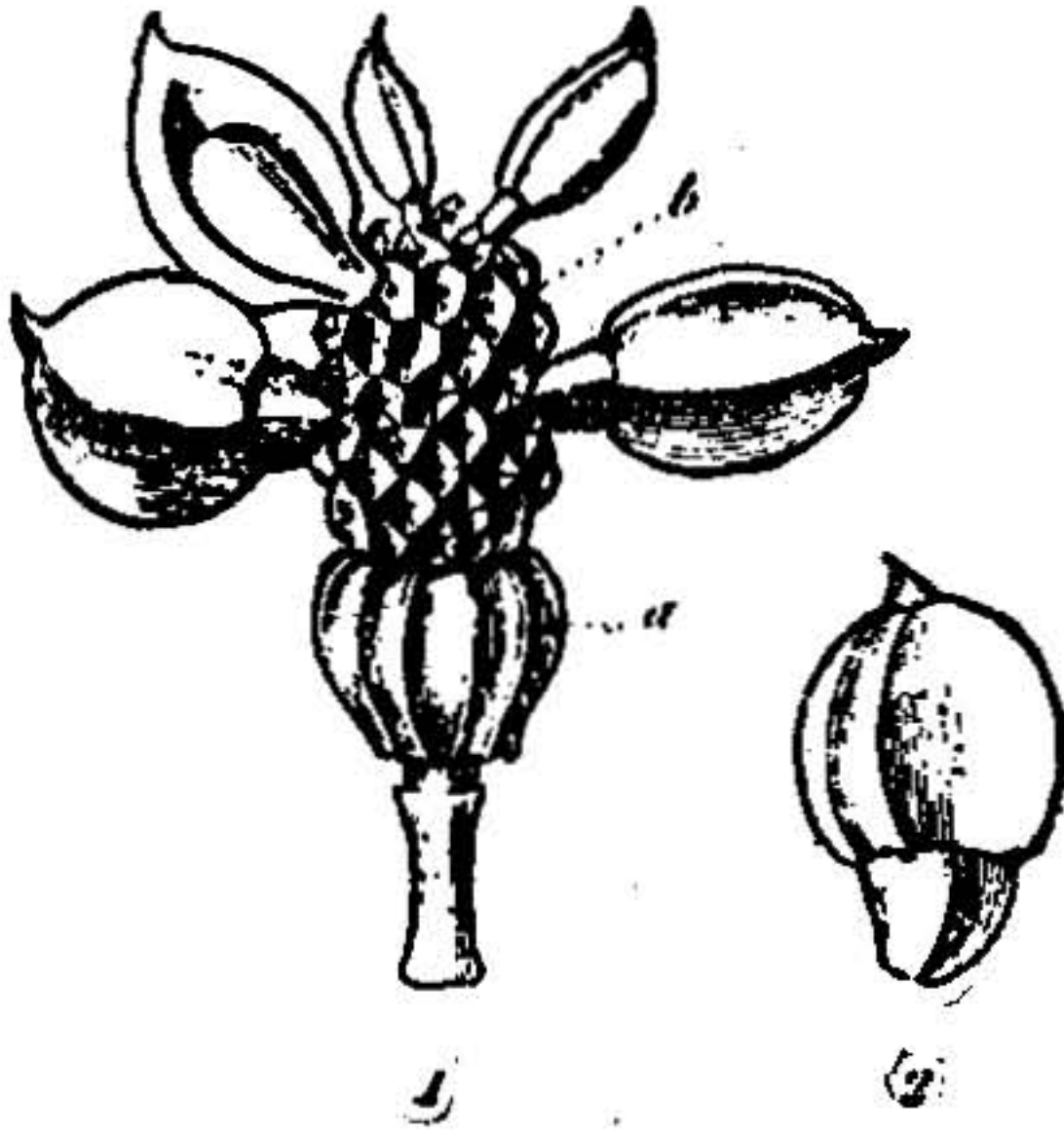


FIG. 68.—Fruit of *Duguetia lanceolata*. 1, Mature fruit with most of carpels detached; a, base of torus from which stamens have fallen; b, upper segment of torus, showing alveolate surface; 2, detached carpel. Reproduced from St. Hilaire.

syncarpium by the fusion of the carpels. In the type specimen of the genus the flowers were lacking, but these were afterwards found to differ from the flowers of *Annona* in having the petals imbricate instead of valvate in aestivation. Further, the indument of the lower surface of the leaves, petioles, and peduncles in this genus is scurfy and stellate-pilose, while in *Annona* the hairs are simple or sometimes fascicled in clusters of 2 to 6. It proved afterwards that *Anona furfuracea* St. Hil. (figs. 69, 70), described and figured in the same work in which it was published, had to be included in the genus *Duguetia*. Many species have since been added to this genus, all of which appear to have the new parts clothed with stellate pubescence or tomentum.

Duguetia was regarded by Baillon as a synonym of Aublet's *Aberemoa*, and Robert E. Fries transferred all the species of *Duguetia* known to him to this

DUGUETIA St. Hil.

Duguetia was dedicated to the venerable Abbé Jacob Joseph Duguet, who, in his stupendous "Ouvrage des Six Jours (1731), wrote elegantly concerning the wonders of the vegetable kingdom." The type of this genus is *Duguetia lanceolata* St. Hil.,¹ a plant growing in meadows at a place called Sumidouro, not far from the Villa do Principe. The fruit in this genus (fig. 68) differs from that of the genus *Annona* in being composed of distinctly woody carpels set in sockets or cavities on the hardened torus or gynophore, instead of forming a solid

¹ Fl. Bras. Merid. 1: 35. pl. 7. 1825.

genus;¹ but Aublet's figure of *Aberemoa guianensis* (fig. 71), on which the genus was based, represents the carpels as pediceled and ovate, very much like those of certain species of *Guatteria*, while the leaf, as figured by Aublet, does not appear to be that of a true *Duguetia*. The type locality of *Aberemoa guianensis* ("Habitat in sylvis remotis sinemariensibus") is not indicated with precision. Flowers were lacking in the type material and there is no specimen identified with certainty as *Aberemoa guianensis* in any herbarium, nor has its flower ever been described. An imperfect specimen in the herbarium of the Museum of Paris of a plant collected by Perrotet and Poiteau was regarded as a variety *glabrescens* of Aublet's species by Sagot, who calls attention to the fact that Aublet's type, with tomentose branchlets and slightly tomentose leaves, is absent from the herbaria of Paris, and characterizes it as "rara et pulcherrima planta nondum bene nota, insignis foliis maximis, fructu carnoso, carpidiis incomplete coalitis; videtur Anonae affinis."² It is thus doubtful if Aublet's *Aberemoa* and St. Hilaire's *Duguetia* are congeneric, and



FIG. 69.—Flower of *Duguetia furfuracea*.
Reproduced from St. Hilaire.

the latter generic name should, therefore, be retained.

RAIMONDIA Safford.³

Raimondia was named in honor of the eminent geographer and naturalist Antonio Raimondi. Its type species is *Raimondia monica* Safford⁴ from the Cordillera Central of Colombia. The fruit in this genus is a solid fleshy syncarpium very much as in *Annona*, but the flowers are monoecious and the stamens differ radically from those of both *Annona* and *Rollinia* in being devoid of the characteristic terminal swollen heads above the pollen sacs at the tips of the connectives.

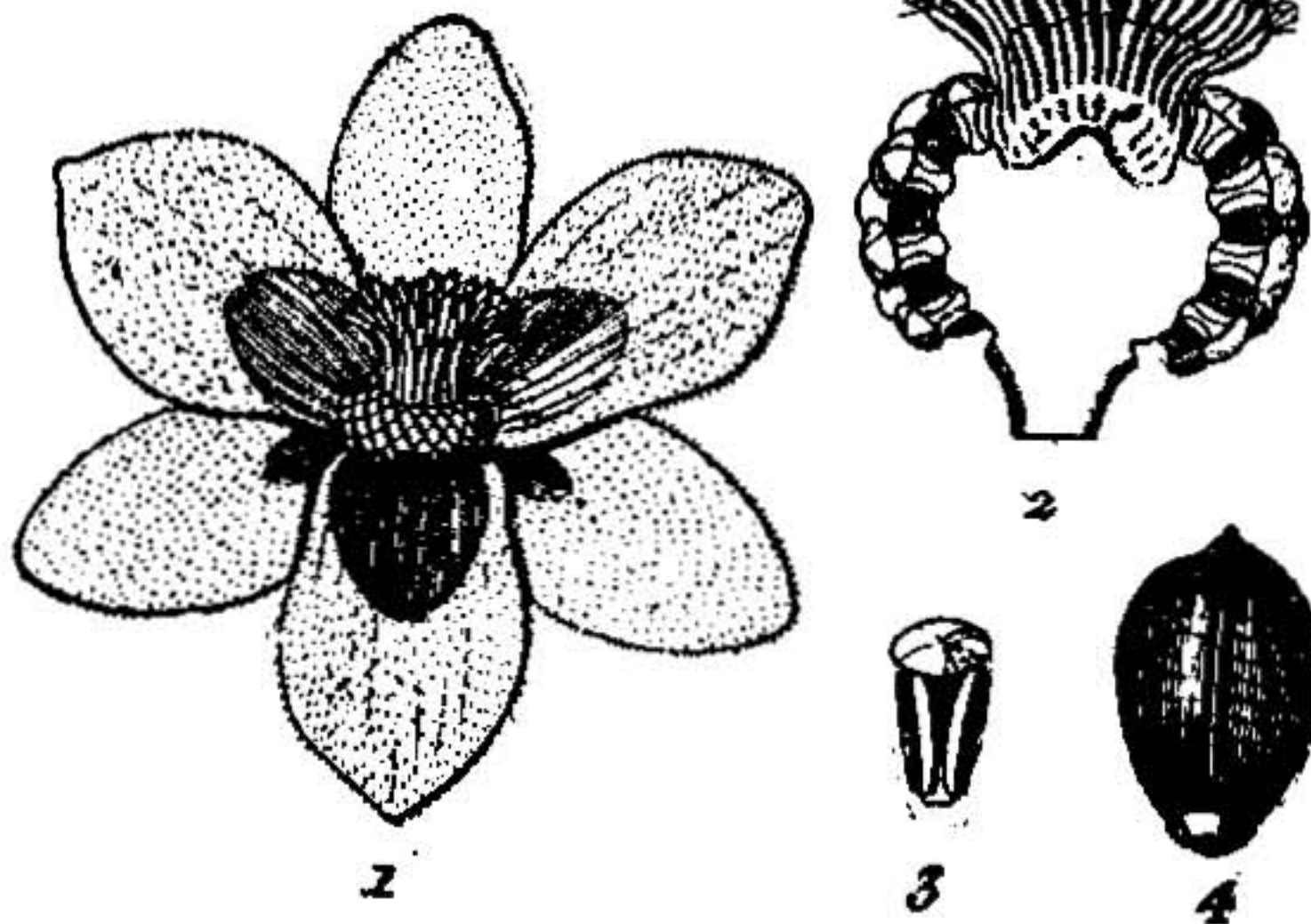


FIG. 70.—Flower of *Duguetia furfuracea*, with essential parts. 1, Open flower; 2, vertical section through the andrœcium or gynœcium; 3, stamen, dorsal view; 4, ripe seed. Reproduced from St. Hilaire.

To this genus must now be transferred the following species:

¹ Vet. Akad. Handl. Stockholm 34⁵:19. 1900.

² Ann. Sci. Nat. Bot. VI. 2:136. 1880.

³ Contr. U. S. Nat. Herb. 16:217. pl. 52, 53. 1913.

⁴ Loc. cit., 218.

Raimondia quinduensis (H. B. K.) Safford.

Anona quinduensis H. B. K. Nov. Gen. & Sp. 5: 60. 1821.

Annona conica Ruiz & Pav.; Don, Hist. Dichl. Pl. 1: 88. 1831.¹

A tree with alternate pendulous branches; branchlets terete, rugulose, glabrous, the younger ones pubescent with simple hairs; leaves alternate, lanceolate-oblong, acuminate at both ends, entire, reticulate-veined, the midrib and lateral nerves (8 to 11 on each side) prominent beneath, thin and membranaceous, at length subcoriaceous, above glabrous and smooth, beneath clothed with scattered

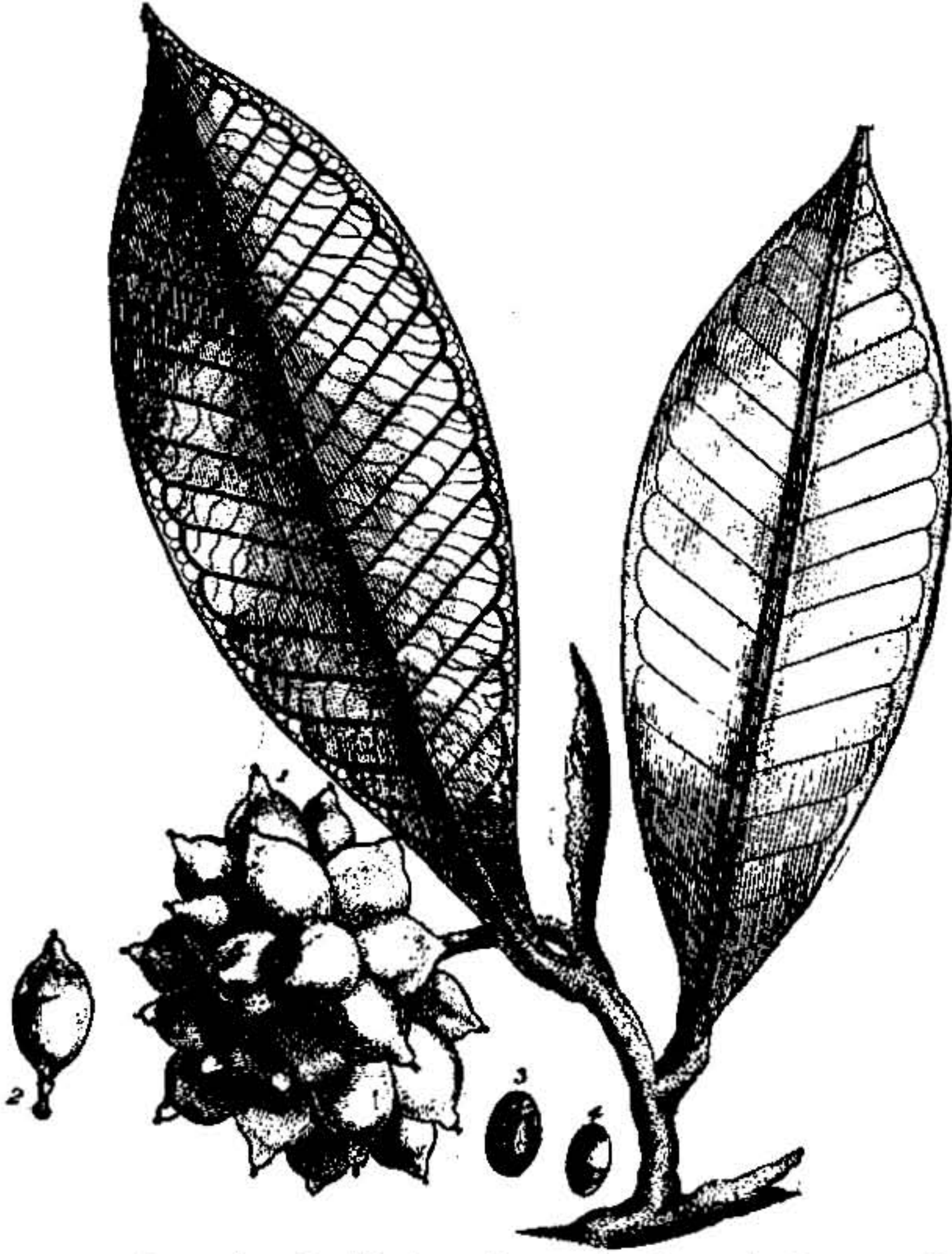


FIG. 71.—*Aberemoa guianensis*. 1, Cluster of carpels; 2, a single pedicellate carpel; 3, seed; 4, endosperm. Scale, $\frac{1}{2}$. Reproduced from Aublet.

minute appressed and longitudinally adnate simple hairs or quite glabrous, pellucid-punctulate, 10 to 22 cm. long by 2 to 6.6 cm. broad, the younger ones more or less pubescent with ferruginous appressed hairs, especially on the nerves and midrib; petioles 6 to 10 mm. long, grooved above, puberulous; inflorescence extra-axillary or subterminal, composed of 1 to 5 long-pedicelled unisexual flowers borne on peculiar specialized flowering branchlets, solitary or in 2's or 3's, invested with small imbricating amplexicaul scabrous distichous bracteoles clothed with ferruginous hairs; pedicels 1-flowered, filiform, 8 to 12

¹ Don cites "Ruiz & Pavon, Fl. Peruv. [Chil.] 5: pl. 490," a volume hitherto unpublished.

mm. long, ferrugineous-hirtellous, with a bracteole a little below the middle and another at the base; bracteoles small, ovate-lanceolate, ferrugineous-hirtellous; flowers (staminate only observed) 6-petaled, the 3 exterior petals ovate-lanceolate to linear, ferrugineous-sericeous on the outside, 8 to 22 mm. long; inner petals much smaller, ovate, acute, 3 to 4 mm. long, connivent over the androecium, at length with their margins revolute; torus conoid; androecium composed of many closely crowded stamens 0.6 to 0.7 mm. long, the filament about equal in length to the pollen sacs, minutely appressed-puberulent, the connective not expanded above the pollen sacs nor swollen at the apex but terminating in a few minute hairs; pistillate flowers not observed; fruit bacciform, of the size of an apricot, with its surface scarcely reticulate; seeds about 20 to 25, ovoid-trigonal, olivaceous-brown, 8 mm. long. (PLATE 40. FIGURE 72.)

Type collected by Humboldt and Bonpland. "Crescit in Andibus Quinduen-sibus, alt. 1,200 hex.," Province of New Grenada (Colombia).

DISTRIBUTION: Known only from the type locality and from Copo, in the Andes of Bogota, altitude 1,000-2,000 meters.

SPECIMENS EXAMINED:

COLOMBIA: Copo, Andes of Bogota, Triana (Herb. De Candolle).

ECUADOR: "In Huayaquil, 1800," Ruiz (Berlin Herb., type of *Annona conica* Ruiz & Pav.).

LOCAL NAMES: Anon cimarron (Tocaimo and Copo, Colombia).

The close affinity of this plant with *Raimondia monoica* Safford is apparent on comparing the two species; yet the two differ widely in the indument and shape of the leaves and in the size and form of the flowers and fruit. Both species occur in the Andes of Colombia, and in both the flowers are unisexual. The identity of *Annona conica* Ruiz & Pav. with *Raimondia quinduensis* was proved conclusively by a careful study of type material of that species from the Berlin Herbarium, collected at Guayaquil by Ruiz in 1800. Allied to the present species, also, is the plant described by Martius as *Annona tenuiflora*.¹ It has similarly a few fine hairs at the apex of the connective, and its peculiar stamens show that it can not possibly be included in the genus *Annona*. It differs, however, from the genus *Raimondia* as defined by the author in the form of its flowers, in which the inner and outer petals are subequal. The fruit of this species is desired.

EXPLANATION OF PLATE 40.—Photograph of specimen in the De Candolle herbarium as cited. Natural size.

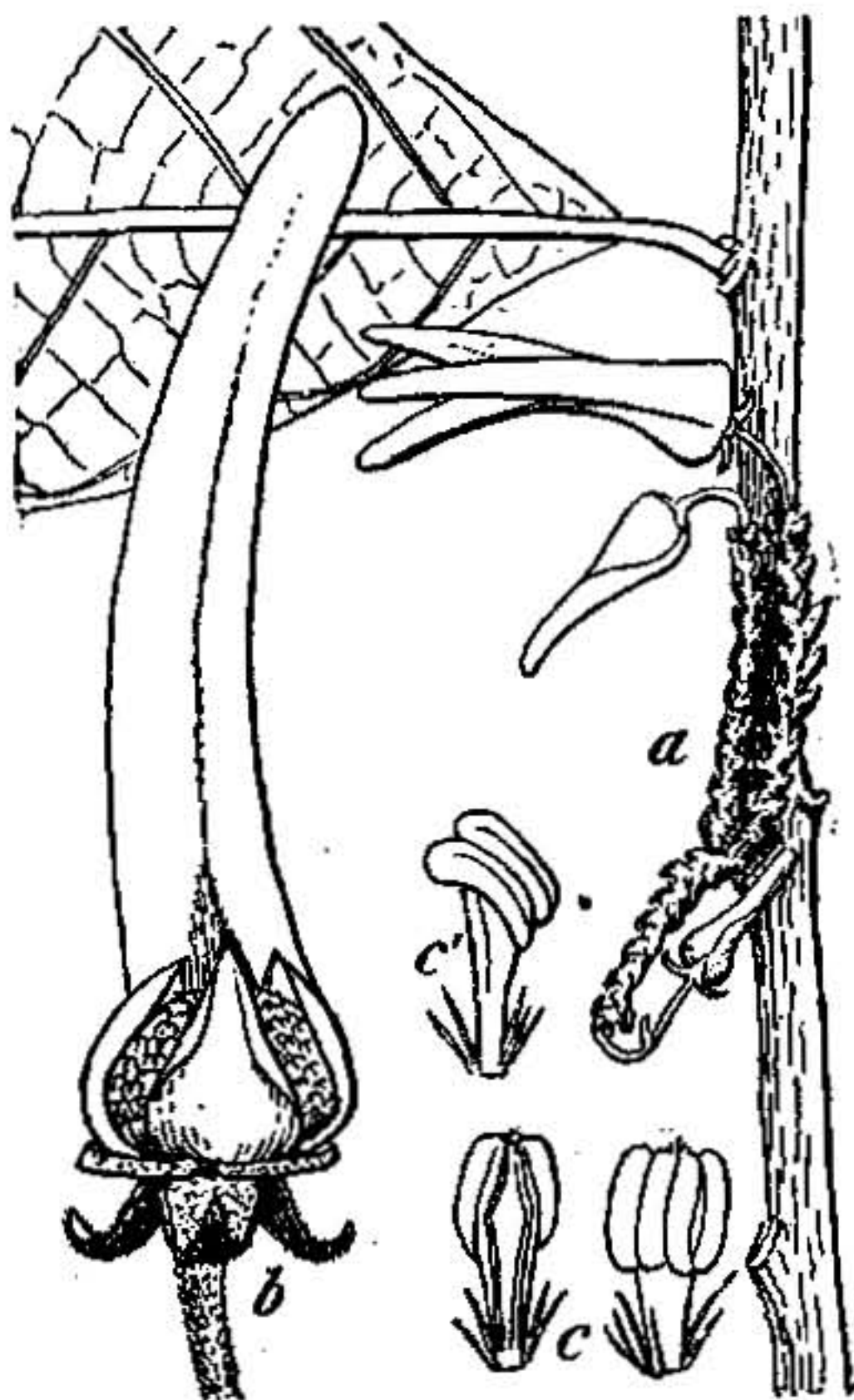


FIG. 72.—*Raimondia quinduensis*. a, Inflorescence; b, staminate flower, showing inner petals; c, stamens; c', stamen, lateral view. a, Natural size; b, scale 3; c, c', scale 20.

¹ Fl. Bras. 13¹: 10. pl. 3. 18.

FUSAEA AND GEANTHEMUM, NEW GENERA.

One noteworthy plant which has been placed under *Duguetia* must undoubtedly be removed from that genus. It was originally described (1775) by Aublet under the name *Annona longifolia*; but Baillon, notwithstanding the fact that the carpels become solidified into a fleshy syncarpium instead of remaining discrete, as in *Duguetia*, that the hairs of the indument clothing its new growth are simple instead of stellate, and that the stamens are radically different from those of the latter genus, placed this plant in the genus *Duguetia*, under the name *D. longifolia*,¹ setting it apart, however, from the rest of the genus under the sectional name *Fusaea*. That it is not congeneric with the plants of the genus *Duguetia* is so evident that the present writer does not hesitate to raise Baillon's section to the dignity of a genus, which must also include *Annona rhombipetala* Ruiz & Pav.

Another plant which must receive generic distinction is *Annona rhizantha* Eichl.² This species, though resembling *Duguetia* in its stellate-hairy and scurfy indument and in the discrete carpels of its fruit, differs radically from it as well as from *Annona* in its peculiar stamens, which closely resemble those of the genus *Raimondia*, in being devoid of an expanded head or swelling at the tip of the connective above the pollen sacs. From *Raimondia* it is separated by the character of its fruit as well as by its indument and the much greater development of the inner petals of its corolla. This plant was placed in the genus *Aberemoa* (*Duguetia*) by Robert E. Fries, who set it apart from the rest of the genus under the sectional name *Geanthemum*. From the peculiarities above noted, however, it is evident that it cannot be included in the genus and the present writer feels compelled to raise Fries's section to generic dignity.

FUSAEA (Baill.) Safford, gen. nov.

Duguetia, section *Fusaea* Baill. *Adansonia* 8: 326. 1868.

Stem subsarmentose, branching, the younger parts, including petioles and peduncles, clothed with simple hairs; flowers perfect; calyx relatively large, 3-parted, the lobes sometimes separate nearly to the base, sometimes united for a great part of their length and irregularly torn in anthesis (Sagot); leaves alternate, entire; flowers (fig. 73) perfect; petals large, sericeous-pilose, all imbricate, ovate-spatulate, the inner ones somewhat larger than the outer; outer row of stamens sterile, converted into small obovate imbricated petaloid appendages surrounding the andrœcium; inner stamens fertile, with the connectives dilated at the apex over the pollen sacs; fruit (syncarpium) globose,

¹ *Adansonia* 8: 327. 1868.

² *Jahrb. Bot. Gart. Mus. Berlin* 2: 320. pl. 11. 1883.

smooth, areolate, composed of many carpels fused together in a solid mass; seeds small, surrounded by edible pulp.

Type species, *Fusaea longifolia* (Aubl.) Safford.

The distinctive characters of the type of this genus were first noted by Baillon, who pointed out that its fruit (fig. 74), instead of being composed (as in *Duguetia* of distinct woody carpels, inserted in cavities in the hardened torus, is a solid mass, "une véritable boule de bois, sans aspérités de la surface rappelant la présence de ses nombreux carpelles;" and that the outer stamens are modified into "lamelles pétaloïdes, imbriquées, longuement obovées;"¹ and Robert E. Fries, who followed Baillon in regarding *Fusaea* as the section of a genus (*Aberemoa*), says that "this section departs in so many respects from the remaining ones, that it should perhaps be regarded as a special genus," and that in its fruit it bears a great resemblance to the genus *Annona*. The synonymy, which the elevation of this section to generic rank entails, and a brief description are as follows:

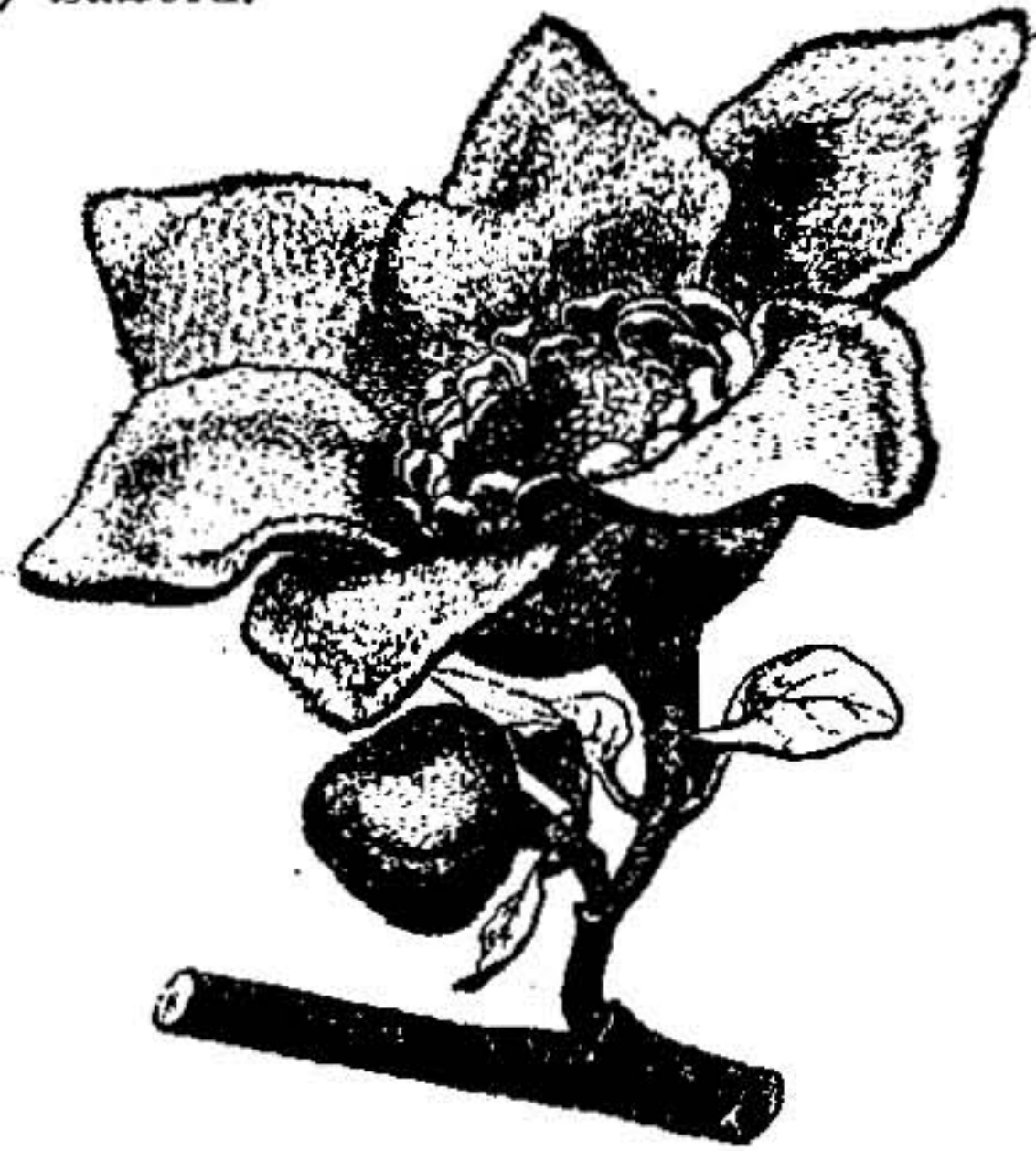


FIG. 73.—Flower of *Fusaea longifolia*. Showing petaloid outer stamens. Reproduced from Baillon.

Fusaea longifolia (Aubl.) Safford.

Annona longifolia Aubl. Pl. Gulan. 1: 615. pl. 248. 1775.

Duguetia longifolia Baill. Adansonia 8: 327. 1868.

Aberemoa longifolia Baill. Hist. Pl. 1: 205. f. 233-235. 1868.

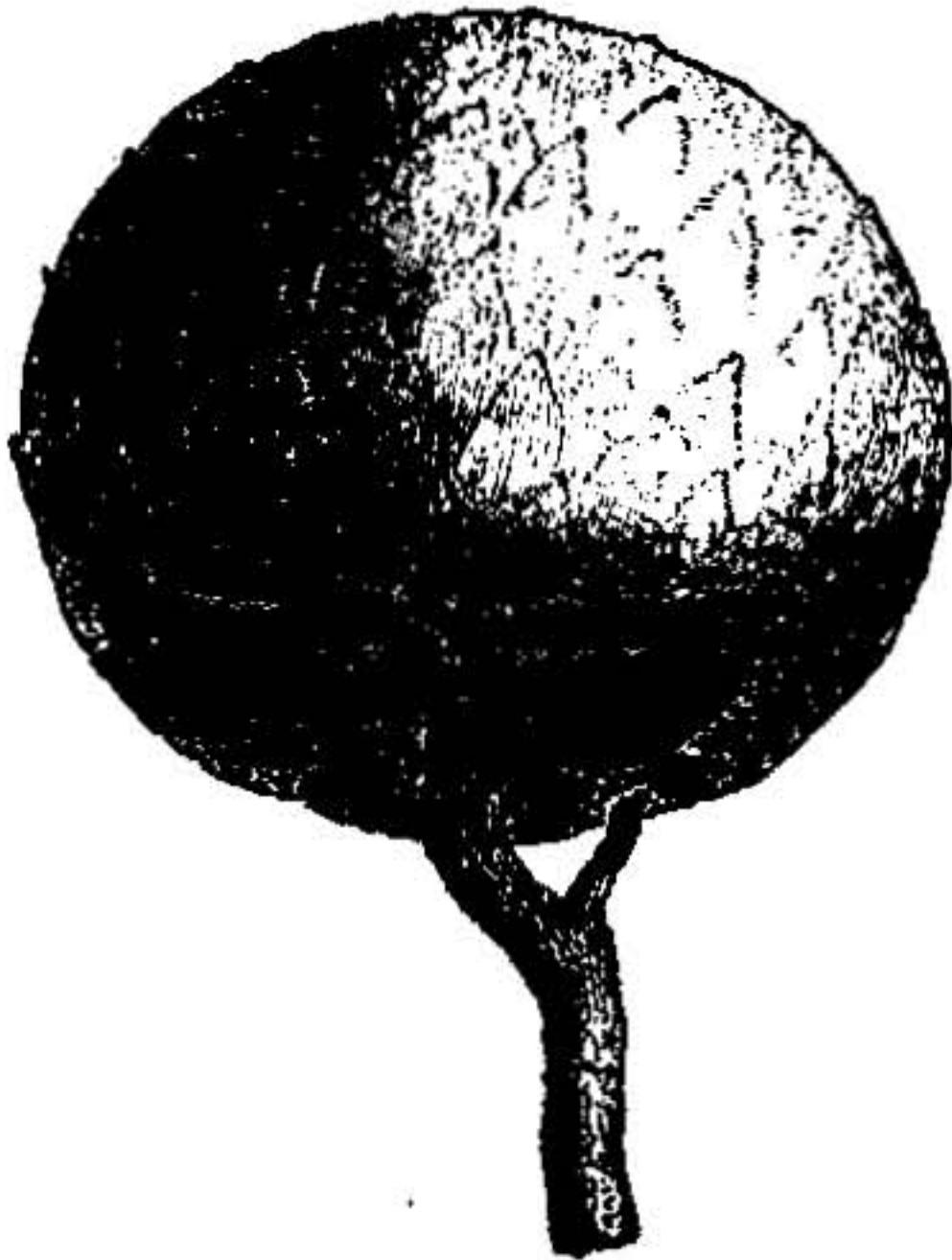


FIG. 74.—Concrete fruit of *Fusaea longifolia*. Reproduced from Baillon.

A tree or shrub; leaves very short-petioled, oblong-lanceolate (25 cm. long and 8 cm. broad), obtuse or shortly tapering at the base, long-acuminate at the apex, above smooth, with midrib and nerves impressed, below the latter very prominent, sparsely hairy; flowers extra-axillary, long-peduncled, solitary or in pairs; peduncles bearing one or two bracteoles; calyx gamosepalous, deeply 3-lobed, the lobes ovate-acute, ferruginous-hirtellous on the outside; corolla broad, widely spreading; petals 6, in 2 rows, purplish, imbricate, sericeous-pilose, ovate-spathulate or oblong with the apices obtusely cuneate, the inner somewhat longer and narrower than the outer; stamens numerous, the outer sterile, petaloid, imbricated, the inner perfect, with the tips of the connectives expanded above the pollen sacs as in the typical *Annonas*; fruit about the size of an orange, globose, smooth, areolate

but without protuberances; seeds small surrounded by a red edible pleasantly flavored pulp. (FIGURES 73, 74.)

¹ Baill. op. cit. page 326.

Type collected by Aublet on the banks of the Crique des Galbis, French Guiana, in the month of May.

DISTRIBUTION: Rather frequent in the forests of French Guiana, but difficult to collect (Sagot).

"This tree," says Aublet, "is called Pinaïoua by the Garipons and the Gallbis [Caribs]. They eat the fruit with delight, and it is of very good flavor."

GEANTHEMUM Safford, gen. nov.

Aberemoa, section *Geanthemum* R. E. Fries, Vet. Akad. Handl. Stockholm 34^b: 24. 1900.

Arborescent, the younger parts clothed with stellate-lepidote indument; inflorescence for the most part issuing from slender subterranean branches;



FIG. 75.—*Uvaria sessilis*. Inflorescence, stamens, and fruit. After Velloso. Scale $\frac{1}{2}$.

flowers hermaphrodite, 1 to several borne on a common peduncle or lateral branchlet bearing many small scalelike bracts; calyx 3-parted, stellate-lepidote on the outside; corolla 6-petaled in 2 series, the outer petals open in estivation, the inner ones imbricate; stamens all fertile, their connectives not swollen, produced, nor dilated above the two short sessile pollen sacs; pistils (carpels) free in the flower, the ovary with a single basal ovule, as in *Annona*, the style terminating in an incurved, acuminate or linear, glabrous stigma; fruit composed of closely crowded but distinct carpels, easily separable, as in the genus *Duguetia*; seeds resembling those of *Annona*. (PLATE 41.)

Type species, *Geanthemum rhizanthum* (Eichl.) Safford.

This genus resembles *Raimondia* in the form of its stamens, but differs from it in having bisexual flowers, fruit with easily separable carpels, and a stellate-lepidote indument. In the two latter features

it resembles *Duguetia*, but it differs radically from that genus and from *Annona* in its peculiar stamens. In this genus are included the following two species:

Geanthemum rhizanthum (Eichl.) Safford.

Anona rhizantha Eichl. Jahrb. Bot. Gart. Mus. Berlin 2: 320. pl. 11. 1883.

Aberemoa rhizantha R. E. Fries, Vet. Akad. Handl. Stockholm 34^b: 24. 1900.

Duguetia rhizantha Huber, Bol. Mus. Paraense 5: 356. 1908.

Type collected near Cascadura, in the mountainous region of Serra da Bica, Province of Rio de Janeiro, Brazil, in January, 1882, by Gustavus Peckolt.

EXPLANATION OF PLATE 41.—Reproduction of drawings of type after Eichler. 1, Trunk with rootlike flowering branches; 2, leaf; 3, diagram of flower; 4, inflorescence; 5, inflorescence branchlet, showing distichous bracteole scars; 6, longitudinal section through

the flower, showing gynæcium, torus with stamens, base of a petal (*p*), and a sepal (*s*); 7, petals from within; *a*, outer petal; *b*, inner petal with excavated base; 8, *a*, stamen dorsal view, showing two pollen sacs; *b*, stamen, ventral view; 9, fruit; 10, same in cross section, showing ruminant albumen of seeds. Fig. 1, much reduced; fig. 2, scale $\frac{1}{2}$; figs. 3, 5, 6, scale 3; figs. 4, 7, 9, 10, natural size; fig. 8, scale about 6.

Geanthemum cadavericum (Huber) Safford.

Duguetia cadaverica Huber, Bol. Mus. Paraense 5: 356. 1908.

Type collected in the moist primeval forests between the rivers Cumaná-mirim and Ariramba, December 18, 1906, by A. Ducke (no. 7995).

Closely allied to these two species and probably congeneric with them is a plant described and figured by Velloso under the name of *Uvaria sessilis*¹ (fig. 75), which Martius erroneously regarded as a synonym of his *Duguetia bracteosa*. If the two species were identical, the specific name of Velloso would take precedence. As seen in Velloso's figure, however, both the leaves and flowers of his plant bear a close resemblance to those of *Geanthemum rhizanthum* and apparently represent a closely allied form. The fruit of *Duguetia bracteosa* has never been figured, but it is described by Martius as equal in size to the nut of *Juglans regia*, globose, with about 30 to 40 pentagonal obovate carpels, mucronate with the persistent style, and of a scarlet to brownish color. The type locality of *D. bracteosa* is the primeval forests of the Province of Bahia, near St. George of the Islands. The flowering branch of a plant in the Museum of St. Petersburg identified as *Duguetia bracteosa*, collected by Riedel at Castel-novo, Province of Bahia (no. 493), and figured by Robert E. Fries,² shows the inflorescence bearing large, persistent, sessile, ovate bracts which are absent from Velloso's figure of *Uvaria sessilis*. Martius was then, in all probability, mistaken in regarding the latter species as identical with the former, the fruit of which is described as being subtended by a persistent involucre.

ADDENDUM.

Annona praetermissa Fawc. & Rendle.

Annona praetermissa Fawc. & Rendle, Journ. Bot. Brit. & For. 52: 74. 1914.

Annona jamaicensis Sprague (in part), Bull. Herb. Boiss. II. 5: 701. 1905.

Annona jamaicensis Safford (in part), Contr. U. S. Nat. Herb. 16: 274. pl. 99. 1913.

Type collected on Craig Hill, near Gordon Town, St. Andrew Parish, Jamaica, June, 1902, by W. Fawcett.

Under the name *Annona jamaicensis* at least two species have been included, growing wild in the mountains of Jamaica. *Annona jamaicensis*, based upon *Annona sericea* Griseb. (not Dunal), was described by Sprague from specimens collected (1) by William Purdie, in 1844, near Bath, at the eastern extremity of the island; (2) by William Thomas March, who lived at Spanish Town (nos. 4, 7, 1571, without definite locality, collected in 1849-50); (3) by Alexander Prior, who collected in the Blue Mountains, in the eastern portion of Jamaica, and in the vicinity of Moneague, near the central part of the island north of the dividing ridge (locality not cited). Of these specimens it is probably Prior's which Grisebach referred to *Annona sericea*, since duplicates of Prior's collections were in Grisebach's Herbarium. This is the plant figured by the writer in volume 16 of the Contributions, plate 98, with subglobose flower bud.

¹ Fl. Flum. 238. 1825. Atlas 5: pl. 125. 1827.

² Arkiv Bot. 5⁴: pl. 1. f. 6, 1905.

A second species, with obpyriform or pyramidal, acuminate flower buds and long, narrow petals, figured by the writer under the name *Annona jamaicensis*, as cited in the above synonymy, has recently been described by Fawcett and Rendle as *Annona praetermissa*. The specimen from which the figure was drawn was received by the writer from its collector, Mr. William Harris, who found it growing on Sheldon Road, St. Andrew, at an altitude of 750 meters, September 10, 1897 (no. 6861). It was distributed under the name of "*A. jamaicensis* Sprague." Its single flower differed greatly from that of *A. jamaicensis* as described by Sprague and as observed on Prior's specimen in the Gray Herbarium. This led the writer to ask for further material, in a letter to Mr. Harris, dated November 29, 1912, in which he made the following notes and queries:

Annona jamaicensis, as described by Sprague (*A. sericea* Griseb. non Dun.), has ovate petals 11 to 12 mm. long and 8 mm. broad, while in the specimen collected by you the flower has quite a different shape, with linear-oblong petals 23 mm. long and 6 mm. broad. The fruit of your specimen and also the seeds are larger than those described by Sprague. * * * The cotype of *A. jamaicensis* in the Gray Herbarium has a single globose flower, like that shown in the accompanying figure. Can it be that specimens seen by Sprague had only immature flowers; or is it possible that there are two similar wild *Annonas* growing in the mountains of Jamaica, one with globose buds and broadly ovate petals, the other with elongate buds like those of *A. reticulata* and linear-oblong, or broadly linear petals? * * *

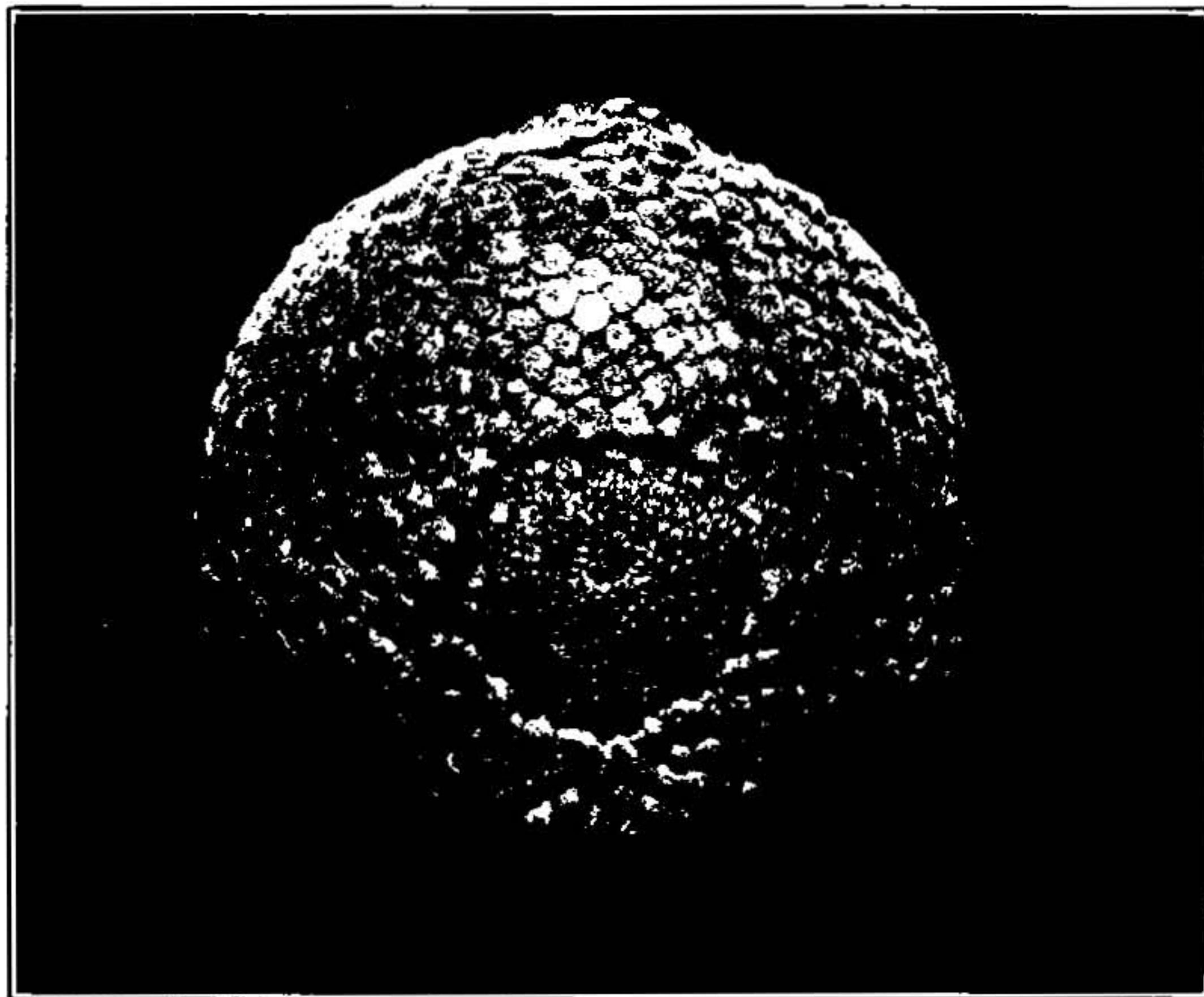
Mr. Harris had at this time no further material available; but on October 13, 1913, he sent a number of fine specimens with abundance of flowers, both immature and mature (collected June 25, 1913, near Petersfield, St. Andrew, no. 11,648). This new material showed by the acuminate, pyramidal or obpyriform buds that it represented a species distinct from *Annona jamaicensis*, but it was too late to make any changes in the writer's paper on "*Annona sericea* and its allies." The writer then sent a photograph of Alexander Prior's specimen of *A. jamaicensis* to Mr. Harris,¹ and once more called his attention to the marked difference between it and the specimens collected by Mr. Harris. In a letter dated December 19, 1913, Mr. Harris acknowledged the receipt of the photograph and conceded it to be quite possible that the specimen represents another species.

Annona praetermissa may be properly called the "wild chirimoya of Jamaica." It must not only be separated from *A. jamaicensis*, but it must take its place with *A. cherimola* Mill., *A. longiflora* S. Wats., and their allies in the section *Atta*. It is described as having 3-petaled flowers, but like *A. cherimola* it has in addition to the three outer elongated petals three minute inner petals, ovate in shape, not exceeding half the length of a stamen, and clothed with tomentum. These are so small that they can be seen only with the aid of a lens; so that it is not strange that, like those of the chirimoya (first described as *Annona tripetala*), they should have escaped observation. The close affinity of this species with *A. cherimola* Mill. is shown by its flowers, fruit, and leaves. As in the latter species, the flowers never open widely. They are solitary or geminate and are extra-axillary or leaf-opposed. The fruit is distinctly areolate, resembling that variety of chirimoya in which the areoles are concave; and each areole bears a mammiform tubercle slightly incurved or hooked at the tip. The leaves, persistently pubescent beneath, are often relatively narrower than those of a typical chirimoya leaf, and are chiefly to be distinguished by the reddish brown midrib and lateral nerves which are conspicuously contrasted with the dull greenish color of the remainder of the lower surface.

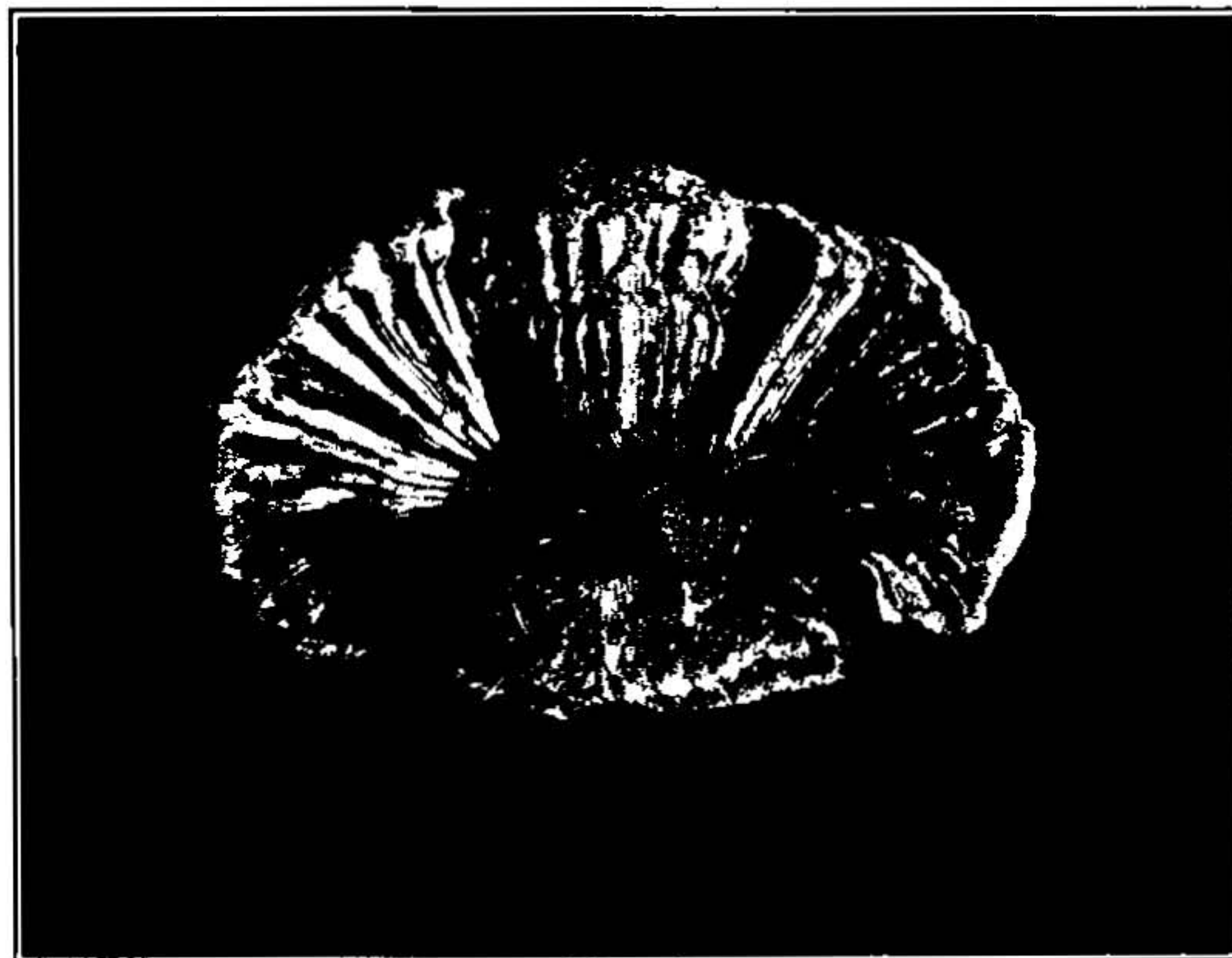
¹ See loc. cit. pl. 98.



ANNONA MURICATA L.



A. REPRODUCTIVE ORGANS OF *ANNONA PURPUREA* MOC. & SESSÉ.

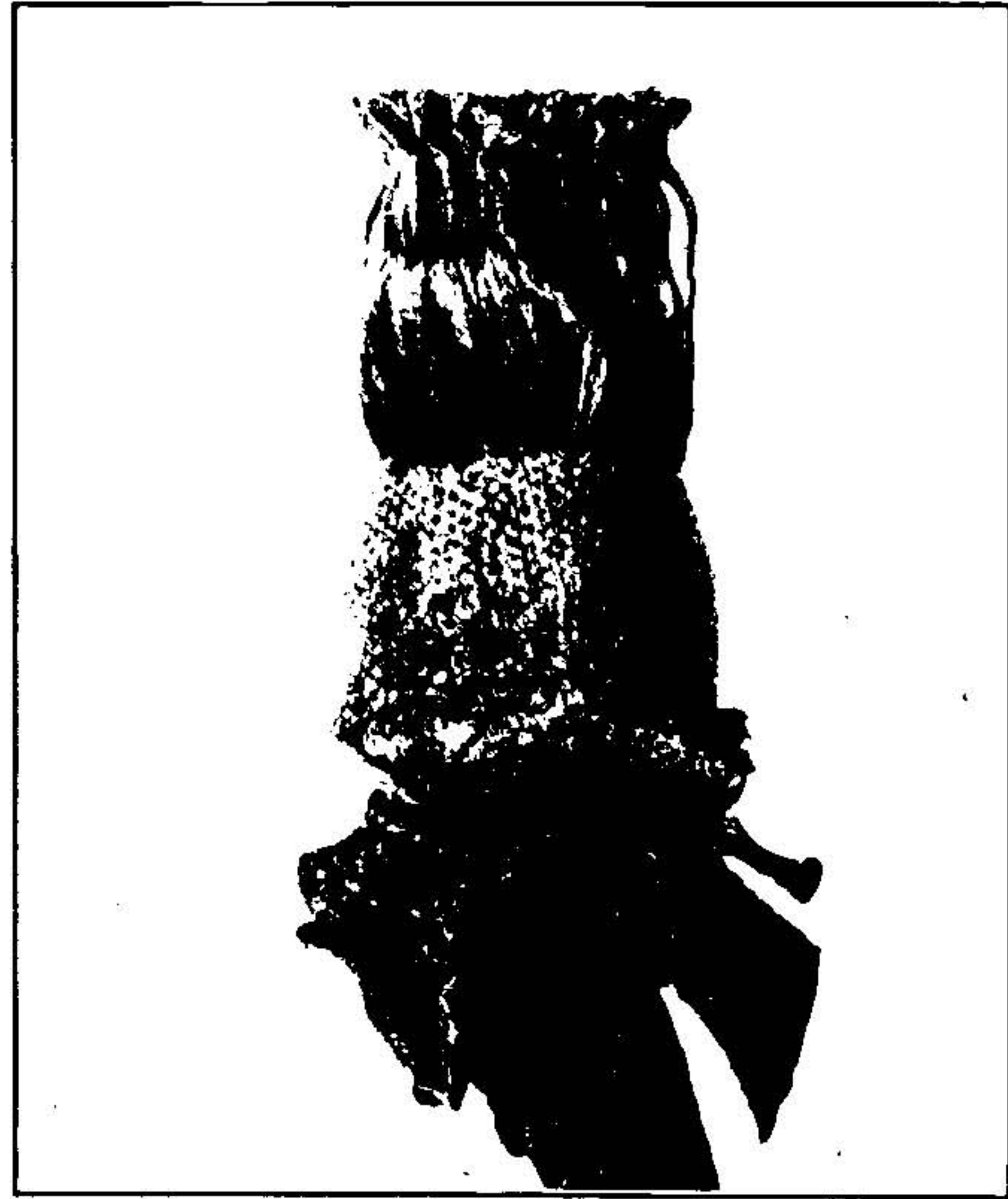


B. REPRODUCTIVE ORGANS OF *ANNONA PURPUREA* MOC. & SESSÉ.



A

GYNŒCIUM OF ANNONA MURICATA L.



B

GYNŒCIUM OF ANNONA MONTANA MACFAD.



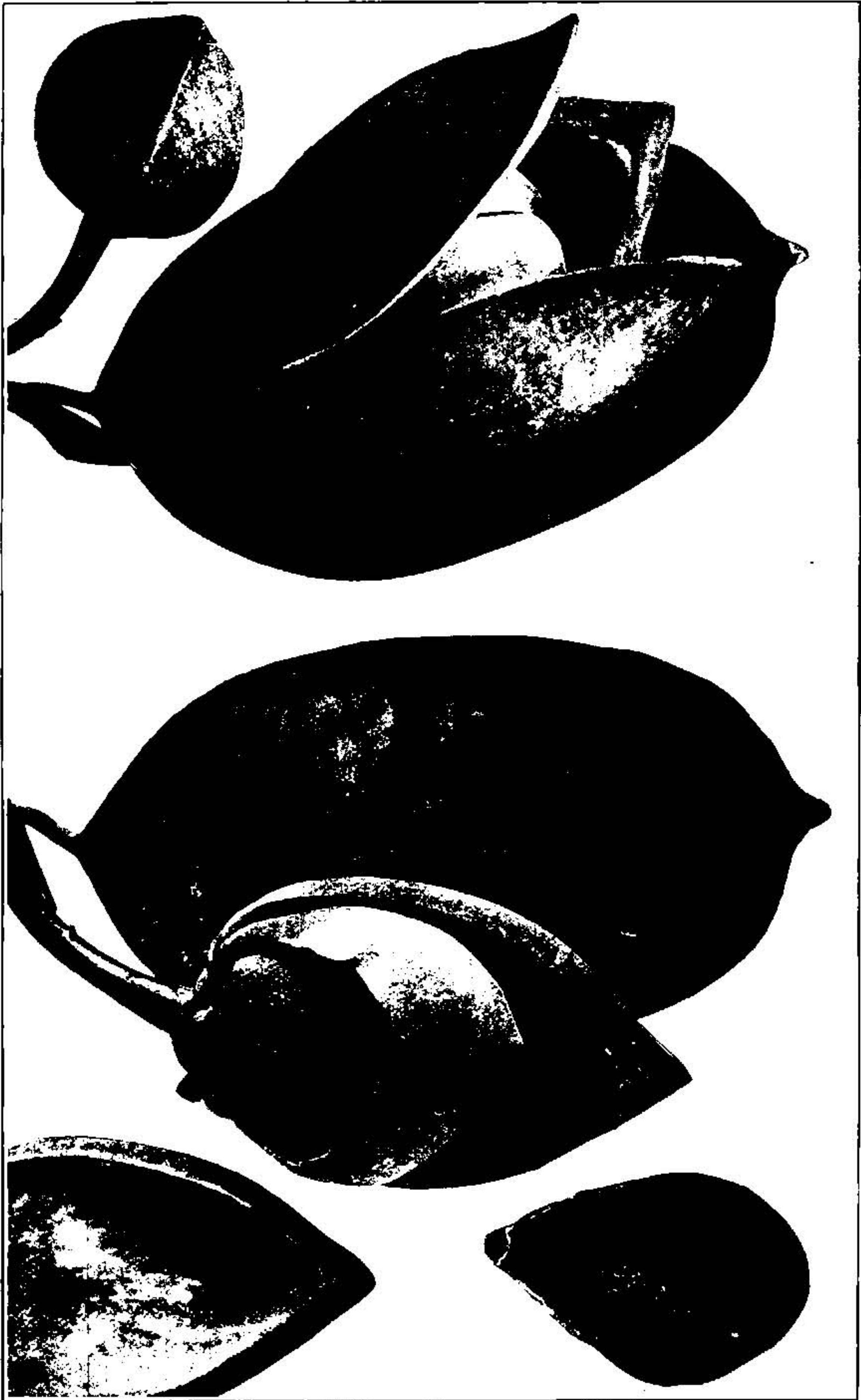
ANNONA GLABRA L., THE ALLIGATOR APPLE.



A. FRUIT OF *ANNONA DIVERSIFOLIA* SAFFORD.



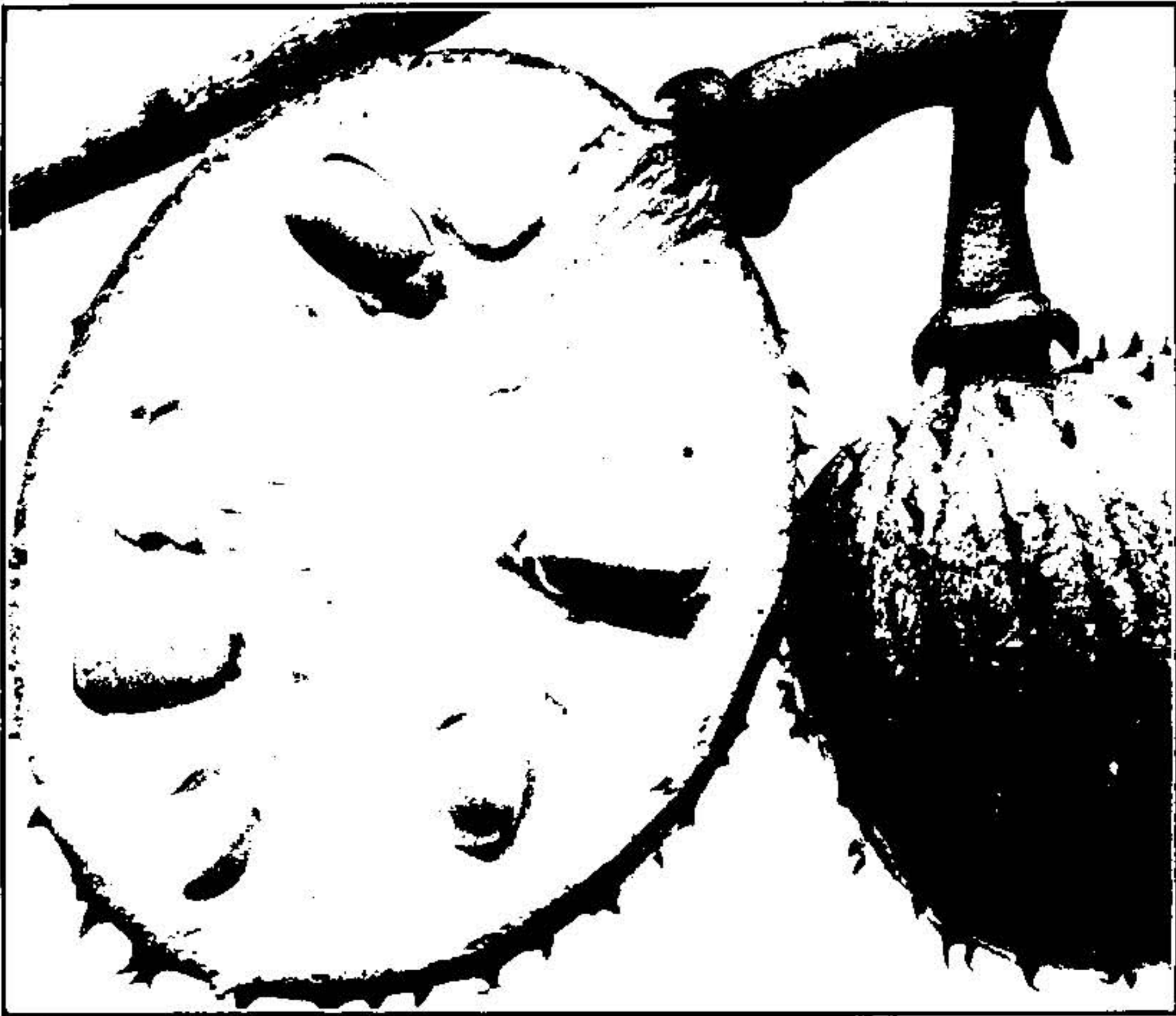
B. FRUIT OF *ANNONA DIVERSIFOLIA* SAFFORD.



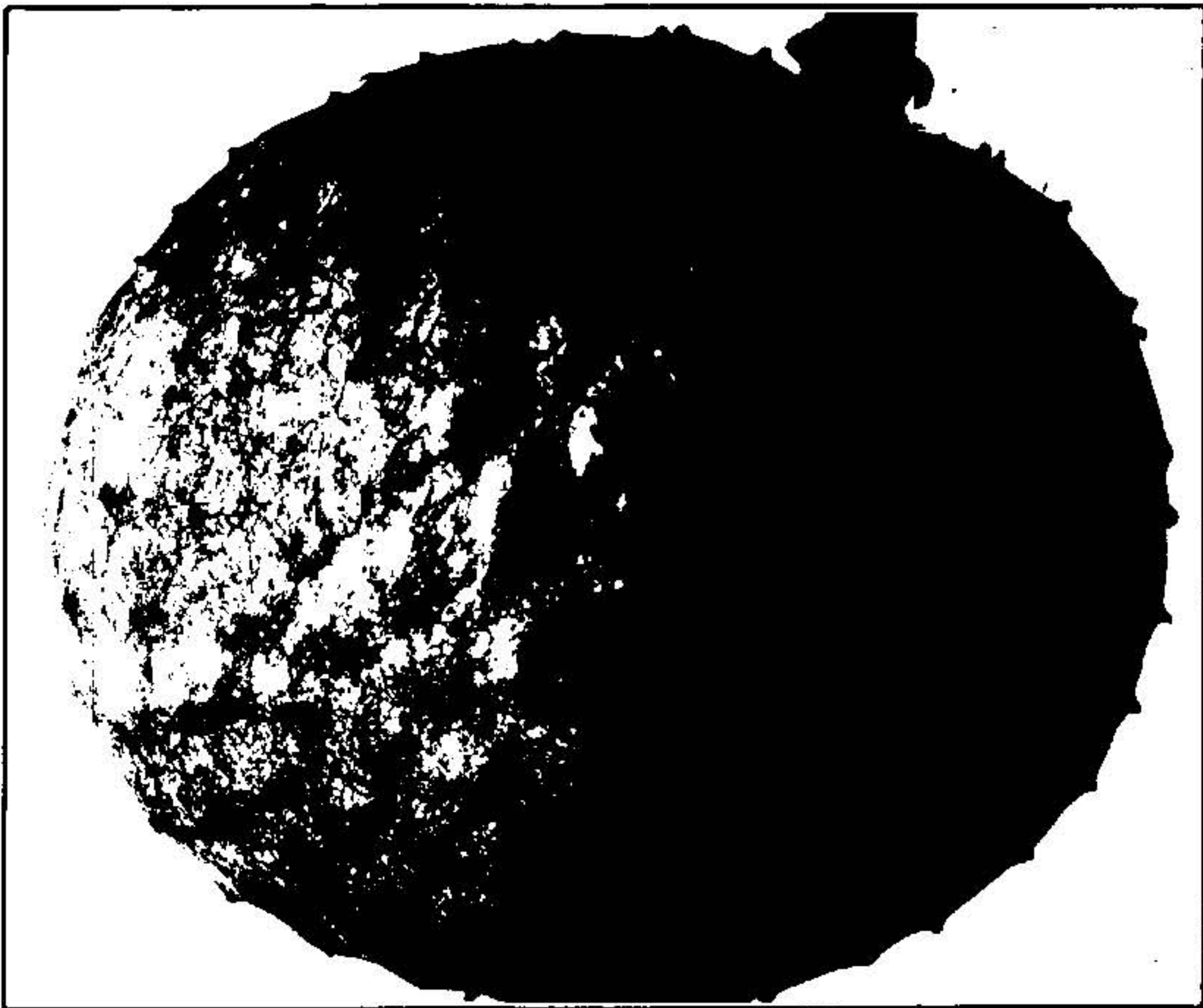
FLOWERS OF *ANNONA MONTANA* MACFAD., FROM PORTO RICO.



SOLITARY FRUIT AND LEAVES OF *ANNONA MONTANA* MACFAD.



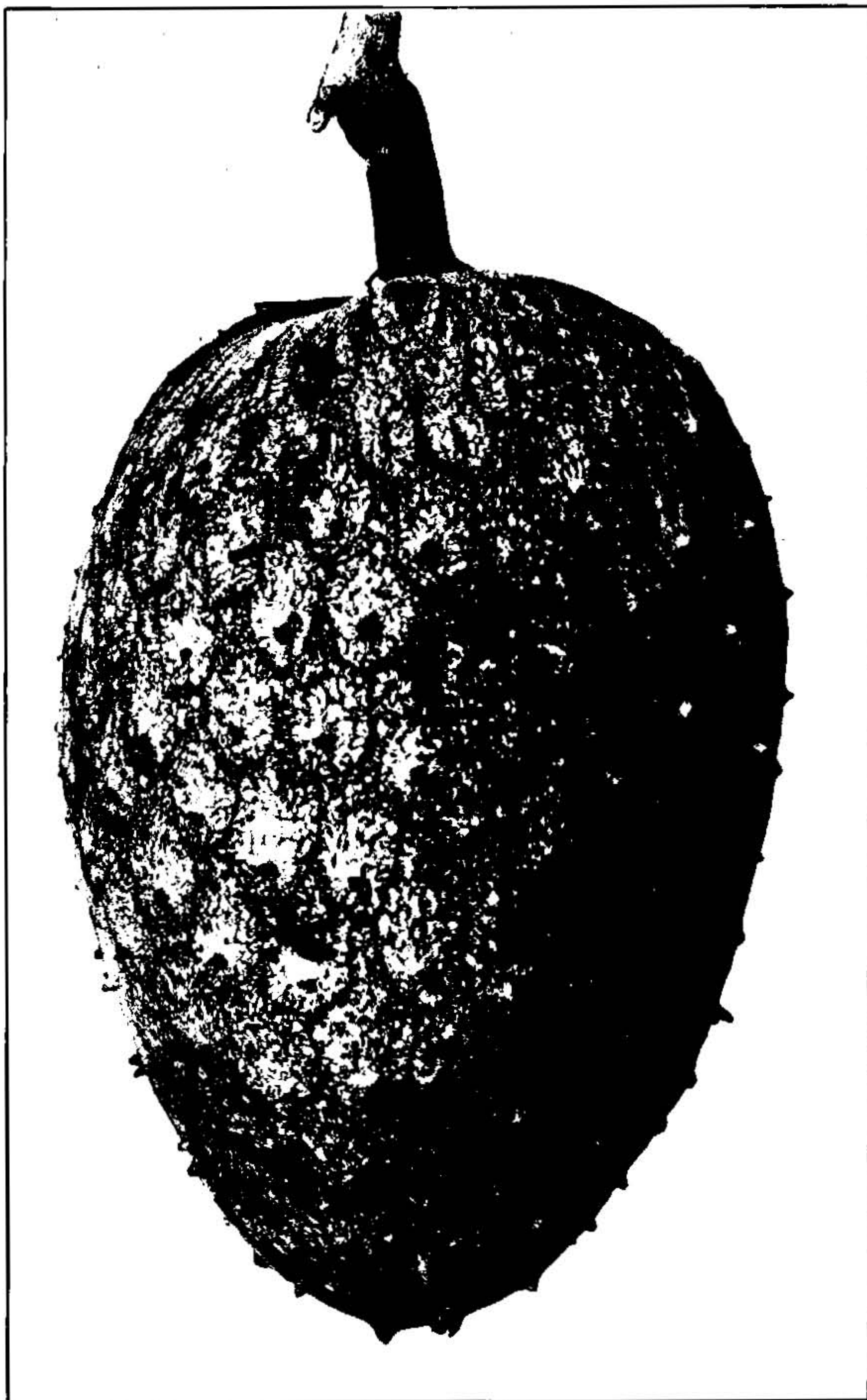
A. GEMINATE FRUIT OF *ANNONA MONTANA* MACFAD., FROM PORTO RICO.



B. FRUIT OF *ANNONA SPHAEROCARPA* SPLITG., FROM PARIMARIBO, SURINAM.



YOUNG FRUIT AND FLOWER OF *ANNONA MARCGRAVII* MART., FROM VENEZUELA.



FRUIT OF *ANNONA MARCGRAVII* MART., FROM VENEZUELA.



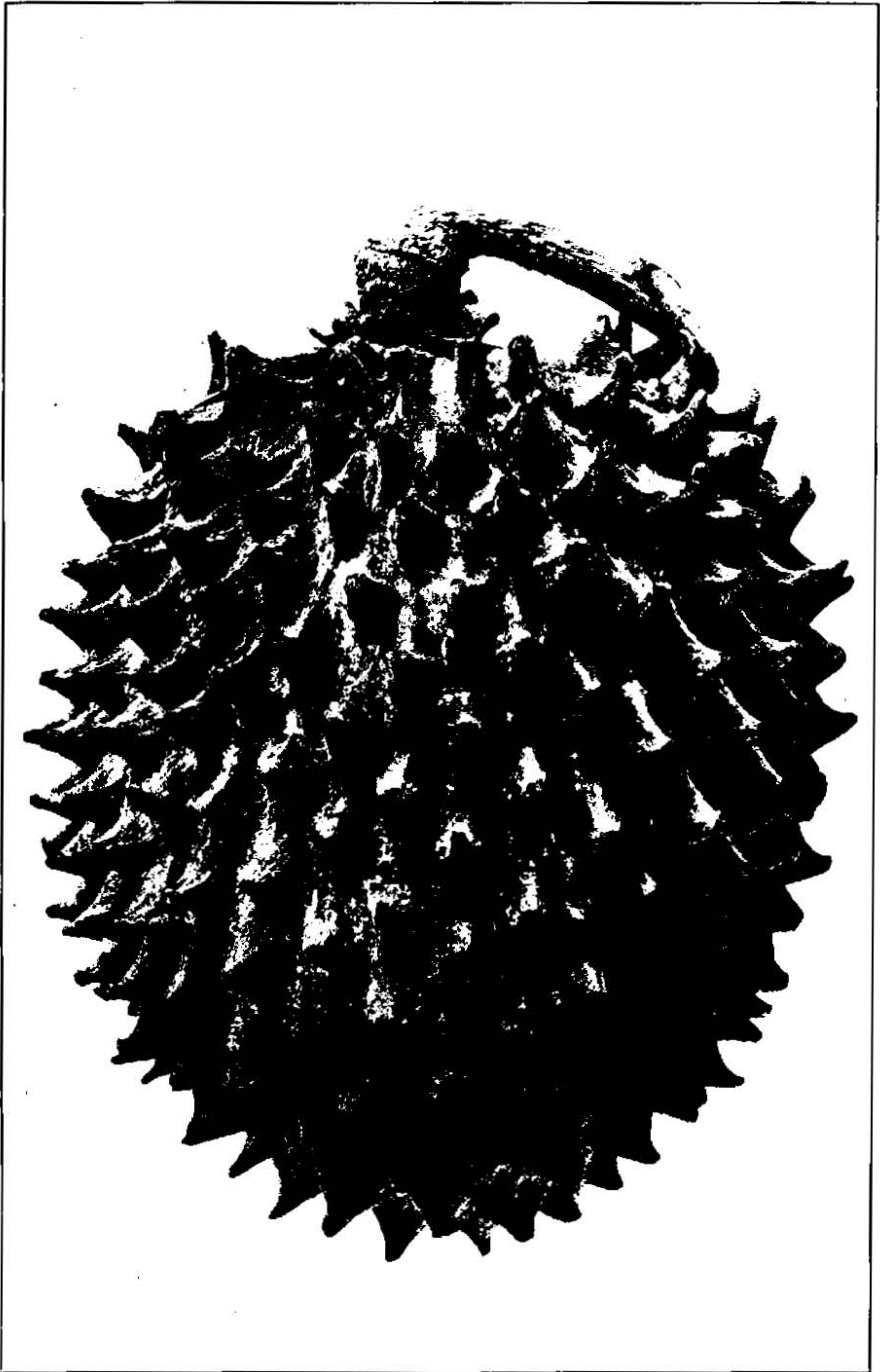
TYPE SPECIMEN OF *ANNONA SALZMANNI* A. DC.



YOUNG FLOWERS AND LEAVES OF *ANNONA PURPUREA* MOC. & SESSÉ, FROM COSTA RICA.



ANNONA PURPUREA MOC. & SESSÉ, WITH MATURE FLOWER, FROM VENEZUELA.



FRUIT OF ANNONA PURPUREA MOC. & SESSÉ, FROM PANAMA.



ANNONA INVOLUCRATA BAILL.



BRANCH OF ANNONA INVOLUCRATA BAILL., SHOWING FLORAL INVOLUCRE.



ANNONA PALUDOSA AUBL.



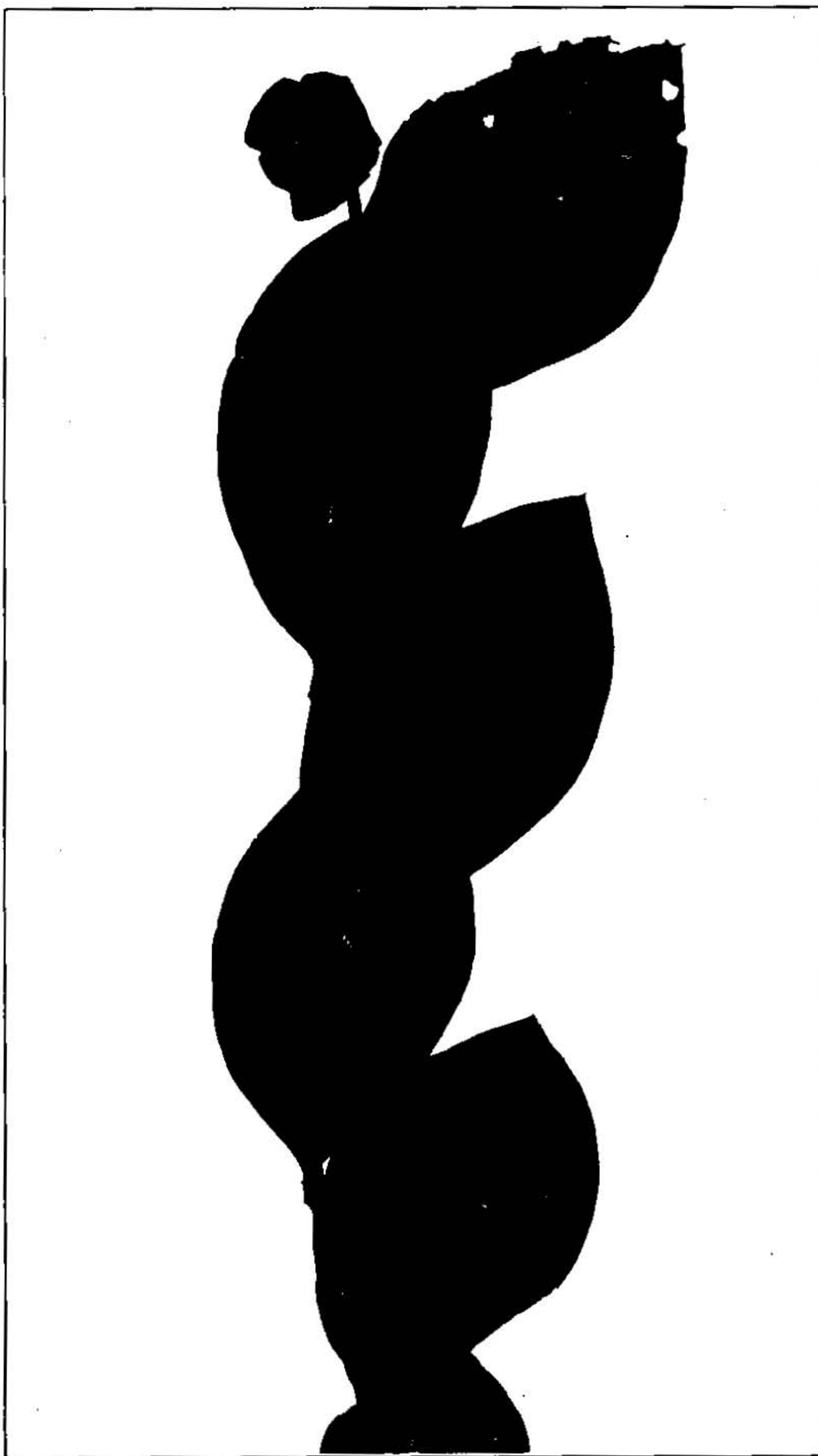
A. ANNONA CORNIFOLIA ST. HIL.



B. ANNONA PALUDOSA AUBL.



ANNONA JAHNII SAFFORD.



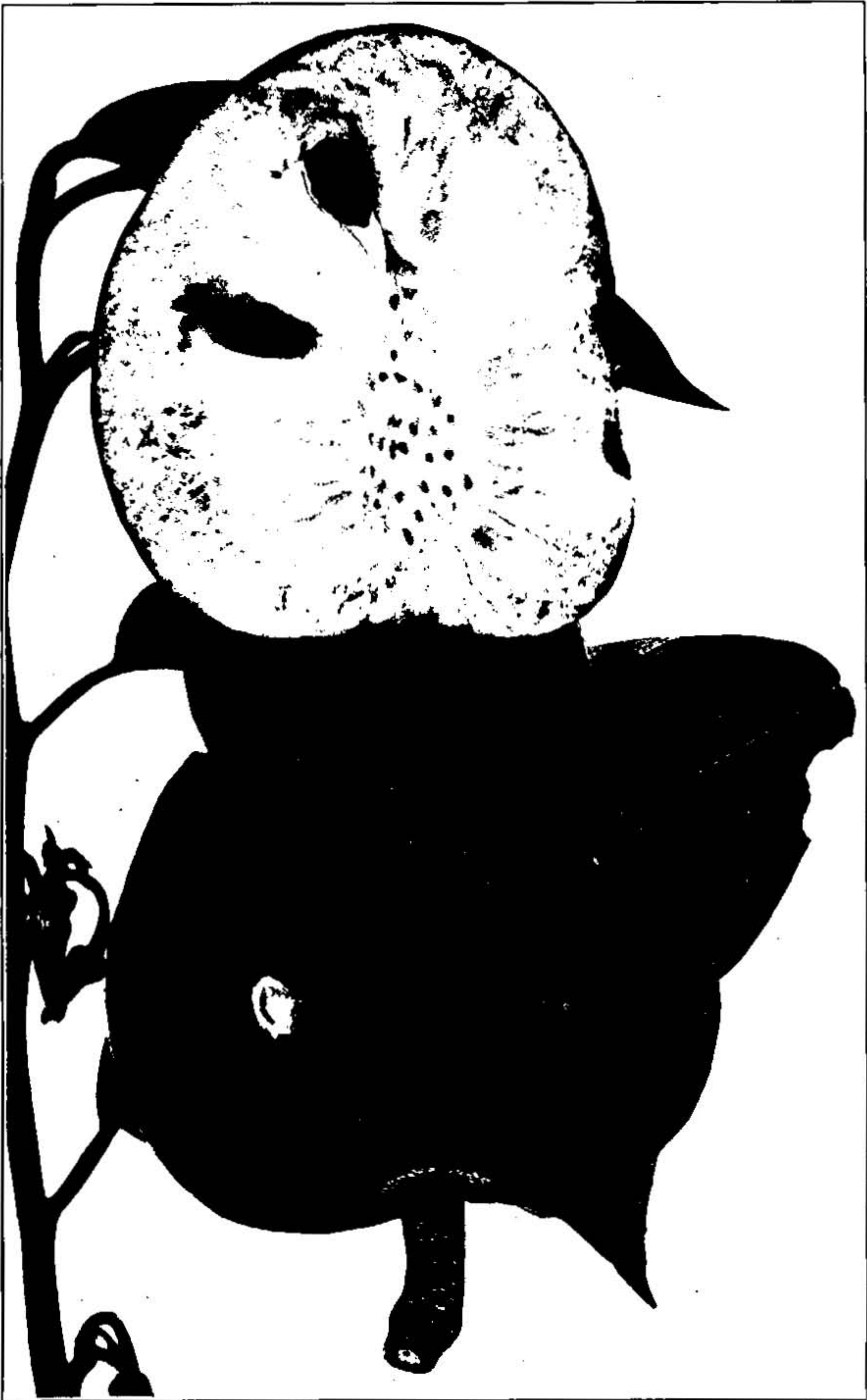
ANNONA CORNIFOLIA ST. HIL., WITH SOLITARY FLOWER.



ANNONA NUTANS R. E. FRIES.



ANNONA ACUTIFLORA MART.



ANNONA LUTESCENS SAFFORD.



ANNONA PALMERI SAFFORD.



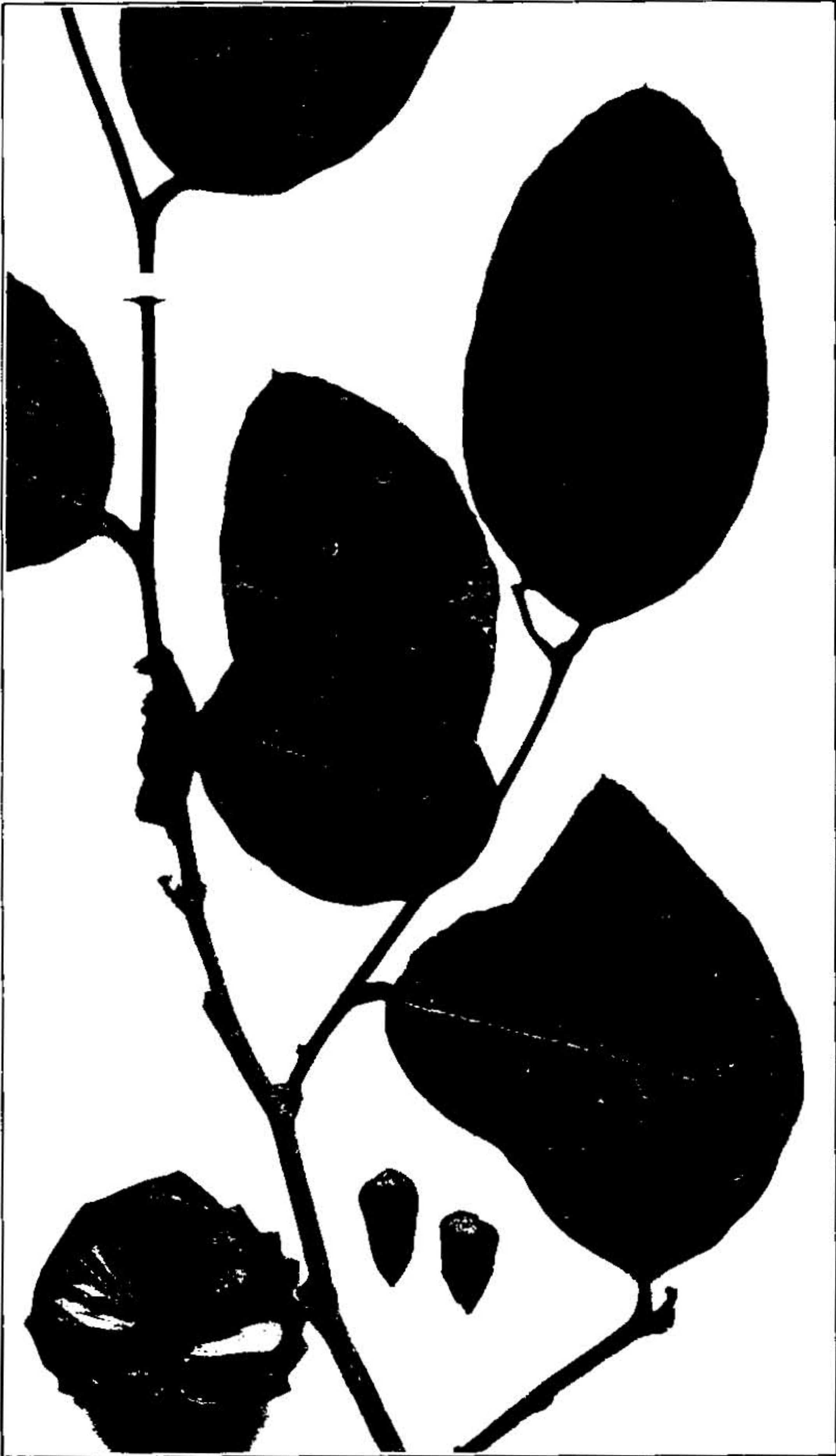
ANNONA LONGIFLORA S. WATS.



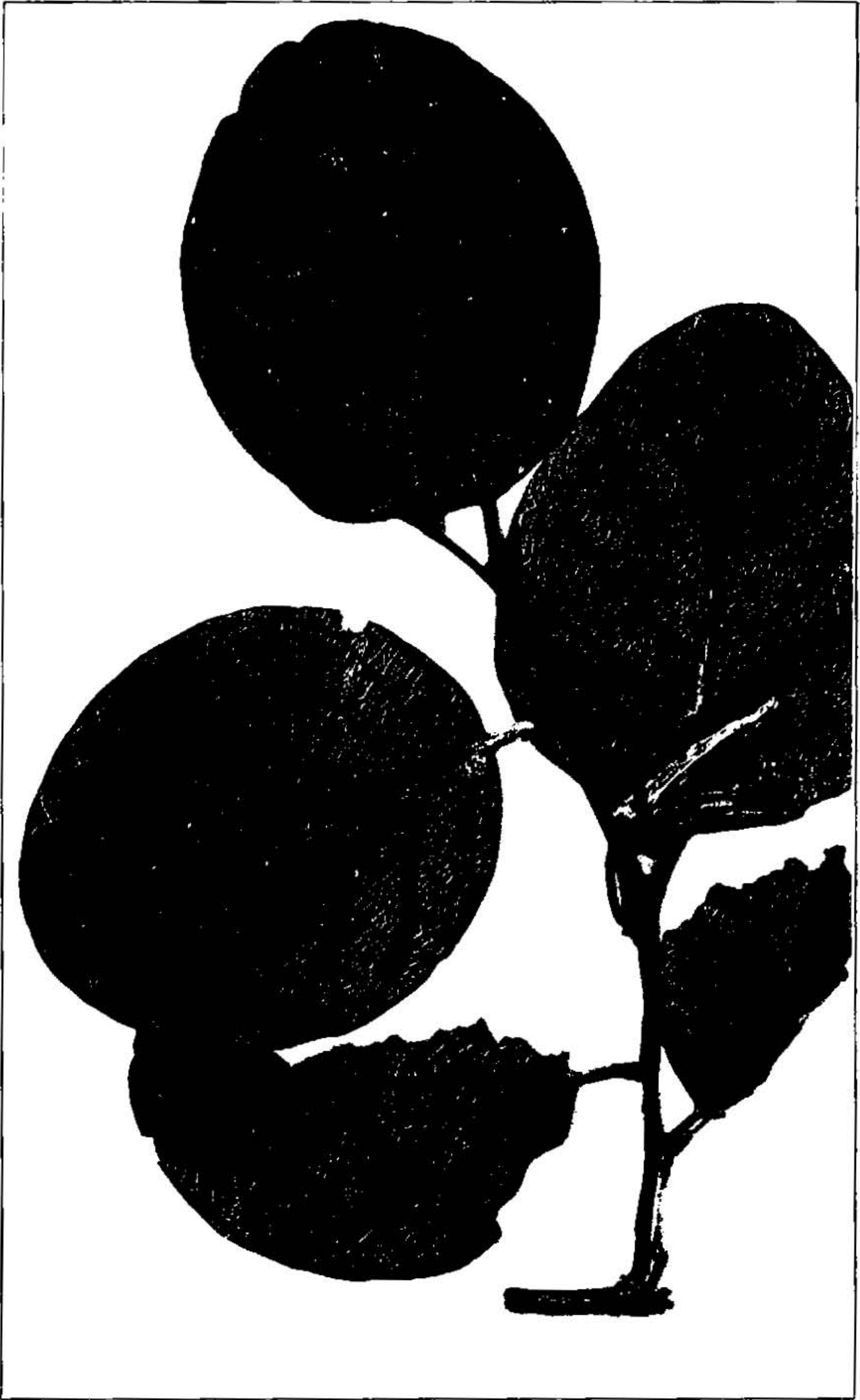
ANNONA MACROPHYLLATA DONN. SMITH.



ANNONA BULLATA A. RICH.



ANNONA BULLATA A. RICH., WITH FRUIT.



ANNONA CRASSIVENIA SAFFORD.



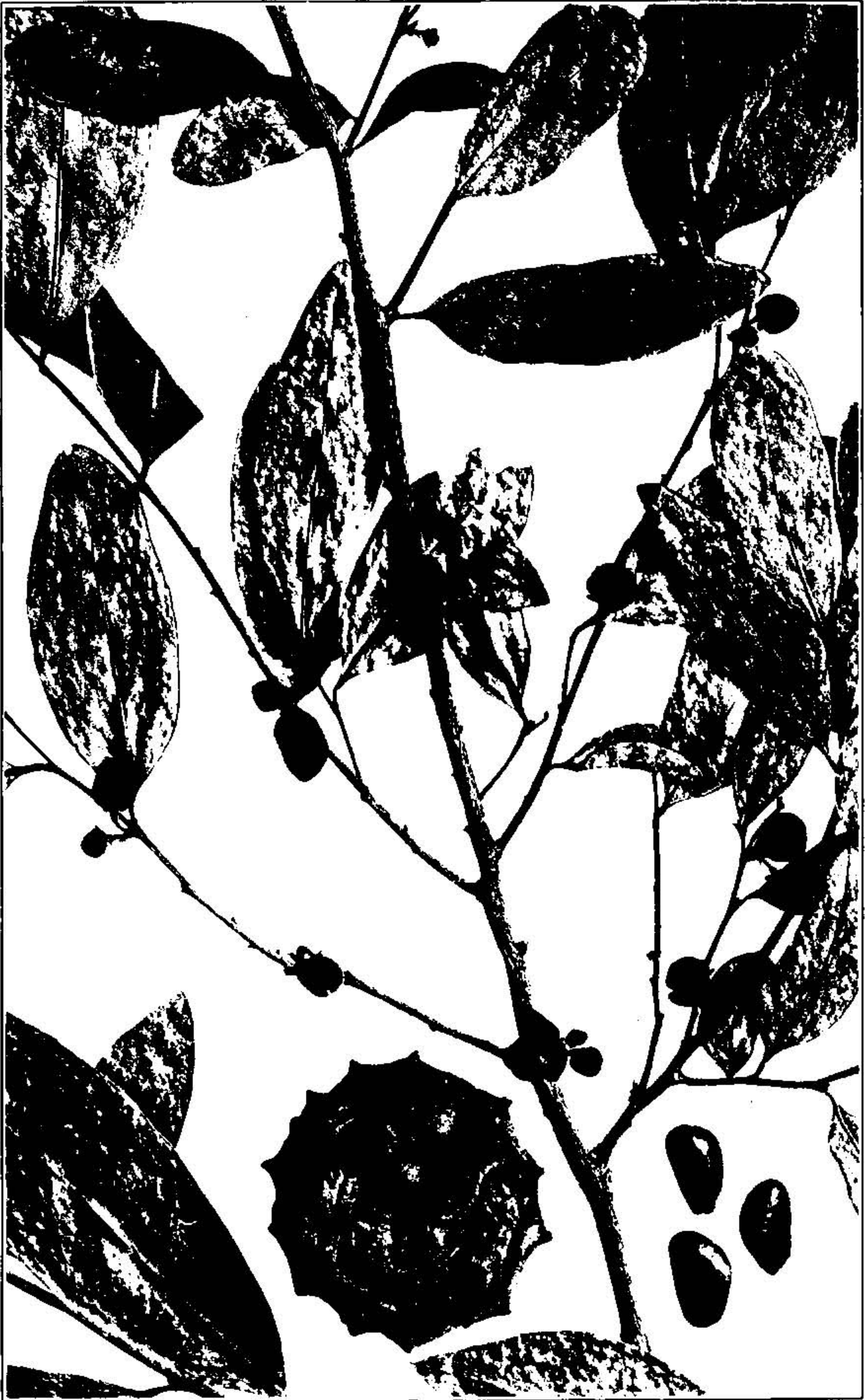
ANNONA CRASSIVENIA SAFFORD, WITH FRUIT.



ANNONA CASCARILLOIDES WRIGHT.



ANNONA SCLEROPHYLLA SAFFORD.



ANNONA GLOBIFLORA SCHLECHT.



ANNONA BICOLOR URBAN.



ANNONA ROSEI SAFFORD.



FLOWERS OF ANNONA ROSEI SAFFORD, ENLARGED.



ANNONA ROSEI SAFFORD.



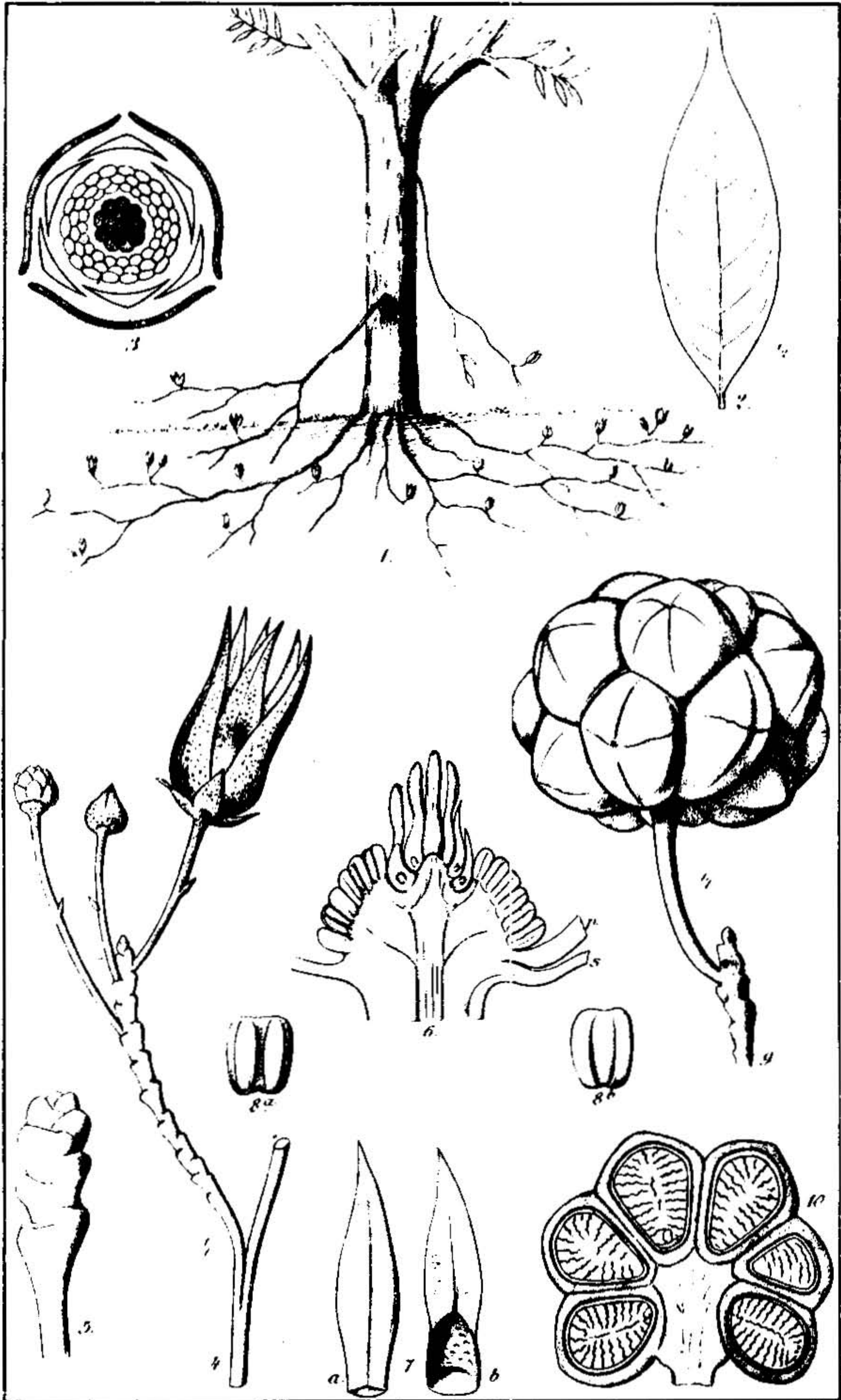
ROLLINIA LONGIFOLIA ST. HIL.



ROLLINIA MUCOSA (JACQ.) BAILL.



RAIMONDIA QUINDUENSIS (H. B. K.) SAFFORD.



GEANTHEMUM RHIZANTHUM (EICHL.) SAFFORD.