SONNERATIACEAE

(C. A. Backer & C. G. G. J. van Steenis, Heemstede/Leyden)

Trees. *Leaves* opposite, biseriate, exstipulate, simple, entire, coriaceous. *Flowers* ☿, either 1–3 together at the summits of the branchlets or in terminal corymbs, pedicelled, rather large, actinomorphic. Calyx thickly coriaceous, persistent, gamosepalous; segments 4–8, valvate in bud, acute, often coloured inside; tube of fruiting calyx flat or not. *Petals* either absent or as many as calyx-segments; in the latter case either broad and wrinkled or very narrow and smooth, alternating with the sepals. Stamens mostly many, sometimes 12, inserted on the calyx, often many-seriate, inflexed in bud; filaments filiform-subulate; anthers medifixed, reniform or oblong, 2-celled; cells opening lengthwise. Ovary superior, sessile with a broad base, during anthesis enclosed by the calyx-base, 4–∞-celled; septa thin; ovules numerous on thick, axile placentas. Style 1, long, robust; stigma 1, capitate, entire or slightly lobed. *Fruit* resting on the calyx-tube, either an indehiscent berry or a valvate capsule, many-seeded. Seeds small, exalbuminous.

Distr. Two small genera, one extending from tropical East Africa and adjacent islands to Queensland, Micronesia and Melanesia, the other confined to SE. Asia and *Malaysia*.

Ecol. *Sonneratias* are trees of the mangrove and seacoasts generally, *Duabanga* is a component of the evergreen rainforest belt. The flowers of *Sonneratia* are ephemeral and expand at sunset; they frequently emit an offensive smell and are conspicuous by a mass of exserted coloured stamens. The pollen is sticky acc. to VAN DER PIJL. For a discussion of the pollination see the notes under *S. caseolaris* (L.) ENGL. On the breathing roots of *Sonneratia* see under the genus.

Uses. The economic value of *Sonneratiaceae* is, on the whole, small. The wood is used for fuel, and for house- and boat-building. Of some *spp.* the fruit is eaten by the people. From the fruits of *Sonneratia* pectin can be extracted; see under *S. caseolaris* (L.) ENGL.

Wood anat. Compare next part.

Note. *Sonneratiaceae* (*Blattiaceae* NIEDENZU in E. & P. 3, 7, 1893, 16) are treated here in their strict sense. By various authors they have been merged with the *Punicaceae*, the *Lythraceae* or the *Myrtaceae*, often together with *Crypteroniaceae*.

KEY TO THE GENERA

1. Flowers 1–3 together at the ends of the branchlets. Petals absent or very narrow, smooth. Stamens very many; anthers reniform. Fruit an indehiscent berry. Seeds not tailed at the ends **1. Sonneratia**
1. Flowers in 5- to rather many-flowered terminal corymbs. Petals broad, crisped. Stamens 12 or many; anther-cells curved or replicate over one end of the connective. Fruit a 4–8-valvate capsule. Seeds tailed at both ends by the protracted testa . . . . . **2. Duabanga**

1. SONNERATIA

LINNÉ *f.* Suppl. (1781) 38 *nomen conserv.*—*Blatti* ADANS. Fam. 2 (1763) 88; O. K. Rev. Gen. 1 (1891) 238; NIEDENZU in E. & P. 3, 7 (1893) 20, *incl.* § *Eublatti* & § *Sciadostigma* NIEDENZU, *l.c.* 21.—*Pagapate* SONNERAT, Voy. Nouv. Guin. (1776) 16.—*Kambala* RAFIN. Sylv. Tell. (1838) 19.—*Mycostylis* RAFIN. *nom. altern. l.c.*—*Chiratia* MONTROUS. Mém. Ac. Lyon 10 (1860) 202.—*Tombea* BRONGN. & GRIS, Ann. Sc. Nat. V, 1 (1864) 362, *nomen*; *ibid.* V, 6 (1866) 266; Bull. Soc. Bot. Fr. 13 (1866) 479.—**Fig. 1–5.**

All parts glabrous; trunk surrounded by 'breathing-roots' arising vertically from often very long horizontal roots buried at slight depth in the substratum; no buttresses. *Flowers* 1–3 together at the summits of the ultimate, mostly pendulous branchlets, 4–8-merous. Calyx-tube obconical or cup-shaped, under the ripe fruit either unaltered or flattened; segments ovate-oblong-triangular, often coloured inside. Petals very narrow or quite absent, caducous. Stamens very many, cadu-

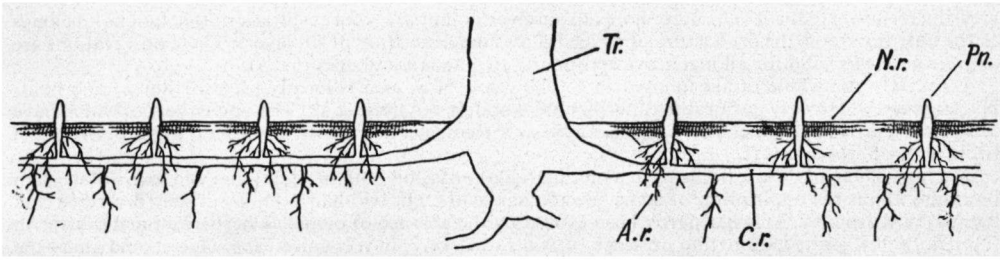

Fig. 1. Scheme of root-system in *Sonneratia: Tr.* = trunk, *C.r.* = cable-roots, *Pn.* = pneumatophores, *N.r.* = nutrition-roots, *A.r.* = anchor-roots. After TROLL.

cous; anthers comparatively small, reniform. Disk saucer-shaped. Ovary 10- or more-celled; style sinuous in bud. Fruit an indehiscent *berry*, depressed-globose, crowned by the style-base. Seeds embedded in evil-smelling pulp, not tailed at the ends.

Distr. Species 5, along the tropical shores of East Africa and adjacent islands, Asia, Hainan, *Malaysia* and N. Australia, to S. Riu Kiu Islands (Iriomote), Micronesia (Carolines: Ponape, Kusaie, Pelew, Yap, Truk, Palau, Korror), Melanesia (New Ireland, the New Hebrides, Solomon Islands), and New Caledonia. Not in Formosa!

Ecol. Inhabitants of coral-terraces (either inundated by flood or not), shallow parts of calm seas, the mangrove and the banks of tidal rivers and creeks.

The structure and functioning of the root-system of *S. caseolaris* has been studied by C. TROLL (Ber. D.B.G. 48, 1930, Gen.-Vers. Heft p. (81)–(99); Planta 13, 1931, 311–473; Trop. Natuur 22, 1933, 33–39). He has found that the so-called 'aerophores' are emitted by numerous long horizontal cable-roots and serve to produce fine nutrition roots penetrating horizontally in the uppermost layer of the steadily in-

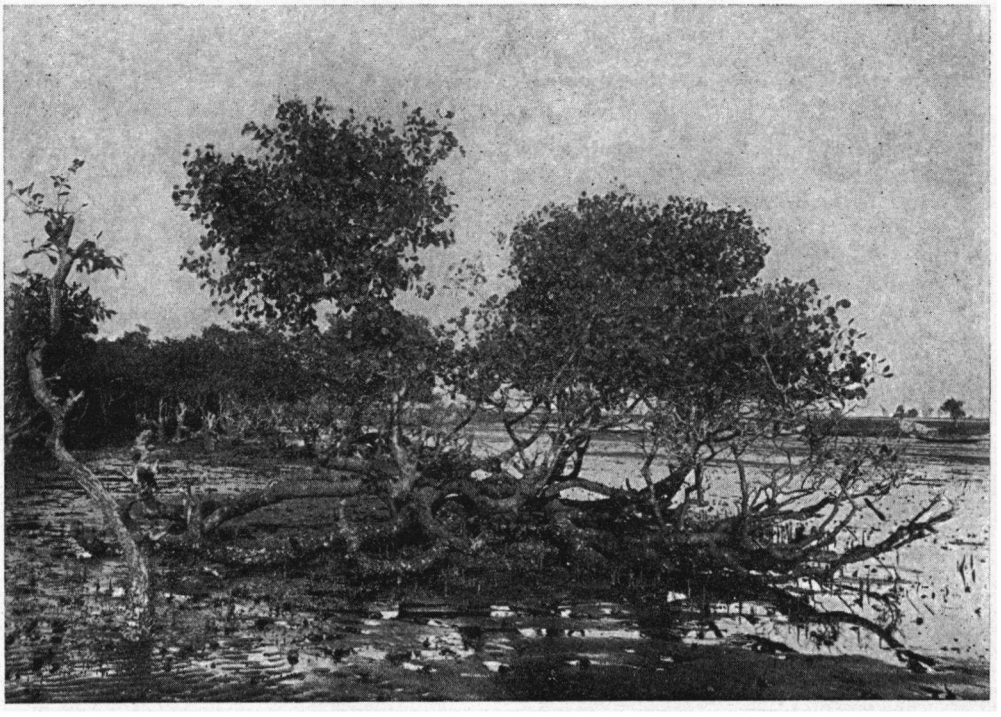

Fig. 2. *Sonneratia*, old specimen, NE. Java, prostrate stems with oyster colonies (JESWIET).

creasing (rejuvenated) silt. The aerophores themselves do not serve for respiration; this function belongs to the nutrition roots the production of which follows the deposition of silt layers. These observations are *mutatis mutandis* valid for all mangrove aerophores or pneumatophores (fig. 1).

Uses. On the whole rather unimportant. The wood of *S. alba* is locally used for house- and boat-building, elsewhere only as (a rather inferior) fire-wood or not used at all. The young berries which have a sour taste are locally eaten; they are also used as a medicine. See for the extraction of pectin from the fruits under *S. caseolaris* (L.) ENGL.

Notes. There has been, in the past, a considerable confusion both in Malaysian and *extra*-Malaysian literature about the application of some specific names though two had been accurately described and figured by RUMPHIUS. This has partly been caused by the absence of complete herbarium materials with full field notes, and partly by the presence of two rather rare, ill-recognized *spp.* One should study the species *in situ* where they can easily be distinguished both in the flowering and fruiting states. The lack of good materials is to some extent due to the fact that the flowers are nocturnal and short-lived: petals and stamens soon fall out. For a proper identification a collector should note: the colour of the inside of the calyx, of the petals (in buds or *young flowers*), and the stamens, and the poise of the calyx under *adult* fruits. The leaf-shape is, generally, less important for specific distinction.

In order to define the proper geographical distribution of the species a revision has been made of the whole genus and type specimens have been examined. Of the 5 species distinguished, three occur in Malaysia, one extends to the Kra isthmus and one to Lower Burma; these two may be expected to turn up elsewhere in West-Malaysia.

As to literature, pure and applied, no attempt has been made to correct all erroneous records.

KEY TO THE SPECIES (*flowering material*)

1. Petals absent[1].
   2. Stigma large fungiform, 6 mm through. Calyx 4-(exceptionally 6-)merous, 1½–2 cm long (incl. ovary). Leaves narrow. . . . . **4. S. apetala**
   2. Stigma capitate, ca 3 mm diam. Calyx (5–)6–8-merous, 2½–4½ cm long (incl. ovary).
      3. Calyx smooth throughout, not ribbed. Leaves obovate to suborbicular, 7–10½ by 5–9½ cm, rather thickish. Leaf base shortly contracted-decurrent. Nerves thickish, (*pro gen.*) distinctly prominent on the upper surface . . . . . **5. S. griffithii**
      3. Calyx finely verruculose, tube distinctly ribbed and somewhat contracted at the rim; inner side of the segments strongly tinged red. Leaves broadly ovate or broadly oval to suborbicular, rounded or subcordate at the base, broadly rounded at the top, 4–10 by 3–9 cm. Nerves very thin, not distinctly prominent on the upper surface. . . . . **2. S. ovata**
1. Petals present[1].
   4. Petals linear, 13–20 by ½–1¼ mm, white or in the lower half tinged with red. Inner side of the sepals red. Filaments white. Leaves obovate or oval from a cuneate base, apex broadly rounded, often emarginate, 5–12½ by 3–9 cm . . . . . **3. S. alba**
   4. Petals linear-lanceolate, dark red (also *statu sicco*), 16–35 by 1½–3½ mm. Inner side of sepals greenish or yellowish-white. Filaments in their lower part red, upper part white. Leaves elliptic-oblong or oval-obovate, base contracted or cuneate, apex blunt or rounded, 5–13 by 2–5 cm. **1. S. caseolaris**

KEY TO THE SPECIES (*fruiting material*)

1. Calyx 4-(exceptionally 6-)merous, ca 2 cm long (incl. ovary). Leaves narrow. Ovary 5–8-celled. Fruit 1½–2 cm diam. . . . . **4. S. apetala**
1. Calyx (5–)6–8-lobed, 2½–4½ cm long (incl. ovary). Ovary 14–21-celled. Fruit 2½–4 cm high, 3–7½ cm diam.
   2. Calyx tube and lobes under the ripe fruit flat-expanded, tube at most obscurely ribbed.
      3. Leaves obovate to suborbicular, base rounded, shortly contracted into the petiole, apex broadly rounded or emarginate, 7–10½ by 5½–9½ cm. Nerves (pro gen.) distinctly prominent on the upper surface . . . . . **5. S. griffithii**
      3. Leaves elliptic-oblong or oval-obovate, base contracted or cuneate, apex blunt or rounded, 5–13 by 2–5 cm; nerves very thin, often inconspicuous, not distinctly prominent and less strong than in the preceding species . . . . . **1. S. caseolaris**
   2. Calyx under the ripe fruit cup-shaped or turbinate, its tube or its segments enveloping the base of the fruit, the tube ribbed.
      4. Tube of the fruiting calyx 1½–2 cm high, smooth, segments under the ripe fruit entirely reflexed. Leaves obovate or oval from a cuneate base, apex broadly rounded, often emarginate, 5–12½ by 3–9 cm . . . . . **3. S. alba**
      4. Calyx distinctly finely verruculose, tube of the fruiting calyx cupular, ½–1 cm high; segments ascending, appressed against the ripe fruit. Leaves broadly ovate or broadly oval, rounded or subcordate at the base, broadly rounded at the apex, 4–10 by 3–9 cm. . . . . **2. S. ovata**

(1) The often fugacious petals may be very narrow and inconspicuous, strongly resembling the filaments. They are best observed in mature buds.

1. Sonneratia caseolaris (L.) ENGL. in E. & P. Nachtr. (1897) 261, *em.* SM. in REES, Cycl. (1819) xxxiii; MERR. Fl. Man. (1912) 344; DRUCE, Rep. Bot. Exch. Club Br. Isl. 1913, III, 424 (1914); MERR. Int. Rumph. Herb. Amb. (1917) 383; En. Born. (1921) 418; PARKER, Ind. For. 51 (1925) 507, *incl. var. mucronata* (MIQ.); BURK. Dict. (1935) 2052; STEEN. Fl. Sch. Indon. (1949) 292; *non* MERR. En. Philip. 3 (1923) 139 *et al.*—*Mangium caseolare rubrum* RUMPH. Herb. Amb. 3 (1743) 112, t. 74.—*Rhizophora caseolaris* LINNÉ *p.p.* in STICKMAN, Herb. Amb. (1754) 13; Amoen. Acad. 4 (1759) 123; Syst. ed. 10 (1759) 1043; Sp. Pl. ed. 2 (1763) 635; BURM. *f.* Fl. Ind. (1768) 635.—*Pagapate* SONNERAT, Voy. Nouv. Guin. (1776) 16, t. 10–11.—*Sonneratia acida* LINNÉ *f.* Suppl. (1781) 252; SMITH in REES, Cycl. (1819) 33, *no* 1; ROTH, Nov. Sp. (1821) 233; DC. Prod. 3 (1828) 231; ROXB. Fl. Ind. ed. CAREY 2 (1832) 506; W. & A. Prod. (1834) 327; DECNE, Nouv. Ann. Mus. 3 (1834) 454; WIGHT, Ic. 2 (1843) 340; GRIFF. Not. Syst. 4 (1854) 652; SPAN. Linnaea 15 (1841) 203; KORTH. Ned. Kruidk. Arch. 1 (1846) 198; BL. Mus. Bot. 1 (1851) 336; GRIFF. Not. 4 (1854) 652; MIQ. Fl. Ind. Bat. 1, 1 (1856) 496 *incl. var. mucronata* MIQ.; Suppl. Sum. (1860) 120, 316; DALZ. & GIBS. Bomb. Fl. (1861) 98; BRAND. For. Fl. (1874) 242; KURZ, For. Fl. 1 (1877) 526; CLARKE in HOOK. *f.* Fl. Br. Ind. 2 (1879) 579; K. & V. Bijdr. Booms. 1 (1894) 198; KOORD. Exk. Fl. 2 (1912) 663; KOORD. Atlas Baumart. (1915) t. 592–594; BACK. Bull. J.B.B. III, 2 (1920) 330; GUILL. & GAGN. Fl. I.C. 2 (1921) 980; RIDL. Fl. Mal. Pen. 1 (1922) 825; MERR. En. Philip. 3 (1923) 138; MEIND. Tect. 15 (1922) 573, f. 18; Trop. Natuur 12 (1923) 77, f. 18; HEYNE, Nutt. Pl. (1927) 1156; WATSON, Mal. For. Rec. 6 (1928) 121, *f.* 22; RIDL. Disp. (1930) 293; KINT, Trop. Natuur 23 (1934) 182; v. D. PIJL, Flora 131 (1936) 25, f. 16; BACK. Bekn. Fl. Java em. ed. 4 (1942) fam. 73, p. 2.—*Aubletia caseolaris* GAERTN. Fruct. (1788) 379, t. 78, f. 2, *pro parte.*—*Blatti acide* LAMK, Enc. 1 (1789) 429.—*S. pagatpat* BLANCO, Fl. Filip. (1837) 424, ed. 2 (1845) 496, ed. 3, 2 (1878) 186; BL. Mus. Bot. 1 (1851) 337; MIQ. Fl. Ind. Bat. 1, 1 (1856) 496.—*S. rubra* OKEN, Allg. Naturgesch. 3[3] (1841) 1952; *cf.* MERR. J. Arn. Arb. 31 (1950) 285.—*S. ovalis* KORTH. Ned. Kruidk. Arch. 1 (1846) 198.—*S. neglecta* BL. Mus. Bot. 1 (1851) 338.—*S. evenia* BL. *l.c.*; MIQ. *l.c.* 497.—*S. lanceolata* BL. *l.c.*; MIQ. *l.c.* 497; KOORD. Minah. (1898) 471.—*S. obovata* BL. *l.c.*; MIQ. *l.c.* 497.—*Blatti caseolaris* O.K. Rev. Gen. 1 (1891) 238, NIEDENZU in E. & P. 3, 7 (1891) 21, *pro parte.*—*Blatti pagatpat* NIEDENZU in E. & P. 3, 7 (1891) 21.—**Fig. 3c.**

Tree, 5–15 m, rarely up to 20 m, with many often very strong breathing-roots and a rather lax crown. Ultimate branchlets drooping, when young obtusely quadrangular, rarely sharply 4-angled, occasionally even narrowly 4-winged; in the latter case the internodes often quadricornute at the apex. *Leaves* variable in shape, elliptic, oblong or oval to obovate from a contracted or cuneate base, blunt or rounded at the apex, mucronate or not, 5–13 by 2–5 cm; on either side of the rather strong midrib with 8–12 more or less widely patent very thin, often inconspicuous lateral nerves, light green; petiole broad, very short, frequently almost obsolete. Flowerbuds broadly oval, with a rounded or very obtuse apex, less than twice as long as broad. *Flowers* (5–)6–8-merous. Calyx tube during anthesis shallowly cup-shaped, smooth; tube not or hardly ribbed; segments usually distinctly longer than the tube, inner side greenish- or yellowish-white. Petals linear-lanceolate, dark red, 1¾–2½ cm by 1½–3 mm. Filaments 2½–3½ cm long, in their lower part red, in their upper part white. Ovary 16–21-celled. Segments of fruiting calyx subhorizontally spreading. Ripe *berry* resting on the flattened calyx-tube, green, 3–4 cm high, 5–7½ cm broad.

Distr. Tropical SE. Asia & Ceylon to N. Australia, Solomon Islands, and New Hebrides, in *Malaysia:* Malay Peninsula, Sumatra (also Simalur & Banka), Java (also Madura), Borneo, Celebes, Philippines, Moluccas (Ambon, Buru), Timor, New Guinea.

Ecol. *Less* salt parts of mangrove-forests on a deeply muddy soil, *never* on coral-banks, often along tidal creeks with slow-moving water and ascending these as far as the flood mounts. In anthesis the flowers contain abundant honey. *Fl.* Jan.–Dec.

BECCARI (Nelle for. di Borneo 1902, p. 140, *in ann.*) makes the following observation:—'On ascending the Sarawak one encounters, after passing Kuching, always in great numbers the *kayu p'dada* or *pĕddada, i.e. Sonneratia lanceolata* BL. (in my opinion only a variety of *Sonneratia acida*), which inhabits not only estuaries but can also grow in localities where the water is occasionally fresh. The leaves of this plant have the power of shifting, during heavy rains, the position of their blades from horizontal (as is usually the case) to vertical. I have observed this fact for the first time not in Borneo, but during my journey to Kendari in Celebes (1874) along the streambed of the river Lepo lepo, where I have also noticed that the flowers of *Sonneratia*, which, being nocturnal, are closed in the day-time, are visited by honey-eating birds in the evening and the first hours of the morning.' DOCTERS VAN LEEUWEN (Ann. J.B.B. 37, 1927, 26) supposes that the flowers are pollinated by large night-moths. VAN DER PIJL (Flora 131, 1936, 25–26, f. 16) saw bats drinking the nectar, with which the cupshaped torus is filled. BRASS mentions a thickened leaf apex which might point to guttation pores. LANE-POOLE saw in the Gulf of Papua '*S. acida* as a resting tree for fireflies gathering in such numbers on certain individual trees that at night the whole tree is lit with a soft greenish glow which is often quite distinctly reflected in the water'.

Uses. The young berries, which have a sour taste, are eaten by the people; they wood is used for fuel but as such only when better fire-wood is unavailable. The breathing roots, after having been boiled in water, furnish an inferior substitute for cork.

TH. M. MEIJER, L. DE VOS & J. P. J. SAMWEL described the extraction and properties of pectin extracted from the fruits (De Ingenieur in Ned. Indië 7 (sect. 5), 1940, *no* 9, p. 5–7, f. 1).

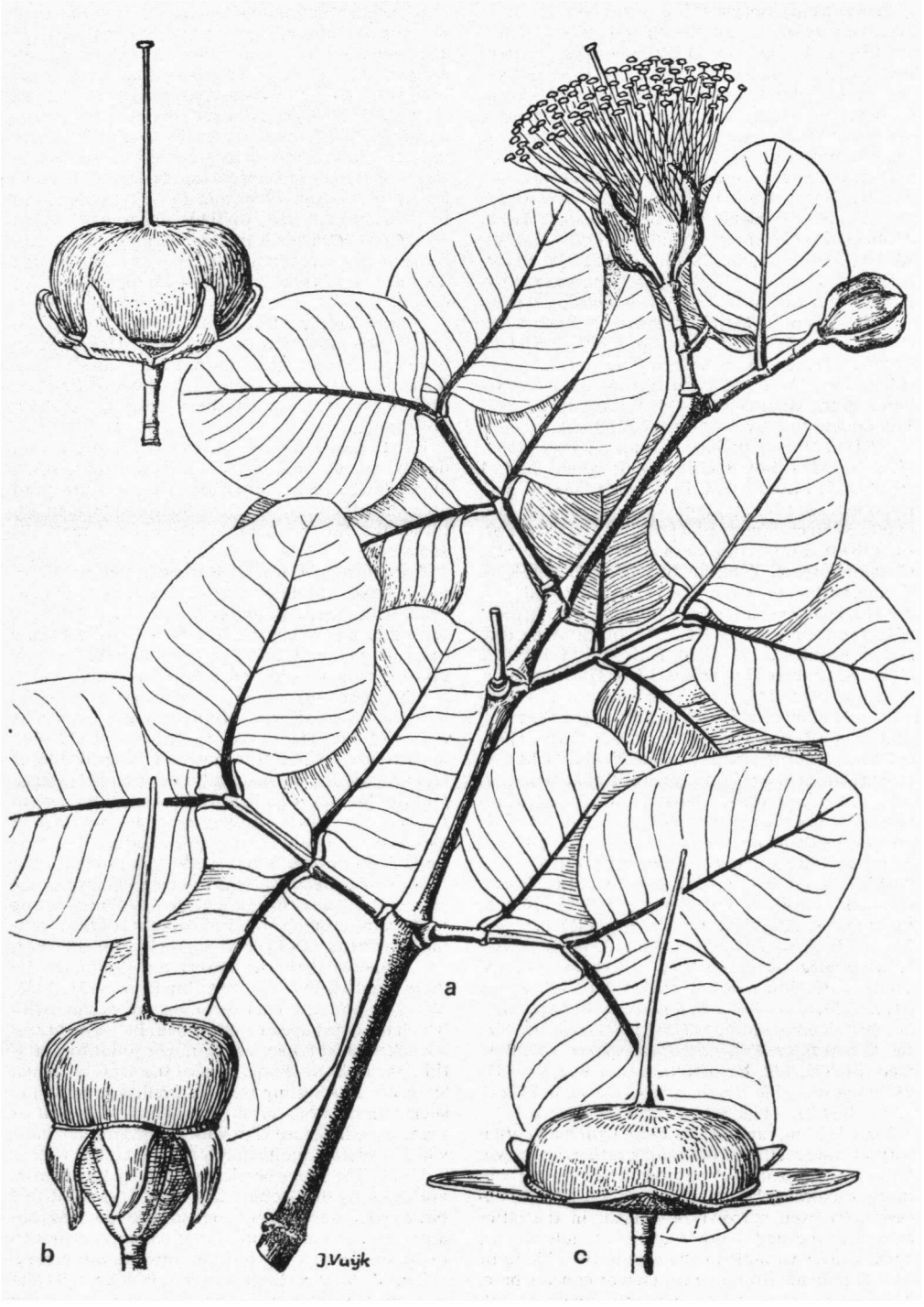

Fig. 3. *a. Sonneratia ovata* BACKER, flowering twig and fruit, *b. S. alba* J.SM., fruit, *c. S. caseolaris* (L.) ENGL., fruit, × 2/3.

Vern. Many names the commonest of which are: *Pĕdada, pĕrĕpat, pidada,* M, *bidada,* J, *bogĕm,* S, with local variants, *bĕrĕmbang* (Mal. Pen.). Philippines: *Pagatpat, palatpát, hikau-hikáuan* (Tag.), *ilukabbán, lukabbán* (Ibn.), *payar* (Pang.).

Nomencl. There has been a considerable confusion both in the identification and application of the specific names in *Sonneratia,* due to the fact that LINNÉ typified *Rhizophora caseolaris* L. (1754) by a reference to *Mangium caseolare* RUMPH., the title of a chapter treating two different plants *viz Mangium caseolare album* and *Mangium caseolare rubrum.* LINNÉ *f.* not aware of this, founded *Sonneratia acida* L. *f. n.g.n.sp.* solely on *Parapate* of SONNERAT without reference to his father's *Rhizophora caseolaris.* GAERTNER, when publishing *Aubletia caseolaris* (De Fruct. 1788, 379), quoted in synonymy *Mangium caseolare album* but from his description and plate (t. 78, 2) it appears that he made, again, no distinction between the two Rumphian plants.

In 1819 Sir J. E. SMITH (in REES Cyclop. xxxiii) disentangled the confusion by segregating and typifying the two species which RUMPHIUS had described. He singled out *S. alba* (based on *Mangium caseolare album* RUMPH.) as a new species. The other part of *Rhizophora caseolaris* (based on *Mangium caseolare rubrum*) he identified—as had been done previously by LAMARCK (Dict. 1, 1789, 429)—with *Sonneratia acida* L. *f.* which he adopted as its proper name as it was amply described and well distinguished.

For the question to which segregate of *Rhizophora caseolaris* L., which, according to art. 52 of the Rules, to our regret should be preserved and retypified, we have considered that SMITH intentionally gave a new name for a part of the type thus having accomplished the retypification himself, leaving the old name of LINNÉ for the rest, that is *Mangium caseolare rubrum* RUMPH. = *Rhizophora caseolaris* L. *p.p.em.* (*syn. S. acida* L. *f.*). MERRILL (Fl. Man. 1912, p. 344 and Interpr. Rumph. Herb. Amb. 1917, p. 383) did the same, though he later reversed his opinion (En. Philip. Fl. Pl. 3, p. 138) but he states to have not seen the original literature.

2. Sonneratia ovata BACKER, Bull. J.B.B. III, 2 (1920) 329; MEIND. Tect. 15 (1922) 573, f. 19; Trop. Natuur 12 (1923) 77, f. 19; STEEN. Bull. J.B.B. III, 12 (1931) 162; MERR. & PERRY, J. Arn. Arb. 22 (1941) 269; BACK. Bekn. Fl. Java, em. ed. 4 (1942) fam. 73, p. 2.—*S. alba auct. plur.*; WATSON, Mal. For. Rec. 6 (1928) 120, 122, f. 23.—**Fig. 3.**

Small or medium-sized tree, 2–5(–20) m high; young branchlets obtusely quadrangular. *Leaves* broadly ovate or oval to orbicular, rounded or subcordate at the base, broadly rounded at the top, 4–10 by 3–9 cm; lateral nerves several, widely patent, very thin; petiole 2–15 mm. *Flowers* solitary or 3 together; pedicels 1–2 cm, sometimes none. Buds broadly oval, with a rounded or very obtuse apex, less than twice as long as broad, finely verruculose, in anthesis 2½–3 cm long, tube widely cupular from an abruptly contracted, shortly stipitiform base; ribs decurrent down the stalk-like lower part. Segments usually 6, ovate-triangular, during anthesis as long as the tube or slightly longer, their inner side strongly tinged with red, in fruit appressed to the berry. Petals absent. Filaments white. Ovary 13–15-celled. Ripe *berry* 3–4¾ cm broad, 2½–3½ cm high.

Distr. Siam (KERR 17875, 14246, 4345, PUT *s.n.*, A. MAREAN 673), in *Malaysia:* Malay Peninsula (Singapore; Sg. Menyala in Negri Sembilan, CF 571; MAINGAY 654), Riouw Arch. (Siantan in the Anambas Islands), Java (also in Karimondjawa Islands), S. Celebes, Moluccas (Sula Islands), SE. New Guinea (Daru Island). Fig. 5.

Ecol. Land-side of tidal forests in the less salt parts on a muddy soil, along tidal creeks, never on coral-reefs. Locally numerous but, on the whole, rather rare. *Fl.* Jan.–Dec.

Vern. *Gédabu* (Mal. Pen.).

3. Sonneratia alba J. SMITH in REES, Cycl. 33 (1819) *no* 2; DC. Prod. 3 (1828) 231; BL. Mus. Bot. 1 (1851) 338; MIQ. Fl. Ind. Bat. 1, 1 (1856) 497; KURZ, For. Fl. (1877) 526; HOOK. *f.* Fl. Br. Ind. 2 (1879) 580; BISSCHOP-GREV. Pl. Ned. Ind. (1883) 163; K. & V. Bijdr. Booms. I (1894) 200; KOORD. Minah. (1898) 470; BAILEY, Queensl. Fl. (1900) 679; BECC. Nelle For. di Borneo (1902) 579; KOORD. Exk. Fl. 2 (1912) 663; MERR. Interpr. Herb. Amb. (1917) 383; BACK. Bull. J.B.B. III, 2 (1920) 330; MERR. En. Born. (1921) 418; MEIND. Tectona 15 (1922) 573, f. 17; Trop. Natuur 12 (1923) 77, f. 17; HEYNE, Nutt. Pl. (1927) 1156; RIDLEY, Disp. (1930) 293; TROLL, Trop. Natuur 22 (1933) 33–39 *cum ic.*; KINT, Trop. Natuur 23 (1934) 173–189, f. 9; BURK. Dict. (1935) 2051; KANEHIRA, J. Jap. Bot. 14 (1938) 423, f. 3 A–K; BACK. Bekn. Fl. Java, em. ed. 4 (1942) fam. 73, p. 2; STEEN. Fl. Sch. Indon. (1949) 292.—*Mangium caseolare album* RUMPH. Herb. Amb. 3 (1743) 111, t. 73.—*Rhizophora caseolaris* LINNÉ in STICKMAN, Herb. Amb. (1754) 13, *pro parte.*—*Chiratia leucantha* MONTR. Mém. Ac. Imp. Sc. Lyon 10 (1860) 203.—*S. mossambicensis* KLOTZSCH *ex* PETERS, Reise Mossamb. Bot. 1 (1862) 66, pl. 12.—*Blatti alba et leucantha* O.K. Rev. Gen. 1 (1891) 238; NIEDENZU in E. & P. 3, 7 (1893) 21.—*Sonneratia caseolaris* ENGL. in E. & P. Nachtr. (1897) 261, *ex parte*; *sensu* MERR. En. Philip. 3 (1923) 139.—*S. griffithii* (*non* KURZ) WATSON, Mal. For. Rec. 6 (1928) 120, 121, f. 24.—*S. iriomotensis* MASAMUNE, Syokubutu-tirigaku fig. 71 (1936), *cf.* MASAM. Trans. Nat. Hist. Soc. Formosa 29 (1939) 272, *in syn.* = *S. alba var. iriomotensis* MASUM. *cf.* YAMAMOTO, J. Soc. Trop. Agric. Taihoku 12 (1940) 162.—**Fig. 3b.**

Tree, 3–15(–20) m high, with many breathing roots (these, on the whole, less robust than those of *S. caseolaris*) and a broad, rather lax crown. *Leaves* emucronate, obovate or oval from a cuneate base, broadly rounded at the top, often emarginate, 5–12½ by 3–9 cm, rather thickly coriaceous, on either side of the rather strong midrib with 11–14 widely patent, very thin, sometimes hardly conspicuous lateral nerves; petiole stout, flattened on the anterior side, 3–10 mm. Flowerbuds oblong, narrowed at base and apex, 2–3 times as long as

broad. *Flowers* solitary or 3 together, 6–7–(8)-merous. Calyx in flower 3–3½ cm long; tube obconical or campanulate from a contracted base, distinctly angular, angles as many as segments and alternating with them; segments ovate-oblong, usually conspicuously shorter than the rest of the calyx, 1½–2 cm long, outside green, inside red, during anthesis more or less erect, under the ripe berry entirely reflexed. Petals in young flowers always present but very inconspicuous, strikingly resembling the filaments, 13–20 by ½–1¼ mm, white or in the lower half more or less tinged with red. Filaments white. Ovary 14–18-celled. Tube of fruiting calyx conspicuously obconical-turbinate, 1½–2 cm high. Ripe berry ± 3 cm high, ± 4 cm broad.

Distr. N. Madagascar, Seychelles and trop. E. Africa, SE. continental Asia and Andamans to N. Australia, S. Riu Kiu Islands (Iriomote), Micronesia (Pelew), Solomon Islands, the New Hebrides and N. Caledonia, in *Malaysia:* Malay Peninsula, Sumatra (also Enggano & Banka Islands), Java (also coral-islands in and before the Bay of Djakarta, Bawean, Madura & Kangean Islands), Lesser Sunda Islands (Bali), Borneo (also Pulu Laut), Celebes (also Saleier & Muna Islands), Philippines, Moluccas, New Guinea & New Ireland.

Ecol. Shallow parts of calm seas, seashores, along the mouth of tidal creeks. Prefers salt water and grows as well on a sandy or rocky as on a muddy soil, not rarely on coral-terraces. Often gregarious and predominating, but usually not forming a dense growth, except sometimes where better fuel-trees have been destroyed. In closed forest the clear bole may attain 15 m.

Uses. In the Minahasa (NE. Celebes) the wood is valued for ship- and house-building (under the roof). Elsewhere it is only used as fire-wood or not used at all.

Vern. Names as those of *S. caseolaris*. Moreover: *Posi-posi* (Ternate). Philippines: *pagatpát* (general); *bunayon* (C. Bis.), *buñgálun* (P. Bis.), *palálan, pirara, pědada* (Mag.), *dalúru-laláki, palapát, palaspát, palatá, palapát* (Tag.), *patpát* (Mbo).

Notes. The fragment of the type of *S. mossambicensis* at Kew is insufficient for critical examination; as all other African sheets from Somaliland, Zanzibar (GREENWAY 1355), Pemba and Mafia Islands, Tanga Bay, Luabo River at Zambesi mouth (KIRK), the Seychelles (Aldabra group), and N. Madagascar (BARON 6631, 6733, Nossi-bé, J. M. HILDEBRANDT 3133) between 1° and 19° SL belong to *S. alba* J.SM., we accept the type to belong to this species, notwithstanding the fact that in the type description the fruit (ripe?) is drawn with appressed lobes and petals are said to be absent.

S. alba appears to be the most widely distributed species both towards Africa and the West Pacific.

4. Sonneratia apetala BUCH.-HAM. in SYMES, Embassy Ava 3 (1800) 477, *cum tab.*; SCHRADER, J. f. d. Bot. II, i, II (1800) 252–253, t. 7; SM. in REES, Cycl. (1819) 33, *no* 3; ROTH, Nov. Sp. (1821) 233; DC. Prod. 3 (1828) 231; ROXB. Fl. Ind. ed. CAREY 2 (1832) 506; W. & A. Prod. (1834) 327; GRIFF. Not. 4 (1854) 650; KURZ, For. Fl. Burma 1 (1877) 527; CLARKE in HOOK. *f.* Fl. Br. Ind. 2 (1879) 579; GAMBLE, Fl. Madr. 3 (1919) 515; PARKER, Ind. For. 51 (1925).—*Kambala apetala* RAFIN. Sylv. Tell. (1838) 19.—*Blatti apetala* O.K. Rev. Gen. 1 (1891) 238; NIEDENZU in E. & P. 3, 7 (1893) 21.

Medium-sized tree up to 12 m; twigs pendulous. *Leaves* sparse, 5½–13 by 1½–3¾ cm, gradually tapering towards the apex, attenuate at the base; nerves and veins indistinct; petiole ½–1 cm. Inflorescence mostly 3-flowered. Buds oblong, 1½ cm long. *Calyx* (incl. tube and lobes) in flower ± 1½–2 cm long, smooth, not ribbed; segments twice as long as the tube. Ovary 5–8-celled, nearly free from the calyx. Stigma in bud roofing over the androecium, but little protruding above it, during anthesis flattening and broadening, up to 7 mm diam., papillose, persistent. *Fruit* pale, broader than high, broadly globose; walls not thickened, 12–18 mm high, ± 2¼ cm diam. Calyx tube flat (as in *S. caseolaris*), lobes under the ripe fruit apparently horizontally expanded or subreflexed.

Distr. India (Sunderbuns, the Deccan as far as the Concan, Madras, Bombay, Orissa, Transgangetic Peninsula to Chittagong, Pegu, and Moulmein), and Ceylon, to be expected in the Malay Peninsula and elsewhere in *West Malaysia.*

Ecol. A well-characterized species, on the whole much less common than *S. alba* and *S. caseolaris.* In a specimen all stigmas were covered by adhering quartz sand which suggests that they are sticky.

Note. The only ovary available to us was 5-locular. The only specimen cited by TRIMEN (Handb. Fl. Ceyl. 2, 1894, 230) from Kotiyar possesses 6 sepals and may be distinguished as *f.* **hexasepala,** *f. nov.* (TRIMEN, Aug. 1885).

5. Sonneratia griffithii KURZ, J. As. Soc. Beng. 40, ii (1871) 56, *in clav.*; Pegu Rep. App. B (1875) 54, *in clav.*; For. Fl. Burm. 1 (1877) 527; CLARKE, Fl. Br. Ind. 2 (1879) 580; RIDL. Fl. Mal. Pen. 1 (1922) 825, *p.p.*; PARKER, Ind. For. 51 (1925) 507, 510; CRAIB, Fl. Siam. En. 1 (1931) 732; *plur. auct. p.p.* —*Sonneratia alba* (*non* SM.) GRIFF. Posth. Pap. 4 (1854) 652; WATSON, Mal. For. Rec. 6 (1928) fig. 23.—*S. acida var. griffithii* KING, J. As. Soc. Beng. 67, 2 (1898) 11.—**Fig. 4.**

Tree, 5–20 m tall, up to 1 m diam. *Leaves* obovate to suborbicular, base rounded, shortly contracted into a short petiole, apex broadly rounded to subemarginate, texture rather thickish, nerves 10–12, (*pro gen.*) distinct, strongish, distinctly prominent on the upper surface, obliquely ascending; blade 7–10½ by 5½–9 cm. Mature bud 2½–3 cm long. *Flowers* greenish-white (PARKER). *Calyx* entirely smooth and not ribbed, tube rather wide-campanulate from a suddenly contracted base. Lobes 6–7, in fruit together with the tube horizontally expanded, not enveloping the base of the fruit, 6½ cm diam., thick. *Fruit* 2½–3 cm high, 4–5½ cm diam., hard, many-celled, apex very broadly rounded; style apparently less persistent than in *S. caseolaris* (= *acida*). Type: GRIFFITH 2433.[1]

(1) GRIFFITH 2432 = *S. alba* J.SM.

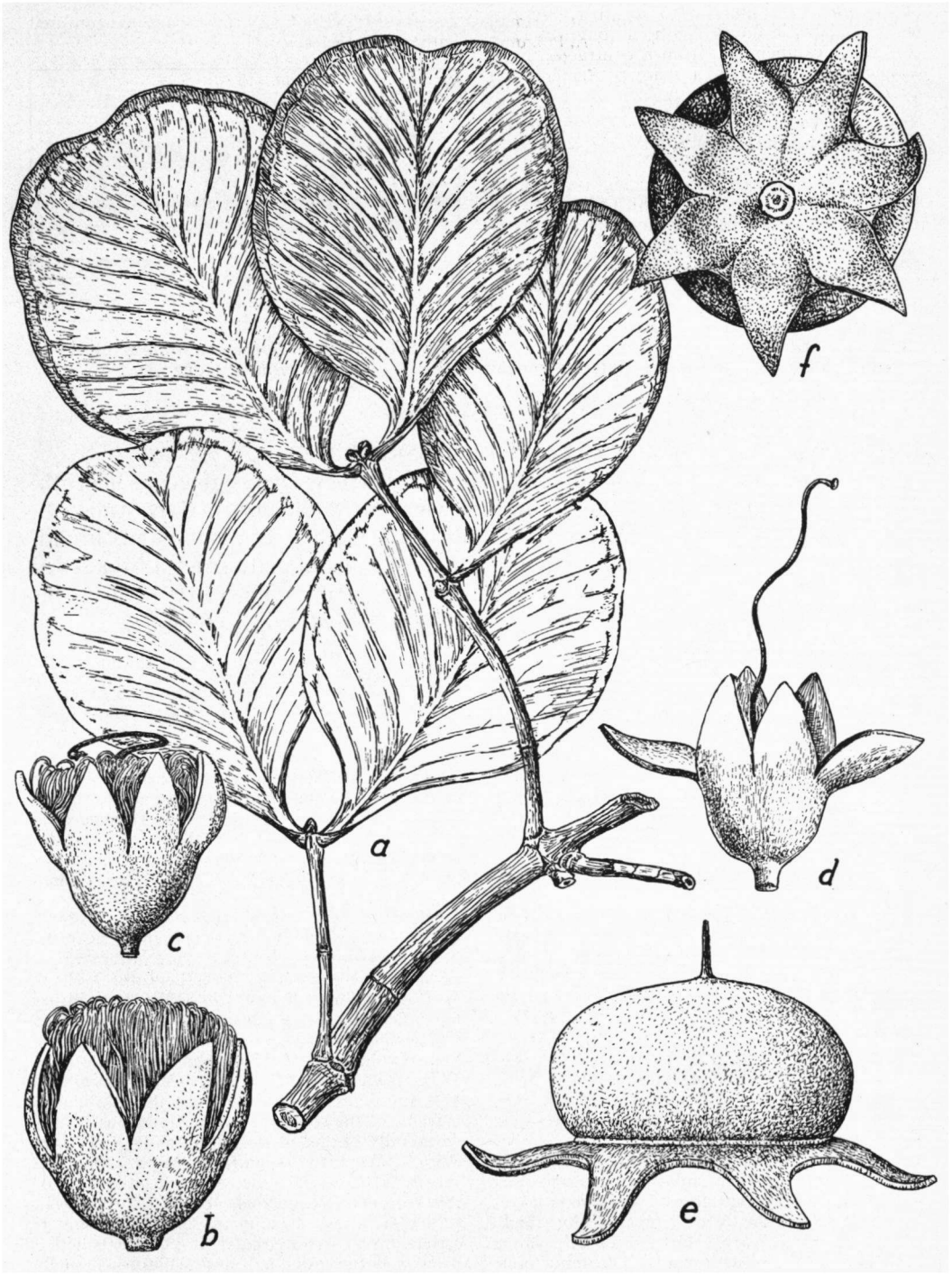

Fig. 4. *Sonneratia griffithii* KURZ. *a.* Twig (LACE 2966), × 2/3, *b.* opened bud (KERMODE 7136), nat. size, *c. ditto* (KERR 16548), nat. size, *d.* flower beyond anthesis (KERR 16548), nat. size, *e.* ripe fruit, lateral (KERR 14246), nat. size, *f. ditto*, basal (LACE 2966), × 2/3.

Distr. Bengal (Chittagong Div., pr. Srimai, COWAN 208), Burma (Myaungmya distr., Polaung, LACE 2966, Bassein village, near Tazin, KERMODE 7136), Lower Siam (Puket distr. Satul, KERR 14246, Ranauwng, KERR 16548), Mergui (PARKER, *l.c.*), Andamans (PARKER, *l.c.*), in *Malaysia:* W. Malay Peninsula (SCORTECHINI 967, KING, *l.c.*). Fig. 5.

Ecol. Said to be common in mangrove swamps, but it is scarce in herbaria, of which the above is a complete enumeration; LACE says: 'in places frequent on banks of streams, sends up many sharp-pointed aerophores'; KURZ defines its occurrence: 'common in littoral forests from Pegu down to Tenasserim, ascending the rivers as far as they are brackish'. *Fl.* Jan. (Siam), *fr.* Jan. (Siam), March (Burma), April (Bengal).

Note. Allied to, but distinctly differing from *S. caseolaris* (L.) ENGL.; by several authors confused with other species.

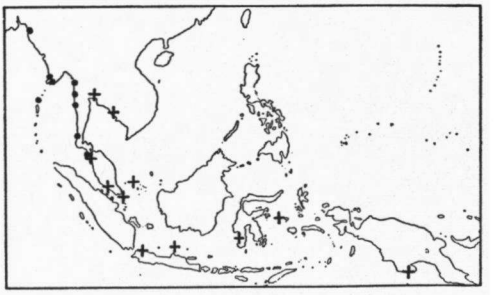

Fig. 5. Localities of *Sonneratia ovata* BACKER (+) and *S. griffithii* KURZ (•).

2. DUABANGA

BUCH.-HAM. Trans. Linn. Soc. Lond. 17 (1835) 177–178.

Buttressed tall trees with pendulous ultimate branches. *Leaves* glaucous beneath. *Flowers* in terminal, 5- to many-flowered corymbs, 4–8-merous. Calyx-tube obconical or cupshaped, segments triangular-ovate. Petals shortly clawed, broad, crisped. Stamens 12 or many, filaments long, filiform-subulate from a broadened base; anther recurved or replicate over one end of the connective. Ovary 4–8-celled, stigma thick, lobed. *Capsule* loculicidally 4–8-valved. Seeds tailed at both ends by the produced testa.

Distr. Species two, SE. Asia and *Malaysia* (as far E as New Guinea). Fig. 6.

Ecol. Evergreen forests.

Uses. Wood used for house- and boat-building.

KEY TO THE SPECIES

1. Flowers and fruit 4-merous. Calyx-tube obconical. Stamens 12. Anther-cells narrowly hairpin-shaped; extrorse arm of hairpin about half as long as introrse arm, closely applied to it and adnate to it. **1. D. moluccana**

1. Flowers and fruit 5–8-merous. Calyx-tube widely cup-shaped. Stamens more than 50, biseriate. Anther-cells recurved but not narrowly hairpin-shaped; extrorse arm of curve much less than half as long as introrse arm, not closely applied to it and not adnate to it . . . . . **2. D. grandiflora**

1. Duabanga moluccana BL. Mus. Bot. 1 (1849) 109; MIQ. Fl. Ind. Bat. 1, 1 (1855) 625; TEYSM. Nat. Tijd. N.I. 11 (1856) 186; VIDAL, Sin. Atl. (1883) t. 52, f. F; K. & V. Bijdr. Booms. 1 (1894) 195; KOORD. Minah. (1898) 469; Exk. Fl. 2 (1912) 663; Atlas Baumart. (1918) t. 784; MERR. En. Philip. 3 (1923) 139; HEYNE, Nutt. Pl. (1927) 1157; MERR. Pl. Elm. Born. (1929) 212; DE VOOGD, Trop. Natuur 27 (1938) 177–178, f. 4; BACK. Bekn. Fl. Java, em. ed. 4 (1942) fam. 73, p. 3; HOLTHUIS & LAM, Blumea 5 (1942) 216.—*D. borneensis* R. KNUTH, Fedde, Rep. 38 (1935) 121.

Tree, 25–35 m, sometimes up to 45 m, 0,70–1,00 m thick; trunk columnar, unbuttressed. Very young branchlets and both surfaces of very young leaves rather densely clothed with appressed short thickish brown hairs, very soon glabrescent; young branchlets obtusely quadrangular, becoming terete with age. *Leaves* ovate, oblong or lanceolate from a shallowly cordate base, acuminate, firmly coriaceous, on either side of the (on the lower surface) much prominent costa with numerous widely patent arcuate lateral nerves inarching near the margin and forming there a strong intramarginal nerve, darkgreen above, paler beneath, 7–30 by 4–12 cm; petiole 4–8 mm. *Corymbs* few- to rather many-flowered, 4–15 cm across, dense or rather lax, at first finely pubescent, afterwards glabrous. Pedicels thick, 1–1½ cm (in bud ½ cm, in fruit to 3½ cm). Buds ovoid-oval, shortly acuminate, with 4 longitudinal ribs (formed by the contiguous margins of the sepals). *Flowers* inodorous? Calyx when fully expanded during anthesis ± 2½ cm diam., afterwards slightly enlarged; segments shortly acuminate, acute, under fruit patent or reflexed. *Petals* caducous, shortly clawed, oval, yellowish, about as long as sepals. Stamens 1-seriate, on a narrow circular rim; filaments with a broadly linear lower half and a filiform-subulate upper half; anthers at first yellow, afterwards brown. Style pale green; stigma dark green or red. *Capsule* ovoid-oblong, 2½–3 cm long, 4-valved.

Seeds ∞, 5–6 mm long (2–2½ mm long tails included); nucleus ± 1 mm.

Distr. *Malaysia:* Java (only easternmost part), Lesser Sunda Islands (Bali, Lombok, Sumbawa), Borneo, Celebes, Talaud, Philippines, Moluccas (Halmahera, Ternate, Batjan, Ambon, Ceram), New Guinea. Fig. 6.

Ecol. Evergreen forests, 60–1200 m, in NW. Sumbawa observed to predominate in majestic trees on the slope of Mt Tambora, possibly also occupying this position in E. Flores.

Uses. Wood used for house- and boat-building.

Vern. In Java: *Takir*, J, *takèr*, Md; in Bali: *kadjimas*; in Lombok: *radjumas*; in Talaud: *waròh*. Further several local names. Philippines: *Adha, adka, karauan, lubtub* (Bik.), *agas, banabáng-bugtong, binuang, buluang, loktob, loktok, lokton, luktúb, malapalikptk* (Tag.), *arik, kadíg* (Ibn.), *bukag, kadil, kadír* (Ilk.), *buyúkan* (God.), *dahá* (Mbo, P. Bis.), *dapul* (Ting.), *hoi* (Bon.), *iloílo* (P. Bis.), *kadél, karíg* (Neg.), *lamod* (Mag., Bag.), *lutub* (Sul.).

2. Duabanga grandiflora (ROXB. *ex* DC.) WALP. Rep. 2 (1843) 114; BLUME, Mus. Bot. 1 (1849) 109; T. & B. Cat. Hort. Bog. (1866) 241; KURZ, Pegu Rep. App. B (1875) 54.—*Lagerstroemia grandiflora* ROXB. (Hort. Beng. 1814, p. 38) *ex* DC. Mém. Soc. Hist. Nat. Genève 3² (1826) 84; Prod. 3 (1828) 93; ROXB. Fl. Ind. ed. CAREY 2 (1832) 503.—*D. sonneratioides* BUCH.-HAM. Trans. Linn. Soc. 17 (1835) 177–178; HOOK. *f.* Ill. Himal. Pl. (1855) t. 11; KURZ, For. Fl. 1 (1877) 525; CLARKE in HOOK. *f.* Fl. Br. Ind. 2 (1879) 579; KING, J. As. Soc. Beng. 67, 2 (1898) 10; RIDL. Fl. Mal. Pen. 2 (1922) 824; BURK. Dict. 1 (1935) 869; CORNER, Wayside Trees (1940) 427, atl. f. 127–128; BACK. Bekn. Fl. Java, em. ed. 4 (1942) fam. 73, p. 3.—*Leptospartion grandiflorum* GRIFF. Ic. Pl. As. 4 (1854) 591.

Tree, 18–30 m, scarcely buttressed, glabrous in all its parts; branches drooping, young branchlets obtusely quadrangular. *Leaves* ovate-oblong from a broad, cordate or rounded base, shortly acuminate, on both sides of the (on the lower surface) much prominent costa with numerous widely patent arcuate lateral nerves, glaucous beneath, 10–30 by 5–10 cm; petiole robust, 3–8 mm; flush reddish pink. Corymbs drooping, rather many-flowered, ± 15 cm across, rather lax. Pedicels robust, 3–4 cm. *Calyx*-tube widely cup-shaped, segments ovate, acute, 2¼–2½ cm. Petals shortly clawed, with an oval, rounded crisped blade, white, 2½–3½ by 1½–2½ cm. Stamens upwards of 50; filaments filiform from a slightly broadened base, white; anthers very mobile, curved but not narrowly hairpin-shaped. Free top of ovary broadly conical; stigma slightly lobed, darkgreen. *Capsule* subglobose, green, eventually turning brown and splitting with 5–7 longitudinal clefts.

Distr. From the S. slopes of the E. Himalaya (Sikkim) to Assam, Burma, Siam, Yunnan, Laos, Kambodja, Cochinchina, Annam, Tonkin, and Andamans, extending to *Malaysia:* Malay Peninsula (as far as Negri Sembilan). The areas of this and the preceding species do not touch, much less overlap. Statements to the contrary are either entirely wrong or must be based on cultivated specimens. Fig 6.

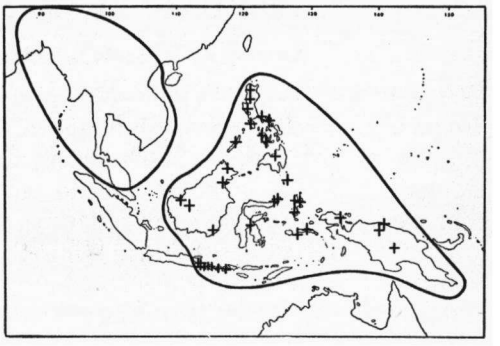

Fig. 6. Area of distribution of the genus *Duabanga: D. grandiflora* (ROXB.) WALP. (left) and *D. moluccana* BL. (right; localities indicated by +).

Ecol. RIDLEY (Disp. 1930, p. 119) says: 'It is an inhabitant of forests in the Malay Peninsula, where it is widely scattered, but not common. The trees are sporadic, at some considerable distance from each other. It appears to prefer loose open soil, which is not to be found in a large quantity in dense tropical forests; but the very numerous, minute seeds blown across the jungle may here and there find a suitable spot for growth, and so carry on the spread of the plant, though in these forests far the greater number of seeds must perish for want of a suitable growing spot.' According to CORNER, *l.c.* one of the characteristic trees of all the passes of the Main Range in the Mal. Peninsula from G. Angsi to Kroh.

Uses. Wood used for tea-boxes and for house- and boat-building. Malays eat the very acid fruits (BURK. *l.c.*).

Vern. Malay Peninsula: *Pĕdada, p. bukit, p. darat, kĕndada, kĕdada bukit, bĕrĕmbang bukit, b. darat, bĕrmah* (Kroh), *bĕrombong bukit*. As *bukit* means hill or mountain, the Malays apparently observe acutely the affinity of *Sonneratia* and *Duabanga* as *pedada* is the universally used name for the former, and the names can thus be translated: inland-Sonneratia.

Notes. The flowers emit an offensive smell.

Excluded

Xenodendron LAUT. & K. SCH. Fl. Deut. Sch. Geb. Südsee (1901) 461; E. & P. Nachtr. 3 (1908) 239, f. 33 = *Acmena* (*Myrt.*), *cf.* MERR. & PERRY, J. Arn. Arb. 19 (1938) 11.