

oligoneura Soepadmo	olig.	<i>woodii</i> Merr.	evan.
oviformis Soepadmo	ovif.	<i>Fagus argentea</i> Bl.	arg.
<i>pachycarpa</i> A. Cam.	rham.	<i>javanica</i> Bl.	jav.
paucispina Soepadmo	pauc.	<i>philipensis</i> Blanco	phil.
<i>pearsonii</i> Merr.	mott.	<i>Lauras ludda</i> Wall.	luc.
<b>pedunculata</b> Soepadmo	ped.	<i>Lithocarpus hypophoenicea</i>	
<i>psnangensis</i> A. Cam.	jav.	(v. Seem.) Barn.	hypo.
<i>philipensis</i> (Blanco) Vidal	phil.	<i>Pasania acuminatissima</i> (Bl.)	
<i>psilophylla</i> Soepadmo	psi.		
<i>reflexa</i> (King) Rehd.: see		Oerst.	acum.
<i>Lithocarpus</i>		<i>discocarpa</i> (Hance) Gamble	jav.
<i>rhamnifolia</i> (Miq.) A. DC.	rham.	<i>Quercus acuminatissima</i> (Bl.)	
<i>ridleyi</i> Gamble	tung.	A. DC.	acum.
<i>schefferiana</i> Hance	sch.	<i>discocarpa</i> Hance	jav.
<i>schlenkeriae</i> Bailey	acum.	<i>fagiformis</i> Jungh.	acum.
<i>scorteehinii</i> Gamble	scor.	<i>hypophoenicea</i> v. Seem.	hypo.
<i>selangorensis</i> A. Cam.: doubtful	species	<i>javanica</i> (A. DC.) Drake	jav.
<i>spectabilis</i> (Miq.) A. DC.	cost.	<i>junghuhii</i> Miq.	acum.
<i>sumatrana</i> (Miq.) A. DC.	iner.	<i>lineata</i> (non Bl.) Miq.	acum.
<i>trisperma</i> Scheff.	cost.	<i>rhamnifolia</i> Miq.	rham.
<i>tungurrut</i> (Bl.) A. DC.	tung.	<i>varingaefolia</i> Miq.	acum.
<i>turbinata</i> Stapf: see		<i>Synaedrys discocarpa</i> (Hance)	
<i>Lithocarpus</i>		Koidz.	jav.
<i>wallichii</i> King ex Hook. f.	wall.	<i>fagiformis</i> (Jungh.) Koidz.	acum.

## STUDIES OF MALESIAN PANDANACEAE. II. TWO NEW SPECIES OF PANDANUS STICKM. SECT. FUSIFORMA ST. JOHN

BENJAMIN C. STONE\*)

### SUMMARY

*Pandanus saint-johnii* and *P. soboliferus* spp. nov. are described and illustrated and placed in sect. *Fusiforma*. It is proposed to include *P. (Acrostigma) biplicatus* St. John and *P. (Rykia) magnifibrosus* St. John in sect. *Fusiforma* also.

### INTRODUCTION

On the basis of its stigmatic structure, sect. *Fusiforma* St. John (*in Pacif. Sci.* 16: 227. 1962. — Type species: *Pandanus dumetorum* Holttum & St. John) is most closely allied in the genus *Pandanus* Stickm. to the sect. *Acrostigma* Kurz. Its chief differences are the blunter styles, the constantly caespitose soboliferous habit, and the extraordinary hardness of the dark leaves. All members of sect. *Fusiforma* produce their long stiff leaves directly from ground level. It is this acaulescent rhizomatous habit which characterizes best all the species known to date and which gives a firm basis to the sectional ranking. As is also true of most species of sect. *Acrostigma*, the ventral pleats of the leaf tips are prickly with small antrorse teeth.

The discovery of the two new species to be described below brings the number of species in sect. *Fusiforma* up to five, but a sixth species is almost surely also to be included. *Pandanus dumetorum* Holttum & St. John (*in Pacif. Sci.* 16: 227, fig. 102. 1962. — Holotypus: *Corner 80066* in SING) has been, until now, the sole member of sect. *Fusiforma*. Other undoubted members of the section are the North Bornean *P. pachyphyllus* Merr. (*in J. Roy. Asiatic Soc., Str. Branch* 85: 154. 1922. — Holotypus: *Ramos 1541* in PNH, now destroyed; isotypus in US; the following recent collections from Sabah in KLU are referable here: Sandakan, Kebon China Forest Reserve, 17 March 1967, *Stone, Meijer & Gaudet 6699*, immature fruit; Sepilok Forest Reserve, N. of Sandakan, 20 March 1967, *Stone &*

\*) School of Biological Sciences, University of Malaya, Kuala Lumpur, Malaysia,

*Meijer 6709*, immature fruit in lowland swamp forest; same locality; Sepilok Besar River, 21 March 1967, *Stone & Meijer 673,2*), *P. biplicatus* St. John (*in Pacif. Sci.* 17: 466, fig. 192. 1963. — Holotypus and only known specimen: *Haniff & Nur 2703* in SING) from lower Thailand, originally assigned to sect. *Acrostigma*, and the two new species *P. saint-johnii* B. C. Stone and *P. soboliferus* B. C. Stone, both from Malaya.

The sixth species, *P. magnifibrosus* St. John (*in Pacif. Sci.* 17: 478, fig. 198. 1963. — Holotypus: *Kerr 19227* in BK) from Thailand, certainly appears to have the essential features of sect. *Fusiforina* rather than those of sect. *Rykia* (De Vriese) Kurz, to which it was originally assigned. It was described as "stemless", and possesses prickly ventral pleats (a character unknown in sect. *Rykia*); the prickles of the midrib near the base of the leaves on the dorsal side are rectiform or retrorse, exactly like those of *P. dumetorum*. The inflorescence is erect, and the individual fruits are highly similar to those of *P. dumetorum*. The totality of the evidence thus points to the inclusion of *P. magnifibrosus* in sect. *Fusiforina*. Nevertheless, this has been done here with slight reservation, and further collections would be extremely valuable to settle the taxonomic position of this interesting species.

#### KEY TO SPECIES OF PANDANUS SECT. FUSIFORMA

- 1a. Drupes with unusually thick longitudinal fibres, which are as much as 0.9 mm diam.; leaf apex with large, stout, deltoid prickles. Thailand ... *P. magnifibrosus*
- b. Not as above..... 2
- 2a. Cephalia racemose, 2—5 together, up to 8 cm long; drupes up to 27 mm long. N. E. Malaya ..... *P. dumetorum*
- b. Cephalia solitary, or if racemose only 2—3 together, about 11—14 cm long or more; drupes 25—50 mm long ..... 3
- 3a. Drupes mostly 40—50 mm long. S. E. Malaya ..... *P. saint-johnii*
- b. Drupes shorter or up to 40 mm long..... 4
- 4a. Drupes 35—40 mm long. Sabah..... *P. pachyphyllus*
- b. Drupes (25—) 30 (—40?) mm long..... 5
- 5a. Styles 6—8 mm long. Lower Thailand..... *P. biplicatus*
- b. Styles 3—4 mm long. N. W. Malaya ..... *P. soboliferus*

#### *Pandanus saint-johnii* B. C. Stone, *spec. nov.* — Fig. 1, Pl. I, II

Planta acaulis caespitosa rhizomatosa. Foliis erectis rigidis perduris ad 7 m longis et 6—8 cm latis, ad basem crassiter coriaceis ad apicem exilibus et subcoriaceis pendente, unisulcatis, M-formatis, in quoque latere cum c. 50 nervis secundarii parallelis, nervis transversis non evidentibus; apice sensim attenuato et breviter acuminato, in paginis ventralibus apicem versus secus plicas laterales conspicue spinulosas. Inflorescentia foeminea

in foliis subclausa, erecta, breviter pedunculata, pedunculo ad 20—30 cm longo trigono ad 13 mm crasso, cephalio solitario ellipsoideo 15—18 cm longo 10—14 cm lato subglaucobubalino; bracteis non vidi; drupas anguste obovatae vel oblongae, (3.5—)4—5 cm longae et 7—11 mm latae, in quinta apicali parte pyramidati, valde penta-hexagonati, rostellati, in stylum obtusum brevicuspidatum breviter prorsum curvatum terminante, superficie dorsali stylis stigmatica; stigmatibus leviter concavo elliptico vel anguste elliptico, ad 3 mm longo et 1—2 mm lato; pileo indehiscenti; endocarpio subbasali obconico 1 cm longo et 5—6 mm lato, semine unico. Inflorescentia mascula erecta, crasso-pedunculata, bracteis carnosius flavibus, pedunculo albo trigonato 18 mm crasso, spicis 7, albidis, 5—7.5 cm longis, 1.6—2.3 cm crassis, staminibus numerosis; phalanges staminorum 3—(rare 2—5-) staminatis, filamentis 1—1.1 mm longis crassis aurantiaceis apicem versus abrupte contractis, antheris c. 7.2 mm longis, apiculo 0.4 mm longo. Pollen album.

TYPUS: *Stone, Chew & Hill 6231* (KLU).

Caespitose, rhizomatous plants. Leaves erect, rigid, very hard, up to 7 m long and 6—8 cm wide, thickly coriaceous at base, thinner toward the tip and somewhat pendent, 1-sulcate, biplicate, M-formed in cross-section, with about 50 nerves on each side of the midrib, transverse nerves "hot" evident; apex gradually narrowed and at last briefly acuminate, ventral lateral pleats spinulose. Details of leaf: midrib, near base, from base out to 8—17 cm unarmed; thereafter with stout somewhat recurved or rectiform prickles to 5 mm long, mostly 1—2 cm apart, lenticular in cross-section; near middle of leaf, the prickles smaller, farther or much farther apart, with much (50—100 cm) of the midrib essentially smooth; but again near the apex prickly, the prickles antrorse, 0.5—0.7 mm long, 5—20 mm apart; margins, near base, unarmed on basal 8—17 cm, thereafter the stout prickles similar to those of adjacent midrib, often retrorse, hooklike; prickles 3 mm broad at base, mostly 5 mm long; near middle of leaf the prickles smaller and antrorse, 1—2 mm long, deltoid, mostly about 1—2 cm apart; near the tip 0.5—0.7 mm long, antrorse, rather evenly spaced, near the acumen 2—4 mm apart. Upper lateral pleats prickly near leaf-tip, prickles antrorse, about 0.5—0.7 mm long, 5—20 mm apart, extending about 30—45 cm back of the tip. Inflorescence erect, hidden near base of plant among the leaves. Pistillate inflorescence of a single cephalium; peduncle 20—30 cm long, 13 mm thick, trigonal; cephalium ellipsoid, 15—18 X 10—14 cm, slightly glaucous and yellow-buff prior to ripeness; drupes narrowly obovate to suboblong, mostly 4—5 cm long (basal ones only 3.5 cm) and 7—11 mm thick, the apical 1/5 pyramidal, sides 5—6-angled, style short and somewhat blunt, curved forward, with a short stigmatic groove; stigma shallowly concave, more or less narrowly elliptic, about 3 mm long and 1—2 mm broad; pileus not dehiscent; endocarp near the base, obconic, 1 cm long, 5—6 mm broad, 1-seeded. Male inflorescence erect, stout-peduncled, with fleshy yellow bracts; peduncle white, trigonal, 18 mm thick, bearing about 7 spikes, each 5—7.5 cm long and 1.6—2.3 cm thick, white, with numerous crowded stamens; stamens usually in triads



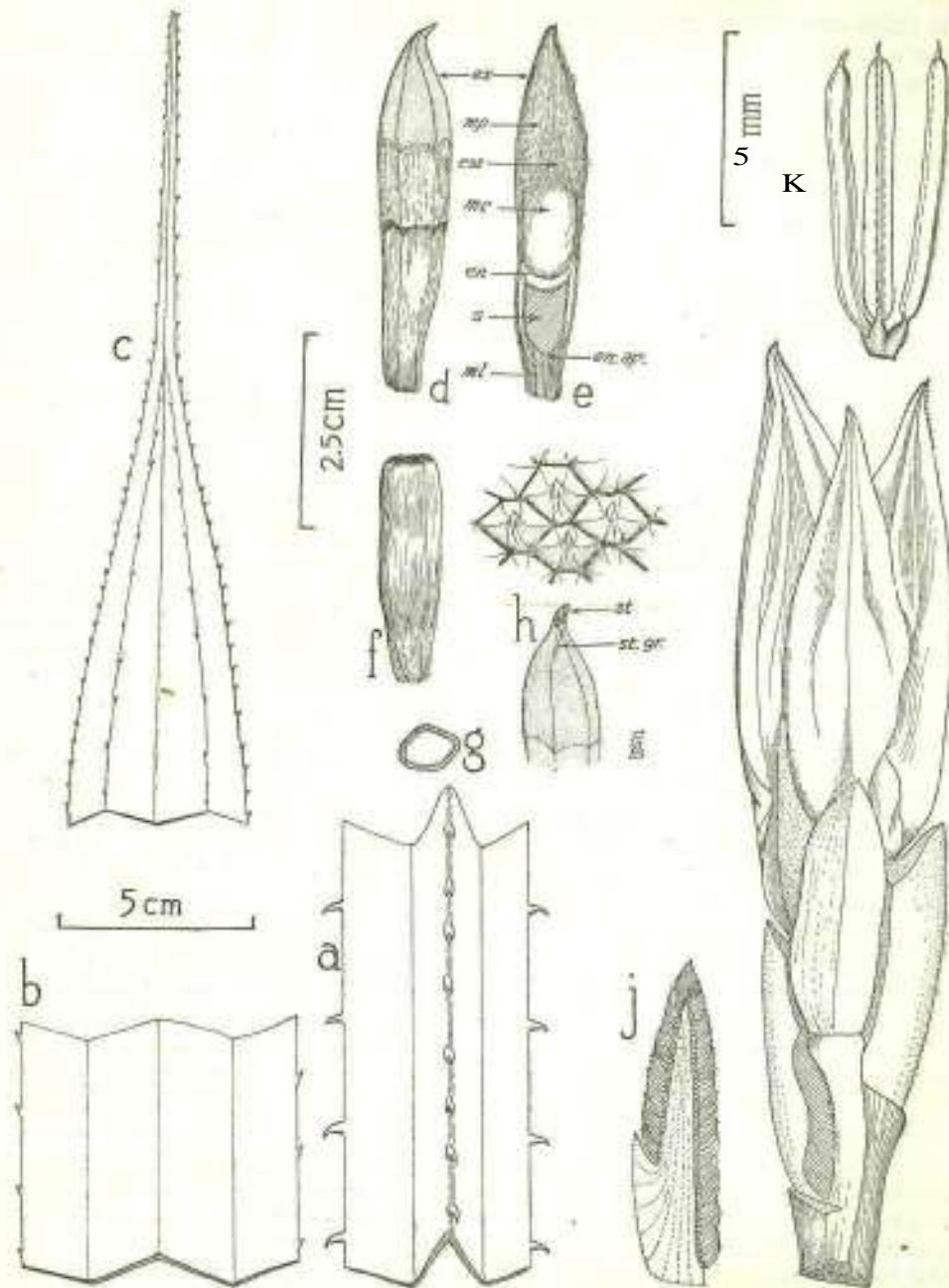


Fig. 1. *Pandanus saint-johnii*: a. portion of base of leaf, dorsal side; b. portion of middle of leaf; c. leaf-tip, ventral side; d. drupe in lateral view; e. the same in longitudinal section; f. pyrene after it is free of the exocarp; g. the same in section; h. detail of apex to show style, stigma, stigmatic groove, and (above) top view of drupes in situ showing stigmas; i. upper part of staminate inflorescence; j. longitudinal section of a staminate spike; k. triad of stamens (a-c from holotype; i-k from *Stone & Cheah 7163*; key to abbreviations: ex = exocarp; mp = mesocarp pith; est = endostylar fiber; me = mesocarp chamber; en = endocarp; en. ap. = endocarp aperture; ml = Lower mesocarp fibers; st = stigma; st. gr. = stigmatic groove).

or sometimes in phalanges of 4 or 5, rarely only 2, with bulbous red-orange filaments 1–1.1 mm long, abruptly contracted at apex; anthers white, about 7.2 mm long, the apiculus 0.4 mm long. Pollen white.

MALAYA. Johore. Kota Tinggi, Panti Forest Reserve, west ridge of Gunong Panti about 1 mile N.E. of Lombong, 800 ft. alt., 4 April 1966, *Stone, Chew & Hill 6231* (KLU, BISH, K, L, SING, US), a caespitose trunkless pandan, common on dry hillside under old secondary forest; *ibid.*, Gunong Muntahak, June 1964, *P. C. Lee s.n.* (KLU). Pahang. Slightly south of Ayer Hitam, in hill forest drained by S. Anak Kelai, 3 miles from old Fort Iskandar, 300 ft. alt., 1 July 1967, *Stone & Cheah 7163* (KLU), dark green-leaved caespitose plants in oak-dipterocarp forest, staminate inflorescence with lemon yellow bracts and white spikes, anthers white with short bulbous red-orange filaments.

***Pandanus soboliferus* B. C. Stone, spec. nov. — PI. III, IV**

Planta acaulis caespitosa rhizomatosa. Foliis erectis rigidis, ad 8 m longis, 7–8 cm latis, ad basem perduris ad apicem valde coriaceis erectis, unisulcatis, biplicatis, M-formatis, apice sensim attenuato breviter acuminato, in paginis ventralibus apicem versus secus plicas laterales conspicue spinulosa. Inflorescentia foeminea in foliis subclausa, erecta, pedunculata, pedunculo 20 cm longo ad apicem dilato, 13–18 mm crasso, cephalio solitario ellipsoideo vel subglobo, 8–? cm lato; bracteas non vidi; drupae (basales) oblongae 25 mm longae, stylo 3–4 mm longo. Stamina probabiliter sine columna axi spicae insidentia. Cetera ignota.

TYPUS: *Whitmore FRI 069Jk* (KEP).

Acaulescent caespitose rhizomatous plants. Leaves erect, stiff, hard and very dark green, up to 8 m long and 7–8 cm wide, 1-sulcate, triplicate, M-formed in cross-section, the apex gradually narrowed and at last briefly acuminate, the ventral lateral pleats conspicuously spinulose. Details of leaf: at the base of the leaf midrib prickles stout, terete, very sharp, recurved, 5–10 mm long, 1–4 cm apart, marginal prickles similar but rectiform, 5–8 mm long, 1–3 cm apart; at the middle of the leaf midrib prickles somewhat recurved, 3–4 mm long, 0.5–2 cm apart, marginal prickles antrorse appressed, 3 mm long, 0.5–1.5 cm apart; near the tip of the leaf midrib prickles small, antrorse, 0.5 mm long, 2–4 mm apart, marginal prickles similar. Upper ventral pleats prickly, prickles similar to adjacent apical margin; apex armed along distal 30–40 cm. Inflorescence erect, basal, hidden among the leaves, the pistillate inflorescence with 1 cephalium, peduncle about 20 cm long, trigonal, somewhat dilated at apex, 13–18 mm thick; cephalium ellipsoid to subglobose, at least 8 cm in diameter; bracts not seen; drupes (only basal ones seen) oblong 25 mm long, the style 3–4 mm long. Stamens arising directly from the column, or perhaps in phalanges of 2–3 as in *P. saint-johnii*.

As is true of *P. saint-johnii*, and probably all members of sect. *Fusi-forma*, the leaves of this species are very notably dark green, almost equally so on both sides, not or scarcely glaucous, and extremely hard.



No other pandan that I have encountered has more rigid leaves; even with a very sharp "parang" or field knife, several energetic blows are needed to cut through the leaf at its base. Furthermore the prickles are extremely sharp and equally hard.

*P. soboliferus* is named for the habit, characteristic of the whole section, of bearing its leaves direct from a subterranean rhizome. This species was mentioned, illustrated and included in a key to the pandans of Penang Island (*in Malay. Nat. J.* 19: Pl. 35. 1966).

The description of the stamens is based on a very imperfect specimen, collected several days too late. The male inflorescences of all pandans are ephemeral, and most are eagerly sought by insects of various kinds. The late comer, inspecting closely the staminate spike, is liable to find nothing but a more or less digested, amorphous mass, teeming with larvae (often of nitidulid beetles). This was the case in the specimen cited (*Stone 632A*) which nonetheless appeared to have a few stamens intact. These appear to show the filament arising directly from the spike. If so, this is a strong indication of the relationship of this section to sect. *Acrostigma*, with which it might even have to be merged- if the present distinction fail to hold for any newly discovered members. In addition the available information corresponds well with the good staminate collections of *Pandanus sainUjohnii* cited above. Probably the basic structure is identical.

MALAYA. P e r a k. Gunong Bubu, common on ridges, 19 August 1966, *Whitmore FRI 069U* (KEP), stemless, with very dark green leaves up to 4 m long, once seen fertile. P e n a n g I s i. Waterfall path in forest, 8 February 1966, *Stone 6163* (KLU), acaulescent pandan on sandy soil with very dark green leaves; *ibid.*, *Stone 616U* (KLU); near Upper Tunnel Road above Methodist Centre, 3 May 1966, *Stone 63U* (KLU), old staminate inflorescence.

#### ACKNOWLEDGEMENTS

For the privilege of examining type and other specimens I am indebted to the directors and curators of the herbaria of Singapore Botanic Gardens, Forest Research Institute (Kepong) and the Botany Department, University of Singapore. My thanks are also due to Dr. T. C. Whitmore (Kepong), Dr. W. L. Chew (Singapore) and Mr. P. C. Lee (Kuala Lumpur) for stimulating discussions and for professional or personal aids. I would like also to thank Inche Jaafar for his excellent photographic assistance. I am most grateful to Professor Emeritus Harold St. John (Honolulu) — under whose aegis I began the study of the Pandanceae — for suggesting some improvements to this account as well as for acquiescing to the dedication in one of the new species.

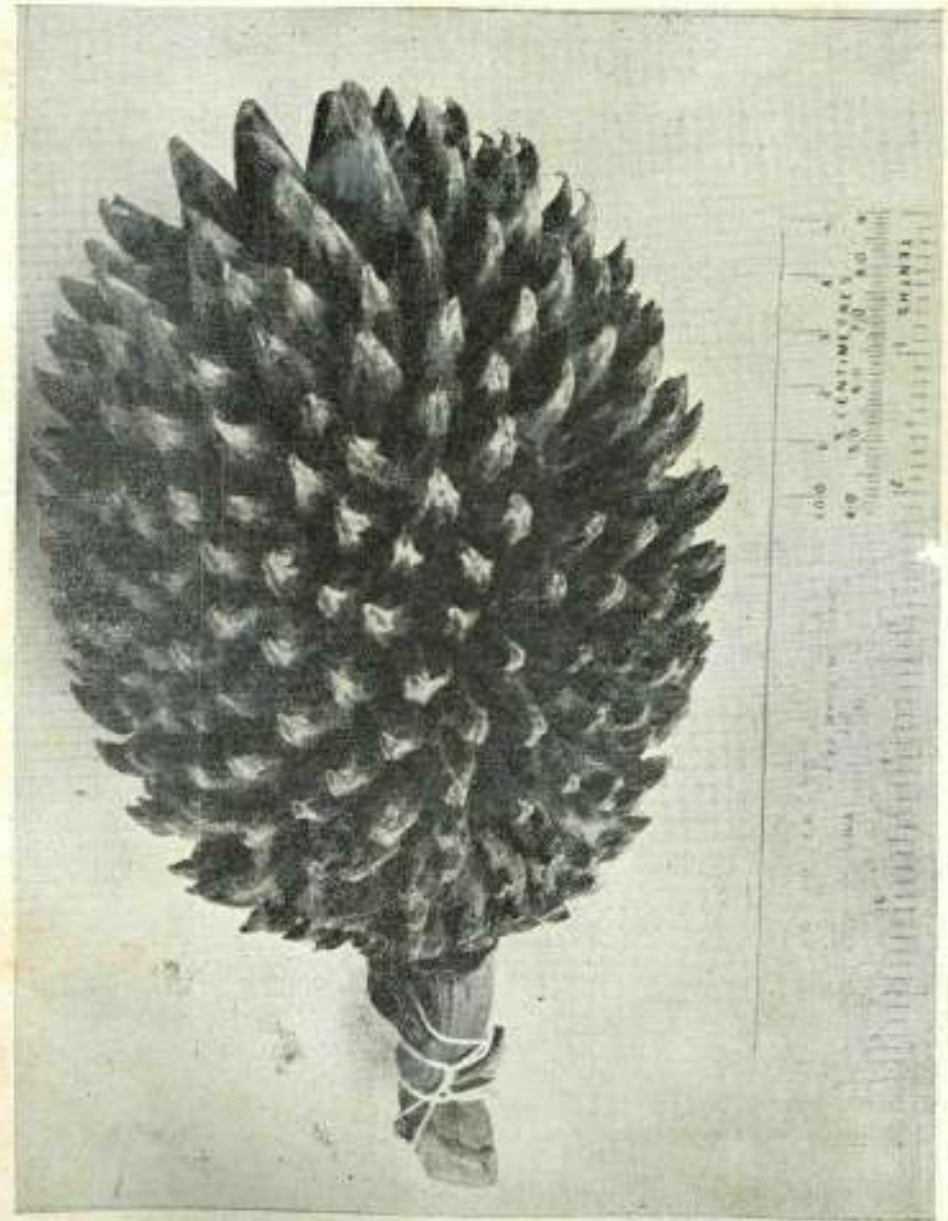


Plate I.

*Pandanus saint-johnii*. Cephalium after drying (from P. C. Lee s.n.)



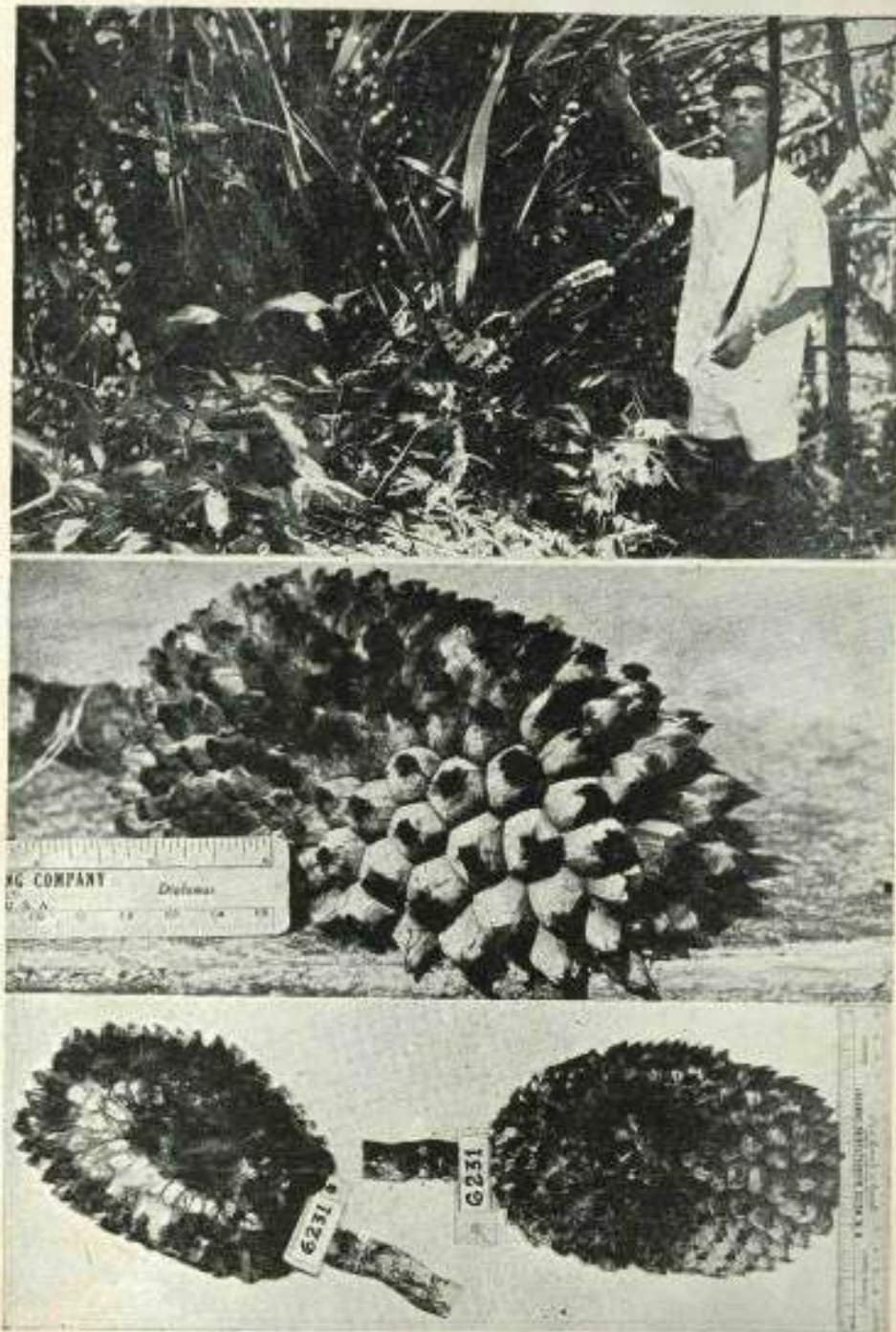


Plate II.

*Pandanus saint-johnii*. Habit and fruit. Top: mature fringing plant. Middle: view of fresh cephalium. Below: at left, fruit in longitudinal section; at right, in profile (from holotype).



Plate III.

*Pandanus sobotiferus*. A clump of plants on Penang Hill.



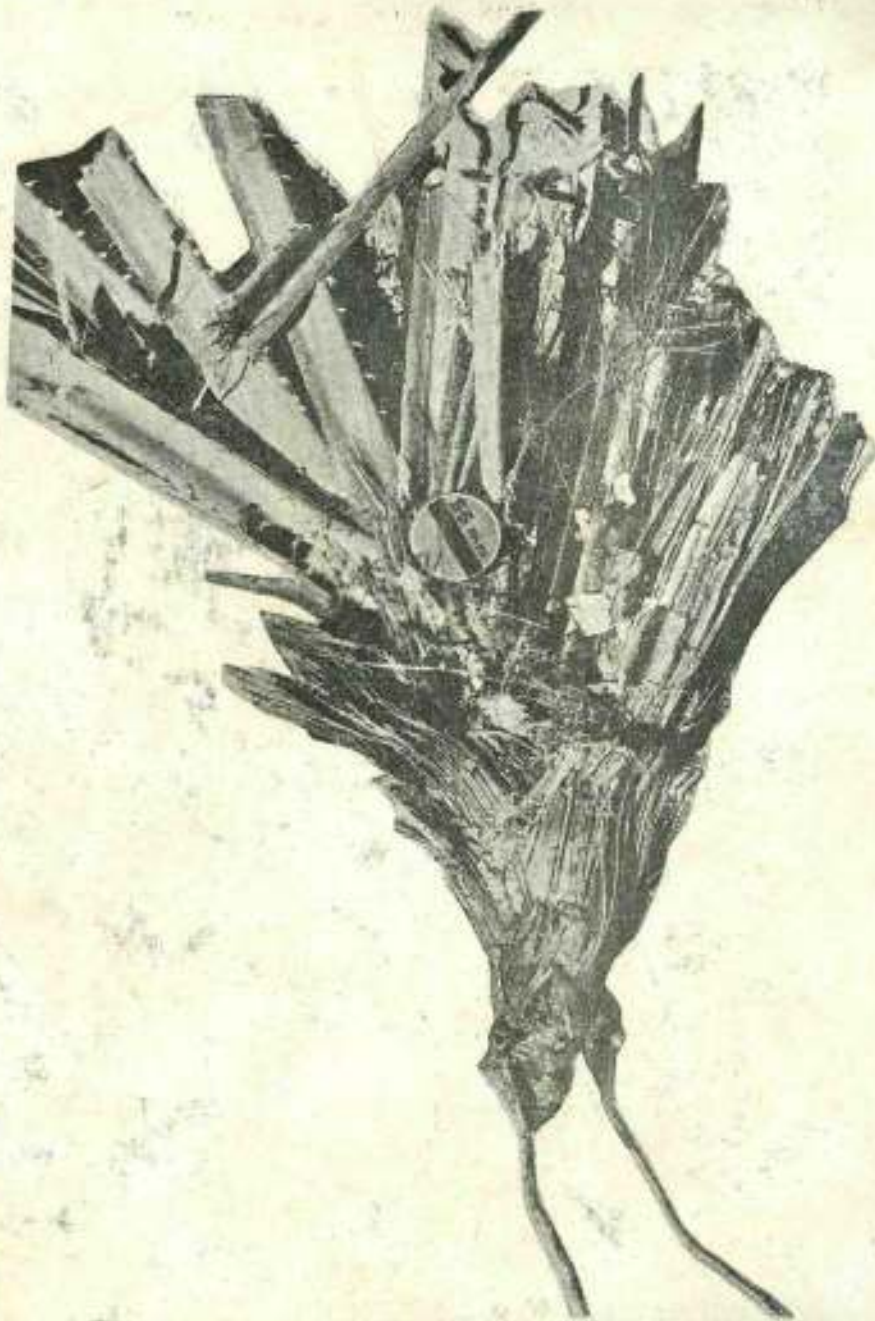


Plate IV.

*Pandanus soboliferus*. The base of a plant from Penang Hill, showing the decayed shaathing leaf-bases from the axils of which arise the roots. Ground level was about two-thirds of the distance from the base of the plant as shown to the lens-cap.

*General:* Manuscripts should be submitted typewritten and double spaced throughout, preferably without any underlining and without the use of capitals to indicate particular letter press, except for names of genera, species, subspecies to be indicated by drawing a single line under the entire word. Copies can not be accepted if they have been reproduced in a way that they become illegible in handling. Captions for textfigures and plates should be written on a separate sheet.

*Illustrations:* Illustrations need not be more than two to three times the size of the desired reproduction. Half tone illustrations can not be accepted. Line drawings should be of sufficient thickness to reproduce well and the dotting should be sufficiently spaced to stand the reduction desired. Drawings should be carefully made with india ink on white drawing paper. Photographs should be made on glossy paper with strong contrasts.

*Tables:* Titles should be given for all tables which should be numbered in Roman numerals, Column heads should be brief and textual matters in tables confined to a minimum.

*Reprints:* Twenty five reprints of each paper are supplied free. Joint authors will have to divide these copies between them at their discretion. Additional reprints will be furnished at cost; the order should be placed before the final printing.

The prices of the issues vary according to the number of pages and illustrations. All correspondence on editorial matters should be addressed to the publishing institutes. For exchange, subscriptions, request of missing numbers and all publications from the above Institutes, please apply to: BIBMOTHECA BOGORIENSIS, Djalan Eaya 20, Bogor.