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OF THE

ASIATIC SOCIETY OF BENGAL.

VOL. LXII.

PART II. (NATURAL HISTORY, &c.)

(NOS. I TO IV.—1893.)

WITH INDEX

EDITED BY THE

NATURAL HISTORY SECRETARY.

"It will flourish, if naturalists, chemists, antiquaries, philologers, and men of science in different parts of *Asia*, will commit their observations to writing, and send them to the Asiatic Society at Calcutta. It will languish, if such communications shall be long intermitted; and it will die away, if they shall entirely cease." SIR WM. JONES.

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OF THE

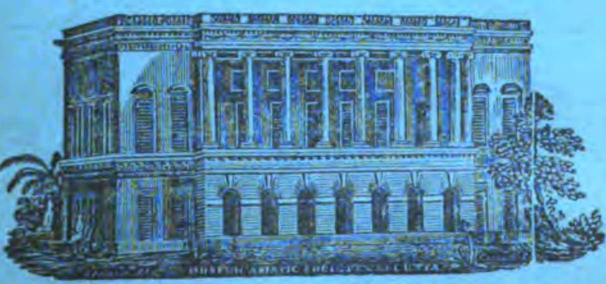
ASIATIC SOCIETY OF BENGAL,

Vol. LXII, Part II, No. I.—1893.

EDITED BY

SURGEON-CAPTAIN J. H. TULL WALSH,

NATURAL HISTORY SECRETARY.



"The bounds of its investigation will be the geographical limits of Asia: and within these limits its inquiries will be extended to whatever is performed by man or produced by nature."—SIR WILLIAM JONES.

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brushwood under the great trees and in open paths through the forests. Their transformations are unknown. The males have no secondary sexual characters. The females differ only from the males in the wings being somewhat broader, and in having the apex of the forewing more rounded.

JOURNAL

OF THE

ASIATIC SOCIETY OF BENGAL.

Part II.—NATURAL SCIENCE.

No. I.—1893.

I.—*On* Erites, *an oriental genus of satyrid butterflies:—By* Lionel de Nicéville, F. E. S., C. M. Z. S.

[Received 16th February;—Read 1st March, 1893.]

The genus *Erites* at the present date contains five species only, (six if *E. ochreana* is held to be a distinct species, I have not seen it), found in Assam, Burma, the Malay Peninsula, Sumatra, Java, Labuan, Borneo, and the Philippines. To these I now propose to add a sixth. All are closely allied, and very similar in general aspect. They are extremely delicate butterflies, semi-transparent, of a brownish-ochreous shade, sometimes just tinted with violaceous on the upperside. All possess a submarginal series of ocelli to both wings, more or less visible on the upperside. These ocelli vary greatly in size, in some species they are large and prominent, in others quite small and inconspicuous. On the underside there are usually two discal bands, often more or less angled. These butterflies are found only in virgin forests as far as I am aware, and fly weakly close to the ground amongst the brushwood under the great trees and in open paths through the forests. Their transformations are unknown. The males have no secondary sexual characters. The females differ only from the males in the wings being somewhat broader, and in having the apex of the forewing more rounded.

I give below a key by which the several species may be distinguished :—

Key to the species of *Erites.*

A. Forewing with five equal-sized ocelli.

1. *E. elegans*, Borneo.

B. Forewing with the posterior ocellus very much larger than the others.

a. Forewing with the large ocellus on the upperside prominently pupilled with white. The apex of the wing falcate.

2. *E. falcipennis*, Assam; Burma.

b. Forewing with the large ocellus on the upperside blind or nearly so. The apex of the wing rounded.

a^1. Both wings with all the ocelli prominent and well-formed on the underside.

a^2. Forewing with three small apical ocelli only in addition to the large anal one.

3. *E. medura*, Java; Philippines.

b^2. Forewing with four apical ocelli in addition to the large anal one.

a^3. The inner discal band on the hindwing straight.

4. *E. argentina*, Labuan; Borneo; Malacca.

b^3. The inner discal band on the hindwing highly angled outwards in the middle.

5. *E. angularis*, Burma; Malay Peninsula; Sumatra.

b^1. Both wings with all the ocelli inconspicuous except the anal one in the forewing, reduced to black dots only.

6. *E. rotundata*, Burma.

1. ERITES ELEGANS, Butler.

E. elegans, Butler, Cat. Diurn. Lep. B. M., *Satyridæ*, p. 147, n. 2, pl. ii, fig. 4, *female* (1868); id., Druce, Proc. Zool. Soc. Lond., 1873, p. 340, n. 2; id., Staudinger, Ex. Schmett., p. 230, pl. lxxxii, *male* (1887).

HABITAT: Borneo (*Butler, British Museum; Druce; Staudinger*); three males Borneo, one female Padas River, North Borneo (*collection de Nicéville*).

2. ERITES FALCIPENNIS, W.-M. and de N.

E. falcipennis, Wood-Mason and de Nicéville, Butt. of India, vol. i, p. 237, n. 230 (1883); idem, id., Journ. A. S. B., vol. lv, pt. 2, p. 351, n. 30, pl. xvi, fig. 2, *male* (1887).

HABITAT: One male Silcuri, August; one male, Nemotha, September—both in Cachar, Assam (*Wood-Mason, collection Indian Museum*); one male, Fort Lungleh, Lushai Hills, October, 1890 (*R. Pughe, collection de Nicéville*); one female, Karen Hills, Burma, April (*collection Phayre Museum, Rangoon*).

3. Erites medura, Horsfield.

Hipparchia medura, Horsfield, Cat. Lep. Mus. E. I. C., pl. v, figs. 8, 8*a*, *female* (1829); *Erites medura*, Marshall and de Nicéville, Butt. of India, vol. i, p. 236 (1883); id, Pagenstecher, Jahr. des Nass. Vereins fur Natur., vol. xliii, p. 96, n. 15 (1890); *E. medura*, var. *ochreana*, Staudinger, Iris, vol. ii, p. 38 (1889); *E. ochreana*, Semper, Schmett. Philipp. Inseln, p. 326, n. 497 (1892); *Satyrus (Erites) madura* (*sic*), Westwood, Gen. Diurn. Lep., vol. ii, p. 392, n. 47 (1851); *Erites madura*, Horsfield and Moore, Cat. Lep. Mus. E. I. C., vol. i, p. 229, n. 484 (1857); id., Hewitson, Journ. Linn. Soc. Lond., Zoology, vol. viii, p. 145 (1865); id., Butler, Cat. Diurn. Lep. B. M., *Satyridæ*, p. 146, n. 1 (1868).

Habitat: Java (*one female, Horsfield collection in the British Museum*); East Java (*Pagenstecher*); Palawan, Philippines *Staudinger*).

Mr. Hewitson (l. c.) describes a variety of this species as follows:—"*Male* and *female*. With five ocelli on the anterior wing, one large and four small. Sumatra; Singapore." This almost certainly equals *E. angularis*, Moore, which undoubtedly occurs in the Malay Peninsula, and also in Sumatra, as Dr. L. Martin, of Deli, Sumatra, informs me.

Mr. Hewitson also describes another variety thus:—"*Male* and *female*. With the five ocelli of the anterior wing small and of equal size, Singapore; Sarawak." This can only refer to *E elegans*, which certainly occurs in Borneo, but very doubtfully in Singapore, at any rate it is not recorded from thence by Mr. Distant in "Rhopalocera Malayana," nor have I seen a specimen from any part of the Malay Peninsula.

4. Erites argentina, Butler.

E. argentina, Butler, Cat. Diurn. Lep. B. M., *Satyridæ*, p. 188, n. 5, pl. v, fig. 8, *female* (1868); id., Druce, Proc. Zool. Soc. Lond., 1873, p. 340, n. 1; id., Distant, Ann. and Mag. of Nat. Hist., fifth series, vol. xix, p. 48, n. 21 (1887).

Habitat: Labuan, an island off the N.-W. coast of Borneo (*Butler, in coll. British Museum*); Borneo (*Druce* and *Distant*); Borneo; Malacca (*Staudinger*); S.-E. Borneo (*collection de Nicéville*).

Unfortunately I possess no specimen of *E. medura*; but comparing the figures of *E. medura* and *E. argentina*, both taken from female specimens, and a single male of the latter in my collection, the only point of difference I can discover between them is that *E. medura* lacks a small ocellus in the second median interspace of the forewing which is present in *E. argentina*.

5. Erites angularis, Moore.

E. angularis, Moore, Proc. Zool. Soc. Lond., 1878, p. 825; id., Distant, Rhop. Malay., p. 46, n. 1, pl. v, fig. 3, *male* (1882); id., Marshall and de Nicéville, Butt. of India, vol. i, p. 236, n. 229, pl. xvi, fig. 50, *female* (1883).

Habitat: Taoo plateau, 3,000—5,000 feet, Upper Tenasserim

(*Moore*) ; Perak (*Distant*) ; Meplay Valley, January ; Thoungyeen forests, March ; near Moulmein, October (*Marshall* and *de Nicéville*); Yoonzaleen Valley, November; Myitta, January, both in Burma; Rawan, Selangor, Malay Peninsula, December (*collection de Nicéville*).

In this species there are four small equal-sized ocelli and one large ocellus to the forewing, the ocelli of the hindwing prominent; the inner band of the hindwing strongly outwardly angled in the middle; the outer band is twice outwardly angled, once in the middle, and once where it is crossed by the second subcostal nervule, this feature being only found in the otherwise quite distinct species, *E. elegans*.

6. Erites rotundata, n. sp.

E angularis, Watson (*nec* Moore), Journ. Bomb. Nat. Hist. Soc., vol. iii, p. 19, n. 38 (1888).

Habitat: Burma.

Expanse: ♂, 2·0 to 2·1; ♀, 2·2 to 2·4 inches.

Description: Male. Upperside, *both wings* semi-transparent, brownish-ochreous. *Forewing* with the two discal bands of the underside showing through by transparency; a large, almost round (slightly oval) black ocellus in the first median interspace and extending slightly into the two interspaces beyond, obscurely pupilled with plumbeous, and surrounded with an ochreous ring. *Hindwing* with a prominent discal ochreous band, outwardly angled in the middle; four large round blind black ocelli, surrounded each by a very wide ochreous ring, the rings touching, thus forming a continuous band, one ocellus in each interspace from the first median to the second subcostal nervule; two fine ochreous and two fine fuscous marginal lines. Underside, *both wings* finely striated with purplish-fuscous; the four apical ocelli present in the forewing of *E. angularis*, Moore and the five of the hindwing reduced to minute black dots in this species. *Forewing* with the fifth large ocellus much as above, but the black portion is smaller, the ochreous ring wider, and the pupil prominent and silvery; two prominent discal deep ochreous bands outwardly sharply defined by a black thread commencing close to the submedian nervure, the inner band straight, crossing the discoidal cell obliquely about its middle, and becoming lost before reaching the subcostal nervure; the outer band curved and bounding the wide ochreous outer ring of the large ocellus in the first median interspace, the band ending on the third median nervule. *Hindwing* with faint traces of two discal bands, the inner one straight, the outer one angled outwardly once only, as in all the species of the genus except *E. angularis*; the marginal lines as on the upperside. Female hardly differs from the male, except that the wings are broader, the apex of the forewing is more rounded, and the forewing has similar fine marginal lines as are found in the hindwing of the male. This species differs structurally from *E. angularis* in that the tooth or angulation at the termination of the second median nervule of the hindwing is as great or greater than that at the third; in *E. angularis* this tooth is quite small.

In one specimen in my collection from the Pegu Yoma, taken in December, the markings are almost as prominent on the underside as in *E. angularis*, there are two apical well-formed ocelli to the forewing, and five ocelli to the hindwing, the discal bands well-marked, but as the inner band of the hindwing is straight (not outwardly strongly angled in the middle), and the outer band is once outwardly angled only (instead of twice), I have no hesitation in placing this specimen under *E. rotundata* rather than under *E. angularis*. Another specimen in my collection taken at the same place and time is quite typical *E. rotundata*.

In the Proceedings of the Zoological Society of London for 1891, page 268, Mr. H. J. Elwes records *E. medura*, Horsfield, from East Pegu, Upper Burma, and places *E. angularis*, Moore, with a query as a synonym of that species, and makes the following remarks :—

"Numerous specimens were sent by Doherty from East Pegu, taken at about 1,500 feet [during March and April], of which several females and one male were by him supposed to be, and marked as, a distinct species. These correspond to the female taken in the Thoungyeen forests by Major Bingham, and described by Marshall and de Nicéville, 'Butt. of India,' vol. i, p. 237,* as nearer to *E. medura* of Java than to *E. angularis*."

"After examining the series closely and comparing them with one Javan specimen, I do not see how to separate the two species [*E. medura*, Horsfield, and *E. angularis*, Moore], for, though in the supposed new

* "A female taken in the Thoungyeen forests in March differs from our other female specimens in the ocellus on the upperside of the *forewing* being very nearly round, not oval, with a distinct yellow iris of equal width throughout; the outer fascia of the *hindwing* much broader and very distinct; four large black spots beyond twice the size of those in the other specimens, the yellow irides prominent and touching. On the underside of the *hindwing* the two discal fasciæ have almost disappeared, and the five submarginal ocelli are very minute. This specimen differs only in the following particulars from Horsfield's figure of *E. medura* : The outer margin of the forewing is not quite so evenly rounded, being in fact slightly concave; the large ocellus is not quite so large as in *E. medura*, and the iris is less wide. On the underside the apical ocelli on the forewing are smaller, and on the hindwing the ocelli are minute, and the fasciæ are obsolete. This specimen, however, is much nearer *E. medura* than *E. angularis*." (*Marshall* and *de Nicéville*, l. c.)

species the ocelli on the upperside of the hindwing are much larger than in the other form from the same locality, whilst on the underside both the ocelli and the bands are almost obsolete, I am rather inclined to suspect seasonal dimorphism, and to think that this form is the last of the first brood, and the others, among which males are far more numerous, are the first of a second brood. In the Javan specimen we have the hindwing like one form below and the other above. Further observations are requisite to decide the question."

E. medura and *E. angularis* are abundantly distinct. The former has three apical ocelli in the forewing, the inner discal band straight, the outer band apparently once outwardly angled in the hindwing; while the latter has four apical ocelli, the inner band outwardly angled in the middle, the outer band twice outwardly angled.

Mr. Elwes suggests that seasonal dimorphism may occur in the genus. At present I see no indications of the appearance of this phenomenon, at any rate if the usual form of seasonal dimorphism observable in the *Satyrinæ* is understood. I possess the strongly ocellated *E. undularis* taken in January, October, November, and December, all of which months (except occasionally October) are dry months, when the ocelli should be obsolete: while the two type specimens of *E. falcipennis* were taken in the height of the rainy season, August and September, but have minute ocelli, instead of the normal rainy-seasonal large and well-developed ocelli. I append a note by Mr. W. Doherty on the subject, which bears out my opinion, and I may add that it is at his suggestion that I have described *E. rotundata.*

"The prehensors of *Erites* are slender and simple, and of the usual satyrid type, resembling those of most of the species of *Lethe* (*Debis*), to which the genus seems allied, the true *Lethe* (*europa*, Fabricius) being exceptional in having the upper organ without branches. Seen from the side, the upper organ (uncus, tegumen) of *E. angularis* is unusually straight; that of *E. rotundata* is much more depressed terminally. In both species the lower organ (clasp, harpago) is truncate at the tip, but in *E. angularis* it is cut square, while in *E. rotundata* the end is concave, so as to form a distinct scallop."

"Apart from these differences in the prehensors, I think Mr. Elwes' supposition, that *E. rotundata* may be the dry-season form of *E. angularis*, an unlikely one. No seasonal variation has yet been observed in the genus. I found *E. angularis*, which should be the wet-season form, commoner in the dry-season than *E. rotundata*. Finally, the dimorphism, if it exists, must be of a new type. Dry-season forms are distinguished by obliterated ocelli and angular wings, but here the non-ocellate form has the wings abnormally rounded."

I possess the following examples of *E. rotundata.* One male and one female from Beeling, Upper Burma, taken on 27th March, 1886, two males on the 29th idem, one female on the 14th April, by Lieut. E. Y. Watson; two males taken in the Pegu Yoma, Burma, by a native collector employed by the Phayre Museum, Rangoon, in December; one female from Quaymoo, Tenasserim, captured in March and another in November, in the Yoonzaleen Valley, also in Tenasserim by Major C. T. Bingham.

Two species of Pedicularis.—*By* D. Prain.

(With Plates I and II.)

[Received March 9th—Read April 5th.]

In 1889 *(Journ. As. Soc. Beng.* lviii pt. 2, p. 255) the writer had the honour to communicate to the Society descriptions of a number of new Indian species of this genus. Since then a considerable number of new species have been reported from China and Tibet and have been described in various periodicals by Messrs Maximowic, Hemsley and Franchet, and by the writer. Now, another new Indian species has been reported; of this a description is given below and the present opportunity is taken of describing an allied new species from Szechuen.

1. Pedicularis diffusa Prain, *sp. nov.* (Pl. I.)

Elata simplex vel e collo diffuse ramosa, radice debili ramosa collo esquamato, caulibus gracilibus simplicibus, *foliis* radicalibus longe petiolatis mox evanescentibus caulinis 4-natim verticillatis laminis glabrescentibus ovato-oblongis pinnatisectis, segmentis 5–8-jugis oblongis obtusis inciso-serratis; *floribus* verticillatis verticillis numerosis inter se remotis, bracteis foliaceis oblongo-ovatis petiolatis pinnatifidis et inciso-serratis; *calycis* breve pedicellati campanulati membranacei inflati totius reticulati antice vix fissi dentibus majusculis inaequilatis anticis et lateralibus ovatis inciso-serratis illis duplo his 4-plo summo deltoideo integro latioribus; *corollae* roseae tubo sursum ampliato calyce duplo longiore basi infracto, labio 3-lobo lobis oblongo-ovatis margine sinuatis lateralibus medio dimidio majoribus, galea leviter arcuata tubo subcontinua apice subincurva erostri; *staminibus* ex adverso summi ovarii insertis filamentis anticis superne hirsutis; *ovario* ovoideo stigmate parum exserto, *capsula* anguste lanceolata apice acuta calyce duplo longiore, seminibus ovoideis testa nigrescente minute reticulatis.

In HIMALAYA ORIENTALI: Sikkim, Mt. Tankra, 11,500 p. s. m.; *G. A. Gammie!*

Caulibus 40–60 cm. longis, foliis caulinis 2–2·5 cm. longis his 0·75–1 cm. latis, segmentis 5 mm. longis 3 mm. latis, petiolis 0·5–1 cm. longis; calyce 6 mm. longo hoc 3·5 mm. lato; corollae tubo 10 mm. longo apice 4 mm. lato, galea 5 mm. longa, labio 8 mm. lato; capsula 12 mm. longa 5 mm. lata.

This species is most nearly related to *P. verticillata* Linn. and *P. refracta* Maxim. but besides differing greatly in habit and foliage from both it differs from *P. verticillata* in having a calyx with large teeth and with a tube reticulated throughout, while it differs from *P. refracta* in having the anterior and lateral calyx teeth serrate and not entire; from both it differs in having acute, not muticous, anther-cells.

Of Indian species, it in habit much resembles *P. flexuosa* Hook. f., though it is glabrescent while that species is hirsute, but the plant that it imitates most closely is *P. gracilis* Wall. VAR. *macrocarpa* Prain, the likeness being so great that though in flower they differ so widely, it is not easy to distinguish fruiting specimens of the two.

2. PEDICULARIS FLACCIDA Prain; *sp. nov.* (Pl. II.).

Ascendens glabra caulibus gracilibus corymbosim ramosis, *foliis* ramisque 3–4-natim verticillatis radicalibus mox evanescentibus caulinis breve petiolatis ovatis pinnatifidis segmentis 5–6-jugis obtusis inciso-serratis; *floribus* in verticillis 4-floris paucis remotisque dispositis, bracteis foliaceis calycem excedentibus; *calycis* glaberrimi parvuli campanulati antice parum fissi 5-dentati segmentis omnibus oblongis integris tubo costato nec reticulato; *corollae* tubo sursum ampliato calycem 3-plo excedente basi infracto, labio 3-lobo lobis lateralibus ovatis medio orbiculato basi constricto 3-plo majoribus, galea leviter arcuata tubo subcontinua apice subincurva erostri, *staminibus* ex adverso medii ovarii insertis omnibus glabris, antheris contiguis muticis; *ovario* ovoideo stigmate exserto.

In CHINA OCCIDENTALI; Szechuen occident. prope Tachienlu, *Pratt* n. 471!

Caulibus 20–25 cm. longis foliis caulinis 1 cm. longis his 0·7 cm. latis segmentis 2 mm. longis 1 mm. latis, petiolis 0·5 cm. longis; calyce 2·5 mm. longo hoc 2 mm. lato; corollae tubo 8 mm. longo apice 4·5 mm. lato, galea 4 mm. longa, labio 7 mm. lato.

Like the preceding species this is also closely related to *P. verticillata* Linn. but differs considerably in habit, and though it has the calyx tube ribbed and not reticulated just as *P. verticillata* has, it differs in having the calyx distinctly toothed and extremely small. The stamens also differ in being all glabrous whereas in *P. verticillata* the anterior pair are hirsute; the anthers though muticous as in *P. verticillata* are contiguous and not discrete. The fruit is unknown.

As both these species belong to one natural group it may be useful to provide a key, modified, so as to admit of their reception, from the key already published by the writer (*Ann. Roy. Bot. Garden, Calcutta*, iii, 94), in which the relative position of these and of the previously known species is shown.

VERTICILLATAE.

- Galea less than half the length of the lip :—
  - Bracts flabellate, spike long, dense; calyx small, subglobose, not cleft, teeth small, entire; anterior filaments hairy ... *P. spicata.*
  - Bracts oblong or linear, spike short; calyx large ovate, teeth large :—
    - Calyx not cleft, teeth crested except the upper; filaments not hairy ... *P. lineata.*
    - Calyx cleft, teeth all entire; anterior filaments hairy ... ... *P. likiangensis.*
- Galea about equal in length to the lip :—
  - Calyx-tube not net-veined between the ribs :—
    - Calyx cleft, hardly toothed; anthers discrete, anterior filaments hairy ... *P. verticillata.*
    - Calyx not cleft, distinctly toothed; anthers contiguous, filaments not hairy ... *P. flaccida.*
  - Calyx-tube net-veined between the ribs :—
    - Calyx hardly cleft, teeth crested except the upper; anterior filaments hairy... *P. diffusa.*
    - Calyx distinctly cleft, teeth entire :—
      - Margin of galea even; anterior filaments hairy ... ... *P. refracta.*
      - Margin of galea toothed; filaments not hairy ... ... *P. szetschuanica.*

Explanation of the Plates.

PLATE I.. Pedicularis diffusa *Prain.*

1, Flower with bract; 2, calyx with ovary and style; 3, half of corolla showing staminal insertion; 4, stamens; 5, capsule; 6 seed: 1, 2, 3 *and* 5 *magnified* $\frac{2}{1}$; 4 *and* 6 *magnified* $\frac{4}{1}$.

PLATE II. Pedicularis flaccida *Prain.*

1, Flower with bract; 2, calyx with ovary and style; 3, half of corolla showing staminal insertion: *all magnified* $\frac{2}{1}$.

Some Observations of the Electrical action of Light upon Silver and its Haloid Compounds:—By Colonel J. WATERHOUSE, I. S. C., *Assistant Surveyor General of India.*

[Received April 20th : Read May 3rd.]

In my paper on "Electro-chemical Reversals with Thio-carbamides," read at the meeting of the Society in April 1891, it was shown that the peculiar reversals of the photographic image produced by the addition of very minute quantities of a thio-carbamide, or sulpho-urea, to an eikonogen developer appeared to be connected with and accompanied by electro-chemical action, if not actually brought about by it. It was remarked also that the experiments brought forward pointed to the conclusion that, at any rate as regards the haloid salts of silver, the formation and development of the photographic image is to a very great extent influenced by electrical action, more so perhaps, than has generally been recognised, although the fact of photographic action being accompanied by electrical phenomena has been known since the earliest days of photography. It was suggested that a further investigation into the theory of photography based on electro-chemical laws, might be of value in throwing light upon much that is now obscure and uncertain as regards the formation and development of the invisible photographic image formed by the exposure to light of silver haloid compounds.

Since that time I have given a good deal of attention to the subject and tried several experiments in various ways with the object of ascertaining the electrical action of light, in connection with photography, on plates of pure silver immersed in various fluids as well as on dry plates and other forms of silver haloid compounds in ordinary photographic use. Also on the action of electrical currents in forming developable compounds of silver haloids similar to those formed by light, and, further, on the electrolysis of ordinary photographic developers and on the currents produced during the development of the photographic image. These observations are not yet sufficiently complete to found any sound deductions upon, but I hope to complete them later. In the meantime, I have thought that a short note on some observations I have lately made on the electrical action of light upon plain silver plates in various solutions, might be of interest and form a suitable introduction to any further notes on this subject I may be able to bring before you. It does not pretend to be complete or exhaustive, and can only be considered as a contribution towards a systematic investigation of the question.

A great many observations have been made from time to time of the electrical influence of light on metals immersed in water and various saline solutions, and before going further, it seems desirable to give a brief summary of these observations, and more particularly of those relating to silver and its salts.

More than half a century ago, in 1839, Edmond Becquerel was the first to show that the electrical action accompanying the chemical changes brought about by the influence of light upon various substances, including several metals and the silver haloids, could be observed with the aid of a very delicate galvanometer. He found that this action was quite independent of any calorific radiation or heating of one electrode more than another, but was powerfully affected by the different rays of the spectrum, the greatest action being produced by the violet, indigo and blue rays, while with the green, yellow and red rays there was little or no action. Becquerel's observations are fully summarized in his work, "*La Lumière, ses causes et ses effets*," Vol. II. To observe these effects he used a covered vessel divided into two parts by a thin membrane. In each of the compartments he placed a plate of platinum or gold, previously made red-hot to remove all impurities, the plates being connected with the poles of a very sensitive galvanometer, and laid horizontally in the apparatus. Each compartment had a moveable cover. He found that when the two compartments contained an alkaline solution, the plate exposed to the solar rays took negative electricity, while the reverse occurred if the solution were acid. With alterable metals, such as silver or brass, analogous effects were obtained and the electrical effect could be largely increased by giving the plates a preliminary polarisation by plunging them in water and then placing them in connection with the positive pole of a battery. When two silver plates were immersed in water acidulated with nitric acid exposure to light of one plate only produced a very weak current and the exposed plate was always positive. If the gold or platinum plates had been thoroughly cleaned, had remained in strong nitric acid and had been made red hot, the different parts of the spectrum were almost powerless to produce electric currents. With well cleaned silver plates which had been heated several times the effects were also almost *nil*, though not quite absent, and from this fact it seemed possible that when the plates were not in this state the effects produced might be due to the action of light upon corpuscles of organic matter adhering to the plates which become oxidised by the action of light, the water supplying the oxygen. If this effect did not take place and there was no alteration in the plates themselves the light must produce a disturbance of the particles, but the former supposition seemed most probable. He found that when silver chloride, iodide or bromide, precipitated in a thin layer on sheets of platinum or gold, was exposed to light as above, the exposed plate was positive, and that the initial action was much stronger with the bromide than with the chloride; though the intensity of the currents observed was variable and depended on the thickness of the film of bromide, moreover the electrical action was soon exhausted. With the iodide the current was almost as strong as with the chloride, but did not remain constant so long.

When plates of silver were employed, instead of platinum or gold, as a support for the haloids, the effects noted were stronger and more regular, but it was found that the direction of the current depended on the thickness of the films; with thin coatings the exposed plate was positive, and with thick coatings negative. This was markedly the case with plates of silver exposed to the vapours of iodine. With vapour of bromine the exposed silver plate was negative, the initial current, even with diffused light, was very strong, but after remaining exposed to light for some minutes then protected from light and again exposed to its influence, it was found that the current was very weak. A film of silver chloride prepared by exposing a silver plate to the vapour of chlorine gave only a very weak effect, but plates coated with the violet subchloride behaved very well in these trials and yielded for a long time results from which comparisons could be made.

On the basis of these experiments Becquerel invented his electro-chemical actinometer which was practically a voltaic element or cell composed of two plates of very pure silver coated usually with the violet subchloride of silver and plunged into a conducting fluid composed of two parts of monohydrated sulphuric acid in 100 parts of water. The apparatus was so arranged that all light was excluded, except from an adjustable opening on one side by which one of the plates could be exposed to light while the other remained in darkness.

When diffused daylight or sunshine acted upon one of the plates, more or less deviation of the needle was observed which remained constant so long as the light remained of the same intensity and the surface was sufficiently sensitive. If the light was shut off, the needle returned to zero or somewhat beyond it, but soon regained its original position. If the light remained of the same intensity and the plate was again exposed, the electrical effect was the same as before, always provided that the sensibility of the plate remained the same, for which purpose the sensitive coating should be sufficiently thick. Under favourable conditions the sensibility of the instrument might be preserved for a whole day and thus several consecutive observations might be made.

The deflections of the needle could not, however, be considered as proportional to the intensity of the chemical action exerted on the substance and consequently to the active luminous intensity; they only shewed whether this luminous intensity was greater or less in one circumstance or in another.

With this instrument Becquerel observed the effect of different rays of the spectrum on silver iodide and violet subchloride, and found that in both cases the maximum of action was in the green about D $\frac{1}{3}$ E; but while with the chloride the action decreased on both sides of this point, and ceased at A and H, with the iodide that had already been exposed there was a second maximum in the indigo blue about G $\frac{2}{5}$ H, and thence the action decreased to P in the ultra-violet. In neither case was any reversed action observed in the red rays, as observed with sensitive papers, but that might be due to the fact that in one case the sensitive surface was in water and in the other in air. Becquerel has not recorded any corresponding observations with silver bromide.

About 1840, Robert Hunt repeated Becquerel's experiments with many modifications, and the results he obtained (*Phil. Mag.*, XVI, 1840), completely confirmed them. More careful trials with the spectrum on plates of different metals made later showed that every ray of the spectrum produces an electrical disturbance. The rays, however, at the least refrangible end, produce a deflection of the needle in one direction, whilst the most refrangible rays set up a disturbance in an opposite direction. There are many indications of a condition analogous to polarity in the action of the prismatic rays. (*Researches on Light*, p. 295.) Hunt also remarks that "This action is only to be regarded as one of the evidences of chemical disturbance, exciting electrical currents; yet at the same time, it opens the question of the identity of the agent producing this disturbance and electricity."

In 1858, Grove (*Phil. Mag.*, XVI., (4), p. 426.) recorded that he had succeeded in obtaining a deflection of the galvanometer needle by allowing a beam of light suddenly to impinge on a daguerreotype plate in a trough of water, the plate being connected with one pole of the galvanometer and a gridiron of silver wire in front of the plate with the other. In experiments with platinum plates he came to the conclusion that the action of light was always in the direction of the polarisation current, though further experiments by Becquerel and others have shown that this is not the case.

In 1863, Pacinotti found that when pairs of plates of copper, zinc, iron or lead were immersed in solutions of certain salts of the same metals, the exposed plate was always negative, but with plates of silver immersed in a solution of nitrate of silver the plate exposed to sunshine was positive, whereas if exposed to the rays of a petroleum lamp, or of a heated thick iron plate it was negative, as were also the other metals. (*Cimento*, XVIII, p. 363.)

In 1875, Hankel published a series of observations on this subject (*Wied. Ann.*, I, 1877) in which he showed that the electrical behaviour of the metals under the influence of light depended very much on the condition of their surfaces; consequently, in such observations it is necessary to consider separately each state of surface. His observations were made on copper in different states, tin, brass, zinc, platinum and silver. With regard to the latter, he records that when two plates of fairly pure silver were immersed in filtered tap water, the plate exposed to the light of white clouds was negative. When the plates had been left a day in the water the rays of the setting sun still gave a pretty strong negative impulsion. Platinum plates coated with silver were slightly positive with white or blue light, while red light produced no effect. Silver plates coated with platinum, (old platinised silver battery plates) which were slightly negative when coupled in circuit with plain platinum, were found to be very sensitive to light, and the exposed plate was positive. With coloured glasses the action was strongest under blue glass, but was also quite strong under yellow and red glasses; gaslight also produced a pretty strong deviations of the galvanometer needle, and it was found that the action under dark red and blue glasses was stronger than under a light green which was much more transparent.

In 1878, Professor Dewar published a preliminary note on "Experiments in electric photometry," (*Proc. Roy. Soc.*, XXVII, 1878, p. 364) in which he dealt principally with the construction of the best form of cell for the general investigation of the electrical actions induced by light on fluid substances. He found that the list of substances that may be proved to undergo chemical decomposition by light, was very extensive, some of the most active being the ferro- and ferri-cyanides of potassium and the nitroprusside of sodium, tartrate of uranium and a mixture of selenious and sulphurous acids in presence of hydrochloric acid. The complete paper does not appear to have been published.

In 1876, M. Egoroff published a note (*Comptes Rendus, Acad. Franc.*, LXXXII, 1876) on a differential electro-actinometer for the purpose of determining the absorption of the ultra-violet rays by different media. The instrument consisted of two of Becquerel's electro-actinometers placed one above the other and arranged so that the current of one might be neutralised by the other. In some preliminary observations with iodised silver plates he found that the intensity of the current was proportional to the width of the opening through which light was admitted. It was also inversely proportional to the square of the distance of the source of light from the apparatus. An oil lamp was used. The instrument appeared to show an exact proportionality between the intensity of the light and that of the current, and its great sensitiveness and precision would enable it to be used as a very delicate photometer. In these experiments he found that the electromotive force exerted by the November sun upon iodised silver plates through an opening 30 mm. wide was $\frac{1}{15}$ of a Daniell cell; with a petroleum lamp, at 8 inches distance, it was only 0·004 Daniell.

Dr. J. Moser afterwards, in 1887, in working on Egoroff's plan found that the photo-electric current might be greatly increased by treating the chlorised, iodised or bromised silver plates with solutions of erythrosin, benzo-purpurin and other dyes, and in sunlight he observed currents of a strength equal to half a volt (Eder's *Jahrbuch der Photographie, &c*, 1888, p. 297.)

At the meeting of the British Association, in 1880, Professor G. M. Minchin gave an account of his experiments on the generation of electric currents by the action of light on silver plates which were coated with emulsions of bromide, chloride, iodide and other salts of silver in gelatine and collodion, as well as with eosine, fluorescine and various aniline dyes, the object of these experiments being the solution of the problem of producing a photographic image of an object at a distance. A detailed account of these and other interesting experiments on light-cells was read before the Physical Society, and published in the *Philosophical Magazine*, for March 1891.

He found that when two pieces of clean silver foil attached to glass plates were coated with an emulsion of chloride of silver in collodion and immersed in distilled water containing a few grains of common salt, the plates being connected with the terminals of a Thomson's galvanometer and one of them screened from the light, that on exposing the unscreened plate there was an electric current produced, and the exposed plate was *negative* to the unexposed. The same effect was observed with plates coated with emulsions of silver bromide in water containing a little potassium bromide. When the plates were coated with iodide of silver in collodion by the wet silver-bath method, the liquid being water containing a little potassium iodide, there was a reversal of the nature of the exposed plate, it being *positive* to the unexposed. With coloured glasses in front of the exposed plates it was found that the red rays produced comparatively feeble currents, while those produced in the blue and violet rays were very great, but the directions of the current were the same for all rays. This agrees with Becquerel's observations. With plates coated with an emulsion of silver sulphide in potassic sulphate, the exposed plate was *positive*, the direction of the currents being the same for all rays, the strength of the current being least for the rays passing through the green glass.

With plates coated with an emulsion of silver nitrate in gelatine in a weak solution of barium nitrate, the exposed plate was *positive.* The effect of the red rays was very small, and of the blue rays very great.

One of the most important points in Professor Minchin's observations is his discovery of the formation of an invisible developable deposit on silver plates coated with an emulsion of silver bromide, by the action of the electrical current from a single bichromate cell passing through the plates when immersed in water containing a little potassium bromide. He found (1) that the plate connected with the carbon pole, the cathode, was without the employment of any developer visibly blackened in its immersed part, (2) that no visible change took place on the other plate attached to the zinc, but when the plate was developed with an ordinary pyrogallic acid developer its immersed portion was also blackened. These effects were entirely due to the passage of the current and were strictly confined to those portions of the sensitive plate through which the current passed.

The special bearing of these observations upon the formation and composition of the invisible or visible developable photographic image formed by the action of light, does not appear to have been generally recognised. I began last year a series of observations on this subject which quite confirmed Professor Minchin's: unfortunately they were interrupted before completion, but I hope to resume them in due course, after the completion of the present series, and bring them before the Society on a future occasion.

Professor Minchin also found that by coating silver plates with eosine and gelatine, comparatively strong currents were obtained and the plates were very sensitive to variations in the light. The current generated by daylight in one of these eosine cells was sufficiently strong to produce the photographic action on a silver bromide plate without any preliminary exposure of the bromide plate to gaslight. He also describes a curious case of inversion of the current occurring in the eosine and other cells, which I have also noticed, the initial current being such as to make the exposed plate *positive* to the other. This current, however, was of very short duration and was succeeded by a steady and much stronger normal current in the opposite direction, the exposed plate being *negative* to the unexposed. On suddenly shutting off the light from the plate the instantaneous effect was to *increase* the existing current, the effect being merely impulsive, after which the current generally disappeared. This cell having been kept in the dark for a fortnight, it was found that while the inverse currents were produced as before, the initial current on exposure was enormously increased in magnitude and duration. It then disappeared gradually and was succeeded by a current in the reverse direction. When one of these plates was removed from the cell and immersed in water in presence of a clean silver plate, it was at once on exposure to light *negative*, like a silver plate coated in the ordinary way with an emulsion of eosine. In preparing these eosine-gelatine films, it was found to be an advantage to immerse them for a few minutes in a strong solution of alum in order to prevent the dye from washing out of the film too readily.

With silver plates coated with napthalene red and gelatine the effects were not so strong as with eosine; the exposed plate was *positive* and with strong red rays there appeared to be a reversal of the sign of the E. M. F.

Plates coated with iodine green and exposed to sunshine gave currents with an E. M. F. amounting to about $\frac{1}{20}$ volt.

M. F. Griveaux, experimenting on silver plates coated with a film of silver iodide, plunged into solutions of iodine of different strengths, circulating through the cell, found that the maximum value of the E. M. F. developed by light acting on one of the plates decreased as the strength of the iodine solution increased, till a certain point was reached at and above which the E. M. F. was *nil*. Also that this point was regulated by the distance of the plates from the source of light; the nearer the plates the higher the concentration point of the solution and *vice versâ*. The same effects were observed with silver chloride and bromide. (*Comptes Rendus Acad. Franc.*, CVII, 1888, p. 837.)

I have entered somewhat fully into these previous experiments because very little appears to be generally known about the subject and it seemed desirable to bring together the scattered observations.

In carrying out my experiments I have used two kinds of cells, one horizontal and one vertical, more usually the latter. It consists of a glass cell in which the plates can be coupled face to face or back to back, one being screened from light by the other and by one or two interposed screens of ruby or yellow glass, the cell being covered all round except at an opening on one side. This glass cell is enclosed in a wooden box with a shutter on one side sliding in front of an opening about 1·5″ × ·5″, corresponding to the one in the glass cell. In front of this shutter there are grooves in which coloured glasses can be placed in front of the opening. The upper part of the wooden case is open, but can be closed by a lid, through which, if necessary, a funnel may be passed to admit of solutions being poured into the cell without letting in light. The silver plates used with this cell are 4 inches long, and $1\frac{1}{4}$ inches wide, other plates, such as photographic sensitive dry plates or celluloid films, being about the same size or smaller.

The other cell is a modification of the form used by Becquerel in his earlier experiments, and consists of a wooden trough divided into two compartments by a double wooden screen which allows the free circulation of the electrolytic fluid, while completely shutting off light from the unexposed compartment. This trough is covered with a lid, having two large openings fitted with hinged shutters, to the underside of which mirrors are attached for the purpose of reflecting light at will on to one or other of the sensitive surfaces in the compartments below. By this arrangement the whole of the sensitive plate can be exposed to light, instead of only part of it, as in the vertical cell, and at the same time the perfect protection of the unexposed plate from strong light is better secured than it is in the vertical cell. This horizontal trough is constructed to take two plates $3\frac{1}{4}'' \times 4\frac{1}{4}''$ or smaller.

In most cases, even under favourable conditions, the light-currents observed, are exceedingly weak, and therefore a very sensitive form of galvanometer is necessary. The one I have used is the latest modification of the Rosenthal micro-galvanometer made by Edelmann, in Munich. It is said to be the most sensitive form of galvanometer made, enabling currents of about a billionth of an ampère to be read with a resistance in the coils of only 1,000 ohms. It is fitted with a telescope by which direct readings are made off the mirror from a millimetre scale placed at one metre from it. In this position and without the directing magnet, using the $\frac{1}{1000}$ shunt, with a total external resistance of about 60,000 ohms in circuit, the deflection caused by one gravity-Daniell cell is one millimetre division of the scale. By using the directing magnet the normal sensitiveness of the instrument can be very greatly increased, though in most of the experiments it has been found sufficiently sensitive without the magnet, and when used, the increase of sensitiveness has been limited to about five times the normal. The instrument can be set up in any position, is simple in construction and I find it very sensitive, convenient in use and easy to observe with fair precision, considering the difficulty there is in obtaining freedom from shake and tremor in a city like Calcutta built on a bad foundation of mud. In reading the scale which is 50 centimetres long, sub-divided into millimetres, I have usually fixed the zero point at 30, so that the readings above or below it may as far as possible show different signs of E. M. F., and the direction of the currents has been so arranged that a change in the position of the index to the apparent left from 30 to 0 shall indicate that the exposed plate is *negative* to the unexposed, as copper to zinc, while a change to the apparent right, 30 to 50, shows that it is *positive*, or as zinc to copper.

The coloured glasses used have been of the kinds ordinarily met with in the bazar. A deep ruby, a brownish yellow, a medium green, and a dark blue, and conditions being favourable it has generally been possible to observe some trace of a current even with the deep ruby in strong sunshine.

When observations were made with the spectroscope, whether with a Rowland's diffraction grating or prisms, it was found that the amount of light admitted through the slit for ordinary work, was quite inadequate, even when the slit was open at its widest; and it was therefore necessary, in most cases, to use a much wider slit, or to dispense with its use altogether; also to use the directing magnet on the galvanometer to increase the sensitiveness.

In all cases sunshine has been reflected on to the sensitive plates by means of a heliostat, as it was not convenient to use the direct rays of the sun. With the flat cell there were thus two reflections, but any loss of light was amply made up by the increased surface exposed.

As is usual in such experiments, there were almost invariably more or less strong local or polarisation currents generated between the plates themselves, especially when they were freshly immersed in the solutions, and it was generally found desirable to leave the cell from 12 to 24 hours before use, so as to give time for these currents to subside. Sometimes, however, from half an hour to an hour, or even in some cases a few minutes is sufficient. It was found, too, that even if there was no polarisation current at the commencement of an experiment, the action of light occasionally gave rise to fairly strong currents quite independent of, and sometimes opposed to, the currents produced by exposure to sunshine, while at others they were in the same direction. Thus it was sometimes difficult to ascertain how far the currents observed were due to light or to polarisation. The only test was the retrograde movement of the needle after shutting off the light.

Another difficulty in making these observations may be noted, and that is, the apparent reversals of current which are due in many cases to decrease in the strength of the light, though the decrease may be almost imperceptible. For the same reason, if coloured glasses be applied without first completely shutting off the light after the plates have been exposed to sunshine, there is an apparent reversal due to the loss of power in the light, and not to change of direction of the E. M. F. As a rule my observations with coloured glasses or the spectrum have agreed with Becquerel's and Minchin's that no reversal of sign is produced by any of the coloured rays. At the same time, I have found that in some cases the blue rays appear to have a reversing tendency, as might be anticipated from their very strong reversing action on certain forms of sensitive photographic plates containing iodide or bromo-iodide of silver. This point, however, requires much more complete investigation with the aid of the spectroscope, and will be further considered when dealing with the silver haloids. During the time I have been engaged with these observations, the weather has been unusually changeable and cloudy for the time of year, and hence it has been difficult to compare the results of observations on different days. For this reason it has been impossible to give more than general indications of the amount of deflection caused by the action of light in the cases recorded: exact observations would have to be made with a standard light.

It seemed desirable to commence the observations with experiments on plain silver plates in different fluids. The plates used were not quite pure, having been reduced from various silver residues, and were about ·974 touch. They were four inches long and one and a quarter inch wide, and were usually cleaned with fine emery powder, or with emery cloth immediately before and after use. It is, however, better to make sure of the purity and cleanliness of the surface of the plates for each operation by heating them red-hot and then immersing them in dilute sulphuric acid. As facilities for doing this with thick plates were not readily available, it has been omitted in all the following observations. As a rule, the plates were immersed in the solutions to a depth of from 2 to $2\frac{1}{2}$ inches, care being taken to avoid moistening the upper unimmersed parts by capillary action or otherwise, and so exposing them to irregular currents from this cause. The plates were about half an inch apart, being kept separated by two wooden blocks with a dark ruby glass plate between them.

I. Silver Plates in Water.

Distilled Water.

Distilled water being almost a nonconductor, the currents observed were naturally exceedingly weak and could only be clearly seen with strong sunshine. The deflection observed without the magnet varied from ·5 to 3 divisions of the scale, and in nearly all cases the exposed plate was positive to the unexposed, and formed the anode or dissolving plate of the couple. In some cases the exposed plate became more sensitive after the first exposure, but after a few exposures lost all sensitiveness. The current being so small, it was not thought necessary to experiment with coloured glass or the spectrum. With the directing magnet placed as before described the deflection was increased to about 6·5 divisions.

Tap Water.

The tap water used was the filtered Hooghly water, supplied in the town mains. It is fairly pure and free from lime salts, but chlorides are present in moderately large proportion, the amount of chlorine varying from ·5 to 1·4 parts per 100,000, and at the time of the experiments it would be about 1 to 1·2 parts per 100,000. The total hardness varies from 3·15 to 11·5 parts and would be about 9 parts per 100,000 at the time of the experiments. In most of the cases observed the exposed plate was distinctly positive to the unexposed, as with distilled water; but in some cases it was negative, and in one or two instances the action was irregular. The plates were rather more sensitive than they were in distilled water, the normal deflections without the directing magnet varying from 1 to 7 divisions of the scale, but usually they were between 2 and 4.

In one case in which the plates had been in the cell for about 38 hours, and there was only a very slight cell-current, exposure to sunshine gave a deflection of + 4·5 divisions without the magnet, but with it the deflection in bright sunshine rose to + 20 divisions, and even in diffused light was + 5 divisions. Exposing under ruby glass gave a deflection of + ·5; yellow glass + ·7; green glass + 1; blue glass + ·5 in diffused light, and + 7·5 in sunshine. Trials were also made with the grating spectroscope without the directing magnet, but the results were not conclusive and the unsettled weather has, so far, prevented their being repeated with the galvanometer in its most sensitive state. The plates were found very sensitive to changes in the strength of the light, but after repeated exposure to sunshine they seeemed to lose sensitiveness. By the action of the water a greyish deposit of chloride was formed and in some cases a darkened image of the exposed part of the plate could be seen. It may be noted that my experience does not agree generally with that of Hankel, who found that, of two silver plates immersed in water the plate exposed to white clouds, or to the setting sun, was negative. I find, however, that on one occasion when fresh plates were exposed to daylight, the exposed plate was negative, the deflection being about − 1·5 divisions of the scale. On again exposing the same plates to sunshine the exposed plate was positive, and remained so afterwards on further exposure. On two other occasions of exposure to daylight, the exposed plate was also negative. When exposed to sunshine the plates were almost invariably positive. I have noticed this difference with plates in other solutions.

II. Silver plates in dilute Acids.

As we have seen above, Becquerel found that with plates of gold or platinum, immersed in acid solutions, the plate exposed to the light was always positive. The same rule seems to apply to silver plates in most cases, but not in all.

Dilute Sulphuric Acid.

The action of dilute sulphuric acid upon silver plates under the influence of light seems to be rather irregular, but I find on looking through all the experiments made, that in nearly all cases the first exposed plate of each pair had a negative tendency when first exposed, though it might become positive by subsequent exposures and in the same way the second plate of the pair, which was screened during the first exposure, might also be positive on first exposure. The general tendency was undoubtedly positive. The irregularities may be partly due to the plates not being quite pure.

With silver plates immersed in distilled water acidified with about a drop of acid in some 60 cc. of water, the exposed plate was generally positive when exposed to bright sunlight, the deflection without the directing magnet varying from 1 to 4·5 divisions of the scale, sometimes increasing after repeated exposures. In one experiment, however, the exposed plate was distinctly and uniformly negative, even after the position of the plates had been reversed, but subsequent exposure of the reversed plate made it positive. In another it was negative on first exposure and then positive.

With a pair of plates in tap water, acidified in the same way, the plate exposed to sunshine was first negative with a deflection of -3 divisions on the scale, which increased to -6 divisions by subsequent exposures. Exposure under coloured glasses also gave a negative deflection, amounting with red glass to -1, with yellow and green glasses to -2; with blue glass to -5, and exposed to sunshine again -6, as before. The same plates being again exposed to sunshine later on were also negative at first, but became positive and much more sensitive. Under coloured glasses the deflections were also positive and very much larger than on the first exposure of the plate. After reversal, so that the former unexposed plate became the exposed plate, the deflection was again negative, amounting to -7 divisions, and increasing with the exposure. These plates were very sensitive to changes in light, and there was a perceptible deposit of chloride (?) on their immersed surfaces.

With plates immersed in a 1 per cent. solution of sulphuric acid in distilled water, it was found that if the plates were exposed to sunshine a very short time after being immersed in the dilute acid, they were at first negative and fairly sensitive to light but afterwards became positive; whereas in a case when the plates were left standing for 24 hours to reduce the polarisation, they were positive, and much less sensitive than the plates which were negative. After a short time they seemed to lose all sensitiveness.

In tap water containing the same proportion of acid, the exposed plates were generally positive on opening the shutter; but the current quickly decreased, and with some plates after several exposures they gave a negative deflection.

With plates immersed in distilled water containing two per cent. of acid the deflections were usually positive and the plates seemed to become less sensitive by repeated exposure and by keeping.

With plates immersed in dilute acid at 5 per cent., which had been allowed to stand for 24 hours, and showed a very small cell-current, the first plate of the pair was distinctly negative when exposed, the deflection being -4, decreasing with exposure to -2, but the second plate when exposed after reversal of the plates in the cell was positive with a deflection of $+6$. Two other pairs of plates in freshly-mixed acid were positive on first and subsequent exposures. The addition of acid lowered the sensitiveness of the plates considerably.

All the plates showed a slight grey deposit or stain on the immersed ends. but no trace of an image.

Dilute Nitric Acid.

With nitric acid the exposed plates are nearly always positive and the action is far more uniform than with sulphuric acid, especially when an appreciable quantity of acid, as one per cent. and over, is used. Becquerel also found the exposed silver plate positive in dilute nitric acid.

With distilled water acidified with about 1 drop of acid in 70 cc., the exposed plate was positive on first exposure, but afterwards became negative. The plates were not very sensitive, the deflections without the directing magnet varying from 1 to 3 divisions of the scale.

With 1 per cent. of nitric acid, *sp. g.* 1·250, in distilled water, after 14 hours standing, the exposed plate was uniformly positive, and more sensitive than with the acidulated water, the deflections in sunshine being from 3·5 to 5·5 divisions, without the directing magnet. There was a slight greyish deposit on the plates, but no image on the exposed part.

With three per cent. of the same acid in distilled water, after 22 hours standing, the first plate exposed in weak sunshine first showed a negative deflection of 2 divisions, and after that was positive, the deflection of repeated exposures being steadily about + 5 divisions, without the magnet. With the directing magnet, the deflection was about + 20 divisions with the 100 ohm, or $\frac{1}{10}$, shunt.

After the experiment the solution was found to contain silver.

Dilute Phosphoric Acid.

With dilute phosphoric acid the deflections were almost always positive. Plates freshly immersed in a mixture containing 1 per cent. of the acid, sp.g.1·750, in distilled water and exposed to sunshine, gave an initial deflection, without the magnet, of + 23 divisions, but this quickly decreased with further exposure. After shutting off the light the cell-current was found to have increased, and on again opening to sunshine the deflection seemed slightly negative, but the action generally was irregular. Subsequent exposures with the same cells or after the plates had been reversed showed positive deflection and the plates were less sensitive than at first.

With the same acid at 5 per cent. the deflections were uniformly positive. With plates exposed to sunshine after 16 hours, the deflection without the magnet was + 8 divisions, but, as in the former case, it was less on subsequent exposure. The same decrease of sensitiveness after exposure was noticed with the plates after reversal in the cell.

Dilute Hydrochloric Acid.

With 1 per cent. of hydrochloric acid, *sp. g.* 1·150, in distilled water, the exposed plates have shewn themselves uniformly positive, and owing to the formation of a deposit of chloride they are much more sensitive to light, than are plates immersed in acids which do not form a sensitive compound with the silver. The deflections with sunshine, without the directing magnet, were from + 6 or + 7, when the plates were first exposed, to + 36, when they had been kept for some hours longer and then exposed. The plates were covered with a greyish deposit of chloride on the immersed parts, and there was a distinct darkened image on the part of the plate exposed to light. Coloured glasses all gave positive deflections, the red being the smallest, and then the green.

With 3 per cent. acid, after 22 hours resting, the plates exposed to sunshine were positive. The increase of acid seemed to reduce the sensitiveness very much, the highest deflection in sunshine, without the directing magnet, being + 16, while after the plates had stood for 37 hours it was only + 11.

There was a dark grey deposit of chloride on the immersed parts of the plates, which took a violet or purple colour on exposure to light, and gave off an odour of chlorine.

Dilute Hydrobromic Acid.

With dilute hydrobromic acid containing 10 cc. of the ordinary pharmaceutical dilute acid, of 10 per cent., to 100 cc. distilled water, the plate exposed to sunshine or diffused daylight was uniformly *negative* and extremely sensitive to light, the first deflection in bright sunshine being about − 187 divisions, without the directing magnet, decreasing to a steady reading of about 140 divisions. Even coloured glasses gave fairly large deflections; red, − 13; yellow, − 54; green, − 64; blue, − 103.

With dilute acid of double the above strength, the exposed plate was also uniformly negative, but the plates did not seem so sensitive, the deflection in sunshine, without the magnet, being only − 82; but the readings depend very much on the strength of the light, and this was variable at the time of observing.

In both these cases the plates were coated with a grey-greenish-yellow deposit of bromide, which turned dark on exposure, and formed a visible image of the exposed part of the plate.

Dilute Hydriodic Acid.

As pure hydriodic acid is somewhat troublesome to prepare, I roughly made up a solution of it by precipitating one gramme of barium iodide, dissolved in water, with sulphuric acid and adding water to make up 100 c.c. There was, however, a considerable quantity of free iodine present, the solution being of a light sherry colour.

The cell containing two clean silver plates immersed in this solution was left standing for 15 hours. The plate exposed to sunshine was then found strongly negative, the deflection, without the directing magnet, being − 110 divisions of the scale, afterwards going up to − 130 divisions. The plate was, very insensitive to weak daylight, the reading being only 12 divisions when the sun was hidden behind clouds. With coloured glasses fairly large deflections were obtained, always in the same negative direction; red glass giving − 15 with daylight, and − 16 with sunlight; yellow − 16·5 with daylight, and − 20 with sun; green − 14 with daylight, and − 19 with sun; blue − 16 with daylight, and − 80 with sun. By keeping, the plates became less sensitive. They were covered with a strong loose deposit of iodide, under which the silver surface was darkened. A faint image of the exposed part was visible.

Dilute Glacial Acetic Acid.

With plates freshly immersed in dilute glacial acetic acid of 1 per cent., the plate exposed to sunshine was positive, the deflection being about + 6·5 divisions, without the magnet; a second exposure gave a deflection of + 8·3 divisions. By keeping for 24 hours the plates were less sensitive, but remained positive.

Plates immersed in dilute acid of 5 per cent. and kept 24 hours before exposure were less sensitive than the above, the deflection with sunshine being only + 3 divisions without the magnet, and they became less sensitive by further exposure, but were always positive.

Dilute Formic Acid.

The only other organic acid I have yet tried is formic acid, one per cent. in distilled water. After the cell had been standing 24 hours, exposure to sunshine gave a deflection amounting to about 8 divisions, the exposed plate being positive. The same plates after another 24 hours standing were found to have become very insensitive, the deflection being only one or two divisions of the scale, the exposed plate still being positive.

III. Silver plates in Alkaline Solutions.

Becquerel found that when platinum or gold plates were immersed in alkaline solutions, the plate exposed to light was negative. So far as my experience goes, this rule does not hold good with silver, the sign of the exposed plate being almost always positive. I have not tried these solutions very thoroughly, but the results obtained with potash and other salts used seem conclusive.

Solution of Potassium Hydroxide.

With a solution of one per cent. of caustic potash in distilled water, the cell having been standing 22 hours, the cell current was *nil.*

Exposure to bright sunshine gave a deflection of about 9·5 divisions without the magnet, the exposed plate being positive. With the magnet the deflection was about + 45 divisions in sunshine, and + 9 divisions in daylight. With sunshine under blue glass the deflection, with the magnet, was + 31; under green + 9; yellow + 8; red + 4·5. There was no deposit on the plates and no image of the exposed parts.

Solution of Potassium Carbonate.

With a solution of one per cent. of anhydrous potassium carbonate, the cell having been standing for about 14 or 15 hours, the cell-current was very small, and the plate exposed to light, either daylight or sunshine, was found to be positive, the deflection in the former case being + 22, and in the latter + 63·5, without the magnet.

With tap water made alkaline with a few drops of ten per cent. solution of the carbonate in about 60 c. c. of water, the exposed plates were also positive and very sensitive on first exposure, but the current decreased with further action of light, and in subsequent exposures the plates were less sensitive to light. They also lost sensitiveness by being kept in the cell.

Solutions of Sodium Carbonate.

With silver plates exposed shortly after immersion in 1 per cent. solution of anhydrous sodium carbonate in distilled water, the plate exposed to sunshine was positive, the deflection being about + 5 divisions without the magnet. In subsequent exposures the plates were less sensitive, but remained positive.

With a stronger solution, at 5 per cent., the results were similar, but the plates seemed somewhat more sensitive.

Solution of Lithium Carbonate.

With plates exposed shortly after immersion in a 1 per cent. solution of lithium carbonate in distilled water, the plate exposed to sunshine was positive, the deflection being about + 6 divisions without the magnet. The plates lost sensitiveness after the first exposure as well as by keeping for 34 hours, but remained positive.

Dilute Solution of Ammonia.

With a solution of 4 c. c. of strong liquid ammonia in 100 c. c. distilled water, the cell having been left standing some 14 or 15 hours, the plates were found to be exceedingly insensitive to light; even with the magnet the deflections in sunshine were only about 2 divisions, the exposed plates being positive.

Another pair of plates immersed in a freshly-mixed solution, containing 2 c. c. of liquid ammonia in 100 c. c. of water, and exposed soon after immersion, were also found insensitive, but not so much so as the last; the deflection on first exposure in sunshine being about 3 divisions, without the magnet. The current, however, decreased on further exposure, and the same effect was observed in subsequent exposures. After a short time no current was perceptible.

The immersed parts of the plates showed no deposit.

Potassium Cyanide.

With a solution of potassium cyanide in distilled water, about 1 per cent., there was a strong negative polarisation current in the cell when first prepared, which took several hours to subside. When freshly immersed the exposed plate was negative, but not very sensitive, the deflection without the magnet being only − 4 divisions for sunlight. By keeping the cell 24 hours the polarisation current subsided entirely, and the plate exposed to sunshine was again negative with a deflection of − 3·5 divisions. A slight movement of the cell, however, seemed to cause a reversal of the current with a deflection of + 6·5 divisions which further continued for another 6·5 divisions after the light had been shut off. The same effect was observed on subsequent exposures, first the plate was negative then positive, while the polarisation current increased in the same direction. After a time the plate seemed to become quite insensitive to light.

With the same plates reversed there was again a very large initial negative polarisation current. On first exposure of a plate to sunshine the deflection was − 14·4 divisions, without the magnet. On shutting off the light, the negative polarisation current was found to have very largely increased. On second exposure the plate was first negative and then positive. On shutting off the light the current continued + 2·5 divisions in the same direction and then turned back in its original direction. The plates were coated with a dark grey deposit, thicker at the upper part of the plates than at the lower. About the immersion line there was a yellowish-white deposit, and the plates were deeply corroded, but no sign of an image of the exposed part was visible.

From the above experiments it would appear that as a general rule sunlight has an oxidising or dissolving effect on silver, whether in acid or alkaline solutions, the exposed plates being nearly always positive and consequently forming the anode of the voltaic couple. With solutions decomposed by silver and forming sensitive compounds the action is variable.

IV. Plain Silver plates dry.

When a comparatively large silver plate about 5 × 4 inches, not immersed in any solution, but with its ends connected by silver bands to the terminals of the galvanometer, the directing magnet being specially placed so as to increase the normal sensitiveness about 13 times, was exposed to light so that the upper half remained unexposed, it was found possible to detect a slight current between the exposed and unexposed halves of the plate; the exposed half being positive to the unexposed. With an uncleaned plate that had lain in a drawer for some months, the deflection in sunshine was fairly large, amounting to about 10 divisions, or rather more than the deflection caused by the contact of dry zinc and copper. When, however, the same plate had been carefully cleaned with a solution of cyanide of potassium followed by the usual rubbing with emery cloth, the deflection was found to be still positive, but much smaller, being only about 1·5 divisions on first exposure, and by repeated exposure it was reduced to about ·25 division.

With subsequent exposures the deflection was generally in the same direction, but once, after fresh cleaning, it was negative. With a plate of pure silver deposited on glass, freshly polished, the first exposure gave after a short interval, a fairly strong negative deflection, but with subsequent exposures at intervals the deflections have been sometimes negative and sometimes positive, but always very small, so that the observations are somewhat uncertain. Plates of almost perfectly pure silver, 999·5 touch, obtained through the kindness of the Mint Master, Lt. Col. Baird, R. E., F. R. S., gave also rather indefinite results, owing to the smallness of the currents, and though the deflections were generally positive on first exposure of the plates, they were sometimes negative, or became so by prolonged exposure. The general tendency, however, appeared for the plates to be positive under the influence of light, and, if this is the case it would seem to point to some slight oxidising action on the surface. At the same time, the results obtained with *pure* silver and the fact that in so many cases the deflections have been first positive and then negative, appear to favour the conclusion that such plates are really negative. It was clearly ascertained that the currents produced were not due to the action of heat, because with the plate first observed and with the purest silver plates, the action of heat applied at the exposed end of the plate was to give a positive deflection, but with the less pure silver plates used in the cells and others largely alloyed with copper, the heated end of the plate was always negative to the cool end. The deflection invariably increased with the continuance of the heating, and was always in the same direction on repetition of it.

The light currents, on the other hand, showed a decrease of deflection from repeated exposures and sometimes a change of sign in a direction contrary to the heat currents shown by the same plates. The observation is rather a difficult one and requires further repetition under more favourable conditions of light, in order to obtain definite results.

I have also tried the effect of solutions of alkaline haloid salts upon silver plates, but as this paper is already beyond the usual limits, it may be well to defer the account of these and other experiments on photographic plates containing the haloid salts of silver to a future paper.

Noviciæ Indicæ VI. *A review of the genus* Colquhounia.—*By* D. Prain.

[Read May 3rd.]

Writing in 1885 (*Flora of British India*, iv, 674) Sir Joseph Hooker had to say of this genus:—"I am quite unable to distinguish the first three species,* or to reconcile their specimens, descriptions and published drawings with one another." And in 1890, when engaged in arranging the Calcutta Herbarium material of the natural order Labiatæ to which the genus belongs,† the writer, after considerable study came to the same conclusion. Since then, however, the opening up of the hill-country to the east of the Irrawaday has enabled the Calcutta Herbarium to send native collectors into hitherto unknown portions of the Shan Hills. One result has been the communication of suites of specimens that have helped to clear up some of the doubtful points. Briefly stated, the result of a renewed study has been that there seems to be no necessity for recognising more than two species in the genus; both these species are, however, very variable, and include between them seven more or less distinguishable and definable forms. The present paper consists of a short bibliographical review of these with diagnoses of all of them, and with an account of their distribution appended.

The genus Colquhounia was founded by Wallich in 1822,‡ on specimens collected by himself in Nepal, in honour of his friend Sir Robert Colquhoun, Bart., of the H. C.'s service. His diagnosis, and voluminous description of *Colquhounia coccinea*, the species then proposed, he republished, practically unaltered, two years later,§ giving at the same time a coloured plate which represents however, not the typical plant originally described, but a variety with smaller flowers. In a note at the end of this second description, Wallich distinguishes by name and by a general diagnosis a second species, *C. vestita*. This, he says, comes from various localities in Nepal, at a higher elevation than the stations for *C. coccinea*, and occurs also in Kamaon. He says that *C. vestita* flowers in the height of the rains, *C. coccinea* at the end of the rains and in the cold weather; the main distinction given, however, is one of tomentum; this is described as being in *C. coccinea* scaly-stellate, rusty, dense and friable, in *C. vestita* soft, white, thick and separable.‖ The flower-spikes and flowers are admitted to be similar; plainly therefore the distinction is not a far-reaching one.

* *Colquhounia coccinea* Wall., *C. vestita* Wall., *C. elegans* Wall.

† *Journ. As. Soc. Bengal*, lix, 2, 294.

‡ *Trans. Linn. Soc.*, xiii, 608.

§ *Tent. Flor. Nap.*, i, 12 t. 6.

‖ *Tent. Flor Nap.*, i, 14.

The LABIATÆ of the H. E. I. Company's Herbarium were distributed by Wallich in 1829;* Bentham, who revised for Wallich the naming of this particular order, treated these two species somewhat differently. In *C. coccinea* he recognized three distinct forms:—†

(1). *C. coccinea* proper; the pink-flowered plant originally described in *Trans. Linn. Soc.*, and re-described in *Tent. Flor. Nap.*

(2). VAR. *β. major* Benth.; the Nepalese plant from higher levels and with denser tomentum, treated by Wallich as identical with the plant from Kamaon that he distinguished specifically from *C. coccinea.*

(3). VAR. *γ. parviflora* Benth.; an orange-flowered plant, not clearly differentiated by Wallich in either of his descriptions, but figured by him in the *Tentamen* as typical *C. coccinea.*

On the other hand the name *C. vestita* was strictly limited to the plant from Kamaon already referred to, which had been communicated to Wallich by Blinkworth,‡ and a new species from Burma, *C. elegans*, was for the first time mentioned.§ In the same year Bentham in another place defined the genus, mentioning all three species, but not there distinguishing the varieties of *C. coccinea.*||

In 1832 Wallich again dealt with these *Colquhounias*, figuring both *C. vestita* and *C. elegans.*¶ He diagnosed *C. vestita* from *C. coccinea* by its "ovate-oblong much attenuate acuminate leaves, very densely hoary tomentose below, as are the branches," adding that this character comprises all the points in which *C. vestita* differs from *C. coccinea.* From the original specimens it is evident that this figure of *C. vestita* was taken from one of Blinkworth's Kamaon specimens; Wallich did not however adopt Bentham's limitation of *C. vestita* to that locality, for he replaced in the species the Nepalese plant that forms Bentham's *C. coccinea* VAR. *major.* In immediate sequence come the definition and figure of *C. elegans*, the Burmese species; of this he mentions having only seen one shrub; the best distinction, Wallich says, between this and *C. coccinea*, which it much resembles, is the colour of the flowers—orange, dotted with crimson specks, instead of red. The plant is described as having leaves very softly tomentose on both surfaces, an idea

* *Lith. Cat.* n. 2084—6.

† *Wall. Lith. Cat.* n. 2085/1, 2085/β, 2085/γ.

‡ *Wall. Lith. Cat.* n. 2086.

§ *Wall. Lith. Cat.* n. 2084.

|| *Bentham, Synops. Labiat.* in *Bot. Reg.*, xv, sub 1292.

¶ *Plant. As. Rar.*, iii, 43, tt. 267, 268.

by no means conveyed by the figure, which represents a plant that, as Sir Joseph Hooker says,* cannot be distinguished from *C. coccinea* VAR. *parviflora.* These two plants are however remarkably dissimilar in tomentum, the hairs being stellate in VAR. *parviflora,* as they are in all the other forms of *C. coccinea,* but simple in *C. elegans.* As regards the *degree* of tomentum of *C. elegans* it is the description that is accurate, the figure that is misleading.

In 1834 Bentham again dealt with the genus†, and on this occasion still confined *C. vestita* to the Kamaon plant of Blinkworth, though in *C. coccinea* he now recognized only two forms:—

(1). *C. coccinea* proper, which now includes the original plant described by Wallich, as well as the Nepalese portion of Wallich's *C. vestita;* this variety therefore now includes the original *C. coccinea* and Bentham's own *C. coccinea* VAR. *major.*

(2). VAR. *β. parviflora* Benth., which is the same as the plant so named in 1829.

The Burmese *C. elegans* is defined in the Wallichian sense.

In 1848 Bentham‡ followed in the main his treatment of 1834, but as regards *C. coccinea* confined the Wallichian number 2085 to VAR. *parviflora* alone, although, as we have just seen, this number applies *in the Catalogue* to every specimen of *Colquhounia* collected in Nepal. Under *C. vestita* also Bentham diverged somewhat from his previous treatment by admitting into the species a plant sent by Griffith from Assam. This is, however, a plant that must be kept specifically apart from *C. vestita* if *C. vestita* deserves to be held specifically distinct from *C. coccinea;* while, even if *C. vestita* and *C. coccinea* be conspecific, this Assam plant is still varietally distinct from both.

In 1850 Sir William Hooker figured§ as *C. coccinea* a plant raised at Kew from seed sent by Wallich from Nepal. This is the plant originally figured by Wallich in the *Tentamen,* and therefore is not exactly the one originally described by him there and in the Linnean Society's *Transactions;* it is not typical *C. coccinea,* but is Bentham's *C. coccinea* VAR. *parviflora.*

In 1851 Schlechtendal described|| as *C. mollis* a plant whose origin he was unable precisely to trace. His description is, however, so full

* *Flora of British India,* iv, 674.
† *Labiat. Gen. & Sp* 644.
‡ *DC. Prodr.,* ii, 457.
§ *Bot. Mag.,* lxxvi, t. 4514.
|| *Linnaea,* viii, 681.

and clear as to leave no room for doubt that his plant is identical with the Assam one referred by Bentham to *C. vestita.**

In 1873 Houllet figured as *C. tomentosa*† what appears to be the same plant.

In 1876 Bentham and Hooker speak of the possible existence of a fourth species‡; it is not clear whether by this fourth species be meant Schlechtendal's *C. mollis*, which is cited indirectly through a reference in Walpers; or a Burmese plant collected by Mason, Parish, Anderson and Kurz since published as *C. tenuiflora* Hook. f.§ but which in 1877 Kurz‖ described as *C. elegans*. Kurz wrote under the disadvantage of only knowing Wallich's plant from the figure which Wallich gives of it; that figure, as has already been said, is quite misleading.

The next account to be noticed is the most important of all—that by Sir Joseph Hooker in the *Flora of British India*. Here four species are described:—

1. *C. coccinea* Wall.; with Bentham's VAR. *parviflora* excluded.
2. *C. vestita* Wall.; limited, in the sense adopted by Bentham in 1848, to the Kamaon plant of Wallich and the Griffithian plant from Assam,¶—the Nepal plant originally included in *C. vestita* being excluded and Schlechtendal's *C. mollis* not being referred to; the identity of *C. vestita* as a whole with typical *C. coccinea* is suggested.
3. *C. elegans* Wall.; limited to the original Wallichian plant from the Taong Doung Mts; its identity with *C. coccinea* VAR. *parviflora* Benth., is suggested.

* There are two minor references to the genus by Walpers, *Annales* iii, 363 (1852) where he mentions *C. coccinea*; and *Annales* v, 689 (1858) where he gives Schlechtendal's diagnosis of *C. mollis*: this last reference is cited in the *Genera Plantarum* though the original description in *Linnaea* is not.

† *Houllet, Rev. Hortic.* (1873) p. 131. It should, however, be pointed out that Sir Joseph Hooker does not agree with the writer's view in this respect. He refers Houllet's plant to *C. coccinea* (and it may be that form of *C. coccinea* called by Bentham VAR. *major*); Griffith's plant is referred in the *F. B. I.*—as Bentham referred it—to *C. vestita*; *C. mollis* is not quoted in Sir Joseph's article.

‡ *Genera Plantarum*, ii, 1208.

§ *Flor. Brit. Ind.*, iv., 674. This form—apparently more common than true *C. elegans*—extends from Tenasserim to Yunnan. In the Calcutta Herbarium it is in evidence that at one time Kurz thought this distinct from the *C. elegans* of Wallich's description—of which he had no specimen—and proposed naming it *C. martabanica*. Later, he decided that it must be the *C. elegans*, of Wallich's figure, which it resembles, as to tomentum, rather more closely than the true plant does.

‖ *For. Flor. Brit. Burma*, ii, 278.

¶ In Mr. C. B. Clarke's Herbarium this Assam plant is distinguished from the Kumaon *C. vestita* proper, as *C. vestita* VAR. *rugosa* C. B. Clarke MSS.

4. *C. tenuiflora* Hook. f.; the new species referred to above.

Two more recent references to the genus have now to be noticed.

Mr. Hemsley in his *Index Sinensis** mentions one species; this he identifies, though rather doubtfully, with *C. coccinea*. The plant comes from Hupeh, South China, and the same form has more recently been collected in the Kya Valley, Upper Burma, by Genl. Gatacre. It is not *C. coccinea*, but is much more nearly allied to *C. elegans;* though a very distinct form, it is probably quite sufficiently differentiated if treated as a variety of the last named species.

Sir Henry Collett and Mr. Hemsley in a paper *On a Collection of plants from Upper Burma and the Shan States*† mention two species:—

1. *C. elegans* Wall.; the true Wallichian plant, never met with since it was collected by Wallich till it was obtained in 1887 by Genl. Collett, who speaks of it as certainly the most beautiful *Labiate* of the Shan Hills. Like *C. coccinea* VAR. *mollis* (*C. mollis* Schlecht.) this is always an erect shrub;‡ as regards colour of flowers there are two distinct forms, one with pale salmon-coloured, the other with dark red corollas.
2. *C. vestita* Benth., *not of* Wallich; not the true Wallichian plant, but Schlechtendal's *C. mollis*, Mr. Clarke's *C. vestita* VAR. *rugosa*.

The generic descriptions given by Wallich, Bentham, Schlechtendal and Hooker are so accurate and full that nothing can be added to them, and little is necessary beyond providing brief diagnoses of the various forms met with in the genus. Of these last there are altogether seven, and though in this paper they are treated as only of varietal rank, it may well be that other writers will find it necessary to consider them distinct species; indeed, as species at present go in the natural order LABIATÆ, it cannot be denied that forms so very distinct as the real *C. vestita* of Kamaon and as Hooker's *C. tenuiflora* are well entitled to the higher ranks. But what has to be pointed out very distinctly is that on those who may feel compelled to give this higher rank to these species of Wallich and of Hooker, it will be incumbent to recognise also

* *Journ. Linn. Soc.*, xxvi, 299 (1890.)

† *Journ. Linn. Soc.*, xxviii, 1–150 (1890),

‡ Genl. Collett remarks (*Journ. Linn. Soc.* xxviii, 8) on the discrepancy between this fact and the definition by Kurz (*For. Flor. Brit. Burma*, ii, 278) of *C. elegans* as 'a scandent or half-scandent shrub.' Kurz's definition however does not in the least refer to Wallich's original plant but to that other form collected by himself in Pegu, named by Sir Joseph Hooker *C. tenuiflora*, which is always a scandent plant.

Schlechtendal's *C. mollis*, and to give specific rank to that very distinct new form collected in Northern Burma by Gatacre and in South China by Henry.

It is remarkable that the character from tomentum which has been mainly relied upon—and with rather unsatisfactory results—in diagnosing the various species, should still prove the most effective and reliable. It has, however, to be noted that hitherto only the degree of tomentum and not its nature has been referred to, the difference between the simple hairs of the *C. elegans* series and the stellate hairs of the *C. coccinea* series of forms having been overlooked.*

COLQUHOUNIA WALL.

NAT. ORD. *LABIATAE.*

Tribe. *STACHYDEAE.*

Tall, robust, rambling herbs with rounded branches. *Leaves* ovate, margins dentate or crenate, petioled, acute or acuminate, base cuneate, rarely truncate or cordate, tomentose, as are the branches, with stellate or simple hairs. *Whorls* axillary, or in dense or lax-flowered spikes or racemes, of pink, orange, or scarlet, concolorous or spotted flowers. *Calyx* distinctly 10-nerved, equally 5-toothed, throat naked. *Corolla* tube incurved not annulate, throat inflated; galea entire or more rarely notched, shorter than the almost equally 3-lobed lower-lip. *Stamens* 4, ascending under the upper lip, the lower pair longer; anthers conniving in pairs, the cells divaricate, confluent. *Disc* equal; *style* shortly 2-fid with subequal lobes. *Nutlets* oblong, compressed, with the tip produced as a submembranous wing.

1. COLQUHOUNIA COCCINEA Wall., *ampl.*

Tomentum of stellate hairs on stems and leaves; hairs on the corolla many-celled, glandular at the tip; wings of nutlets sub-laciniate, not longer than body of nut; calyx teeth triangular.

HIMALAYA: INDO-CHINA.

VAR. *a. typica;* leaves dentate-crenate, tomentum white, usually sparse, ultimately almost disappearing; flowers large, pink or red. *C. coccinea* Wall., Trans. Linn. Soc., xiii, 608 (1822); Tent. Flor. Nap., i., 13, *fig. excl.* (1824); Cat. n. 2085/1 (1829); Benth., Bot. Reg., xv., *sub* 1292 (1829); Lab. Gen. & Sp. 644 (1834): DC. Prodr., xii, 457 (1848); Walp., Ann., iii, 268 (1852): Hook. f., Flor.

* The co-ordinate difference in the nature of the glandular hairs on the corolla, which is as striking, was pointed out to the writer by his friend Mr. Brühl, who kindly went over the forms after they had been sorted out.

Brit. Ind., iv, 674 (1885). *C. coccinea* VAR. *β. major* Benth. *in* Wall. Cat. n. 2085/β (1829). *C. vestita* Wall., Tent. Flor. Nap., i, 14, (1829), *and* Pl. As. Rar., iii, 43 (1832), *in part and excluding the Kamaon locality and the figure.*

NEPAL; on Gossain Than, *Wallich! Scully!* and Sheopore, *Wallich!* SIKKIM: Jongri, *King's collector!* and Lachen, *Hooker! G. Gammie!* KHASIA: Mairung, *Hooker and Thomson! Mann!*

A shrub 8–10 feet high, erect when standing alone but of sprawling habit and semi-scandent when growing with other species. In the form originally issued as VAR. *β. major* Benth., the tomentum is white as in *C. vestita*, and unusually dense, while the flowers are generally of a rather paler pink than in the specimens originally intended as typical, where the leaves are often ultimately quite glabrous from an initial rusty pubescence, and the flowers are dark red. Both forms have, however, similarly shaped dentate-crenate leaves, and in both the wings of the nutlets are nearly as long as the body of the nut These are the forms to which, in spite of his figure, it would be necessary to restrict Wallich's name *C. coccinea*, if *C. vestita* and the others are distinct species.

VAR. *β. vestita* Prain; leaves (sometimes cordate at the base) crenate, crenations large, tomentum dense, floccose, white, separating in patches but not disappearing completely; flowers large pink. *C vestita* Wall., Tent. Flor. Nap., i, 14 (1824) *in part, the Kamaon plant only*; Pl. As. Rar., iii, 43, t. 267 (1832) *as to fig.*; Wall., Cat. n. 2086 (1829): Benth., Bot. Reg., xv, *sub* 1292 (1829); Lab. Gen. & Sp. 644 (1834); DC. Prodr., xii, 457 (1848) *excl. the Assam plant:* Hook. f., Flor., Brit. Ind., iv, 674 (1885) *the Kamaon plant only.*

KAMAON; Srinagar, *Blinkworth!* Naini Tal, *Anderson!* Mussoorie, *King!* Kali valley, *Duthie* n. 3308! CHUMBI; at Tak-Chang, *King's collector!*

Like the preceding this is according to circumstances erect or semi-scandent. The flowers are pale red as in *C. coccinea β. major*, where also the tomentum is white. The leaves, however, (which in *C. vestita* are crenate, none of the crenations being sharp pointed) enable us to distinguish easily the two forms. The gathering from Chumbi has the thinner tomentum of *C. coccinea β. major*, but the leaf-margins are crenate not serrate; it thus serves to connect *C. coccinea* with *C. vestita.*

VAR. *γ. parviflora* Benth.; leaves and flowers smaller than in the type, tomentum rusty, flowers orange or golden yellow, with orange red lobes. *C. coccinea* Wall., Tent. Flor. Nap., i, t. 6 (1824) *the fig. only*; Hook., Bot. Mag. t. 4514 (1850). *C. coccinea* VAR. *parviflora* Benth. *in* Wall., Cat. n. 2085/γ

(1829); Lab. Gen. & Sp. 644 (1834); DC. Prodr., xii, 457 (1848).

NEPAL; on Sheopore, *Wallich!*

Scandent; this variety is represented only by specimens collected by Wallich; the leaves have larger teeth and somewhat resemble those of *C. elegans*, which is however always a shrub. It is quite as entitled to specific rank as is *C. vestita;* if treated as a species it ought to be known as *C. parviflora*.

VAR. δ. *mollis* Prain; leaves crenate, crenations very small, tomentum dense, rusty, permanent; flowers large, orange or red. *C. mollis* Schlecht., Linnaea, viii, 681 (1851); Walp., Ann., v, 689 (1858). *C. tomentosa* Houllet, Rev. Hortic., (1873), 131. *C. vestita* Benth., DC. Prodr., xii, 457 (1848) *not of Wall., the Assam plant only*: Hook. f., Flor. Brit. Ind., iv, 674 (1885) *excluding the Kamaon plant; not of* Wall.: Collett & Hemsley, Journ. Linn, Soc. xxviii, 116 (1890); *not of* Wall., *C. vestita* VAR. *rugosa* C. B. Clarke Mss.

SIKKIM; Balasun, *King's collector!* BOOTAN; *Griffith!* MISHMI; *Griffith* n. 4028 (*Kew Dist.*)! KHASIA; Mairung, *Simons! Oldham! Clarke* n. 16138! Shillong, *Mann! Collett!* Dingling, *Clarke* n. 5900! Cherra, *Hooker and Thomson! Clarke* n. 5322! MANIPUR; Kassome, *Watt* n. 5123! BURMA; Shan hills at Pwehla, *Collett!*

An extremely distinct form, always a shrub, and easily recognised by its stout virgate habit and by its nutlets with very short wings. This might be still considered specifically distinct even if C. *vestita* were merged in *C. coccinea*, and if looked upon as a good species it ought to bear the name *C. mollis* Schlecht. The leaves differ from those of *C. coccinea* in being always crenate, and from those of *C. vestita* in the small size of the crenations, and in the rusty, not white, tomentum.

2. COLQUHOUNIA ELEGANS Wall., *emend.*

Tomentum of simple hairs on stems and serrate leaves; hairs on the corolla few-celled, glandular at the base; wings of nutlets entire, acute, longer than body of nut; calyx teeth acuminate.

INDO-CHINA; S. CHINA.

VAR. α. *typica*; whole plant densely, softly tomentose; flowers in very dense many-flowered axillary heads; corolla dark-red or salmon-coloured, with or without crimson spots, tube long, throat wide. *C. elegans* Wall., Cat. n. 2084 (1829); Benth., Bot. Reg., xv, *sub* 1292 (1829); Wall., Pl. As. Rar., iii, 43, t. 268 (1832): Benth., Lab. Gen. & Sp. 645 (1835); DC. Prodr., xii, 457 (1848): Hook. f. Flor. Brit. Ind., iv, 674 (1885); Collett & Hemsley, Journ. Linn. Soc. xxviii, 116 (1890).

MANIPUR; Sirohifurar, *Watt* n. 7443! BURMA; Taong Doung Mts., *Wallich*: Shan Hills at Toungye, *Collett!* at Mone, *Manders! Fulton!* at Lwekaw, *Manders!* Ruby Mines district, frequent, *King's collectors!*

A shrub, 8 to 10 feet high, and apparently never scandent; the flowers are sometimes red (*Collett, King's Collectors*) sometimes salmon-coloured with crimson spots (*Wallich*) sometimes uniformly salmon-coloured (*Collett, Fulton, Manders*).

VAR. β. *pauciflora* Prain; almost glabrous throughout, flowers in loose few-flowered axillary heads; corolla red, tube very short, throat wide. *C. coccinea* Hemsl., Journ. Linn. Soc., xxvi, 299 (1890) *not of* Wall.

S. CHINA; Ichang, *A. Henry* n. 3334! BURMA; Kya Valley, *Gatacre!*

A very distinct, always scandent form, with a much more slender habit than the preceding; the nutlets are however not distinguishable, and the tomentum is of precisely the same character, though so much slighter in degree. If this is treated as a distinct species, which will be necessary if specific rank continues to be claimed for *C. tenuiflora*, it might be known as *C. pauciflora*.

VAR. γ. *tenuiflora* Prain; sparsely hairy throughout, flowers in loose many-flowered long axillary racemes; corolla red, tube very long, throat narrowed. *C. tenuiflora* Hook. f., Flor. Brit. Ind., iv, 674 (1885). *C. elegans* Kurz, For. Flor. Brit. Burma, ii, 278 (1877) *not of* Wallich. *C. martabanica* Kurz Mss. in Herb. Calcutta.

S. CHINA; Yunnan, *Anderson!* BURMA; Poneshee *Anderson!* Pegu, *Kurz!* Karenni, *Mason!* TENASSERIM; Moulmein, *Parish!*

Also a very distinct form; in habit exactly like the last, but with much longer flowers than even in the type, and with an absolutely, as well as relatively, narrower corolla-throat. Distinct, however, though the form is it is not convenient to give it specific rank, as this would necessitate the recognition of *C. parviflora*, *C. mollis*, and *C. pauciflora* as distinct species also.

D. Prain delt. A. C. Mukerjei lith.

PEDICULARIS DIFFUSA Prain.

A. D. Molla delt. A. C. Mukerjei lith.

PEDICULARIS FLACCIDA Prain.

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On the Flora of Narcondam *and* Barren Island.—*By* D. Prain.

Plates III and IV.

[Read May 3rd].

§ Introductory Sketch.

The Indian Ocean is broken on the north by the Indian Peninsula into two roughly triangular seas. The eastern, rather the smaller, forms an area known vaguely as the Bay, Gulf, or Sea of Bengal—the first of these names being that most usually employed—bounded on the west by Ceylon and India, on the east by the Malay Isthmus (Tenasserim) and Indo-China, and on the north by the Gangetic Delta. The ocean-surface thus defined is, however, further differentiated into three distinct hydrographical areas.

These areas are (*a*) the Bay of Bengal, a bight limited to the west by the Kistna Delta, to the east by Cape Negrais and situated to the north of an arbitrary line—the parallel of Lat. 16° N.—beyond which it passes into (*b*) the Sea of Bengal, stretching from Coromandel and Ceylon, on the west, to the Andamans and Nicobars on the east. The Sea of Bengal opens southwards into the Indian Ocean proper, from which it is hydrographically rather definitely limited by the somewhat rapid upward shelving of its floor from the bottom of that ocean to a uniform depth of 2200 fathoms along a line roughly coincident with the parallel of Lat. 6° N. Thereafter its floor is a plain and practically a level one, for it slopes so gradually northwards that, as it passes into the Bay proper, its depth is still 1400 fathoms. No such clear delimitation exists between Sea and Bay; the plain that forms their common floor still slopes gradually upwards towards the north till, in the neighbourhood of Lat. 20° N., the edge of the shelf of the Gangetic Delta is reached.

The southern edge of the floor of the Sea of Bengal may, in spite of its depth of over 2000 fathoms, be taken as, in a sense, the margin also of the continent of Asia, for there is more than the rapid increase of slope towards the bottom of the Indian Ocean to characterise it. To the west it coincides with that remarkably abrupt terrestrial elevation which results in the island of Ceylon, off the south-west coast of which island, less than 40 miles from the Basses, the ocean depth of 2300 fathoms is reached. To the east a precisely similar terrestrial elevation, though of smaller size and much less height, is met with. Just as Ceylon lies, a pear-shaped eminence, to the east of Lon. 80° E., so to the east of Lon. 90° E. lies the pear-shaped eminence known as Carpenter's Ridge,* a terrestrial mass that rises from a depth of 2300 fathoms in Lat. 5° N., till in Lat. 6° N. and Lon. 90° 30′ E., it reaches a point which carries only 1380 fathoms. The 'thick end' of the pear in both cases faces the south, and just as the 'stalk,' in the case of Ceylon, tails north-westward into the Indian Peninsula, the 'stalk,' in the case of Carpenter's Ridge, tails north-eastward into Middle Andaman. There are these differences between the two; the connecting ridge between Ceylon and India carries nowhere more than 8 fathoms, that between Carpenter's Ridge and the Andamans carries 1600 fathoms, while the highest point of Carpenter's Ridge is as much beneath as the highest point in Ceylon is above sea-level.

The third area (*c*) is the land-locked sea †, bounded on the west by the Andamans and Nicobars, on the north by the Irrawady Delta, on the east by Tenasserim and Kedah, and prolonged south-eastward into the Straits of Malacca, between Sumatra and the Malay Peninsula. This sea is not, as a rule, distinguished by any general name, though

* Alcock: Annals and Magazine of Natural History, ser. vi., iv., 377.

† Carpenter: Records of the Geological Survey of India, xx, 48, had proved, as conclusively as it is possible in the absence of actual soundings to prove, that this body of water must be separated from the Sea of Bengal by a ridge nowhere deeper than 760 fathoms, the shallowest sounding known between Acheen and the Nicobars, since the temperature at 1200 fathoms east of the ridge is that appropriate to 740 fathoms to the west of it. Since then the indication of 736 fathoms as the depth on the line from the Nicobars to the Andamans is a striking confirmation of the justice of Carpenter's reasoning.

that portion of it close to the Irrawaday Delta is spoken of as the Gulf or Bay of Martaban; it has, however, sometimes been spoken of as the Gulf of Pegu, and more recently has received the much more appropriate name of the ANDAMAN SEA.*

* Alcock: Annals and Magazine of Natural History, ser. vi., iv., 378. The degree of confusion in nomenclature that prevails is sufficiently exemplified in the various Atlases of recent date. Keith-Johnstone's "Royal Atlas"—an excellent example of an English Atlas—shows, on the same sheet (India, southern sheet) in the general map, the Bay of Bengal and the Sea of Bengal limited as they are in the text, though the Bay is called the "Gulf" of Bengal: in the small map of the South-Eastern provinces placed on the same sheet this "Gulf" is called, as is more usual, the Bay. No name is given to the Andaman Sea, though the Gulf of Martaban is distinguished. In Stieler's Hand-Atlas—an excellent example of a German Atlas—we find (Sheet 67, by Berghaus) the phrase "Meerbusen von Pegu" used as the precise equivalent of Alcock's later-published but perferable name of "Andaman Sea;" the Gulf of Martaban of the English maps is designated, much more correctly than in English maps, "Bai von Martaban." So much confusion of names and their incidence, renders it necessary to insist on some definite system of nomenclature, with a rigid definition of the areas to which the names apply.

It would seem therefore that German geographers are prepared to admit the distinctness of the Andaman Sea as a geographical area, while to modern English geographers the necessity for considering the question has apparently not occurred. If, however, at present they refuse to recognise this as a truly land-locked area deserving of a specific designation, the following passage from a letter dated Calcutta, the 4th March 1795, from Major A. Kyd to Sir John Shore, then Governor-General, will show that even a hundred years ago those who knew the area best realised its true nature. Kyd says:—The Andaman Islands, "comprehending what "are called the Great and Little Andamans, extending from N. Lat. 18°31′ "southward, and lying nearly in a N. and S. direction between 92° and 93° E. of "Greenwich, are part of a continued range of islands extending from Cape Negrais "to Acheen Head, including the Preparis, Cocos, Car Nicobar, and the Great and "Little Nicobars, the whole being a chain of islands between which there is reason "to believe that there is a continuation of soundings, entirely dividing the eastern "part of the Bay of Bengal." Kyd was Superintendent of the second, or Port Cornwallis settlement in the Andamans, instituted in 1792, when the settlement, under Blair at Old Harbour, now Port Blair, begun in 1789, was abandoned.

As an example of the usage which terms the whole sea-area between India and Indo-China the "Bay of Bengal," may be mentioned a paper by Hume (*Stray Feathers*, vol. ii.) wherein these two islands, along with Preparis, the Cocos, and of course the Andamans and the Nicobars, are termed the Islands in the Bay of Bengal, as opposed to Ceylon, on the one hand, and the Mergui Archipelago, on the other. This is also the usage of the Admiralty Maps of the region, and though it is certainly indefensible on hydrographical grounds, since the area to the east of the Andaman-Nicobar chain fulfils in every particular—far more so than the Sea of Bengal itself—the conditions laid down in the definition of a "Sea," it is preferable to the slip-shod system that distinguishes the Bay of Bengal from the Sea of Bengal, without distinguishing between the Sea of Bengal and the Andaman Sea.

It is in this last-named area that the islands of Narcondam and Barren Island, which form the subject of the present paper, are situated. These islands the writer was, through the kindness of Col. Cadell, v. c., late Chief Commissioner of the Andamans, enabled to visit in March and April 1891, in order to investigate their Flora. Narcondam was examined for ten days in the end of March; after an interval occupied in visiting Little Andaman and the Nicobars,* Barren Island was examined from April 5th to April 8th.

The volcanic island of Narcondam is situated in the Andaman Sea in Lat. 13° 26′ N. and Lon. 95° 15′ E., 80 miles to the east of Port Cornwallis in North Andaman, 74 miles north-north-east of Barren Island, 150 miles to the south of the nearest point on the coast of Pegu, and 250 miles due west of Mergui. The island rises abruptly out of deep water, more especially on its eastern, western and southern sides, to a height of 2330 feet above sea level, and of 8000 feet from the floor of the Andaman sea between it and North Andaman to the west, and between it and Tavoy on the east.†

The soundings on which the conclusion is based are given in the following table:—

Table I.‡—*Soundings in the vicinity of* Narcondam.

General direction of line of soundings.	Distance in miles from central peak.	Depth of soundings in fathoms.
E. S. E.	1⅓	90
E. S. E.	2	75
E. S. E.	2⅓	138
E. S. E.	3¼	284
E. S. E.	3¾	333
E. S. E.	4¼	486
E. S. E.	100	1050
S. S. E.	1⅓	242
S. S. W.	1⅜	182
S. S. W.	2⅜	465
S. S. W.	3⅓	652
S. S. W.	24⅓	1010

* Proceedings of the Asiatic Society of Bengal for 1891 (December), p. 156.

† Stieler: Hand Atlas, sheet 67 shows depths, which are quite wrong, of 2097 and 2200 fathoms to the E. and S. E. of Narcondam; how these errors have arisen the writer cannot trace. Sheet 58 of the same Atlas gives the true depth.

‡ This Table, with the corresponding one for Barren Island, is mainly derived from Mallet and Carpenter, Records of the Geological Survey of India, xx, 46, *et seq.*, with additional soundings from a copy of the Sounding-Book of H. M. I. M. Survey Steamer "*Investigator,*" kindly lent by Dr. Alcock.

TABLE I.—*Soundings in the vicinity of* Narcondam.—(*Continued.*)

GENERAL DIRECTION OF LINE OF SOUNDINGS.	DISTANCE IN MILES FROM CENTRAL PEAK.	DEPTH OF SOUNDINGS IN FATHOMS.
....	....	....
S. W.	50	1140
....	....	....
W. N. W.	1¼	162
W. N. W.	2½	407
W. N. W.	3	509
W. N. W.	3½	585
....	....	....
W. by S.	40	922
....	....	....
N. N. E.	2	74
N. N. E.	2½	104
N. N. E.	3¼	150
N. N. E.	4¼	411
N. N. E.	9½	362
N. N. E.	16	290
N. N. E.	52	70
N. N. E.	70	50

The island is a fairly-regular oval with the longer diameter in a line running north-north-east to south-south-west; this diameter is two and a half miles long, the other one and a half. The regularity of outline is somewhat broken at the north-east corner by an oblong peninsula about three furlongs long and half a mile across; this spit, which is occupied by a steep-sided twin-peaked hill, quite dwarfed by the central mass, is in no sense detached from the rest of the island but passes through two or three intervening heights into the main peak. This peak, situated slightly to the south and west of the centre of the island, is crowned by three small points of which the most northern is the highest. The two others, situated a quarter of a mile to the south and to the south-east, respectively, are at the seaward ends of two ridges that diverge from the highest peak, and are separated by the beginning of a deep gorge. The northern point, as already mentioned, reaches 2330 feet; the point to the south is 2150 ft., that to the south-east 2200 feet high. The gorge that separates the two latter, after passing southward between them for about a quarter of a mile, turns south-west round the shoulder of the lower one, and thus partially separates the south end of the island, as a narrow ridge 1200 to 1500 feet high, from the rest of the hill. It is, however, only the western end of this ridge that is free, the eastern end is connected, by means of a narrow but lofty ridge, with the south-eastern part of the central peak. Numerous other gorges, none of them however so striking as that just described, furrow the hill on every side.

The chief interest of this configuration resides in the misapprehensions as to the structure of the island to which it has given rise. McCelland mistook either the ravines or the ridges between them for streams of lava*; Kurz has described and figured the island as a central volcanic cone, surrounded by an outer ring, not much over half the elevation of the central mass, and very largely broken down.† Seen from Kurz's point of view (N. W., ½ N., at a distance of 20 miles) an oblique view of the mouth of the yawning south-western gorge is obtained, while the main mass hides the connection of its southern wall with the central peak. At the same time the peaks already mentioned as connecting the main hill with the somewhat outlying north-eastern spit, serve to conceal their own connections and complete the illusion. At this distance too the three hummocks at the top of the peak look very much like as many points on the edge of a crater. In a nearer view from the same direction the appearance of a central cone is still well-preserved, though the regularity of what seems at a distance the remains of an outer ring quite disappears.‡ Even close in-shore it is impossible to say whether the three points on the peak are, or are not, indicative of the remains of a crater, the forest that clothes them disguising their true relationship. The appearance from another point of view (W. ½ S., at a distance of 40 miles) agrees well with the description by Horsburgh of "a cone or pyramid with its summit broken off."§

* McClelland: Jour. As. Soc., Beng., vii, 77. It would depend a good deal on the distance from which the island was seen, whether the ravines or the ridges between them be what were taken for 'lava-currents.' Seen from a distance of 6 miles or more, through a glass, the darker shadows caused by the gorges might well enough, as Ball (Records, Geol. Survey of India, vi, 89), and Mallet (Memoirs, Geol. Survey of India, xx, 281) suppose, be what led McClelland astray; as however the drawing on which McClelland based his opinion was taken from about a mile and a half, or two miles from the eastern shore—the drawing was made by Griffith—there is no doubt that what he took for streams of lava were the ridges between the ravines: on this side of the island these are, towards the top, bare and rugged, and are not unlike streams of lava. After all, however, McClelland had nothing to support his idea that the island was volcanic but its conical shape and its isolation.

† Kurz: Report on the Vegetation of the Andaman Islands, p. 4. Kurz appears to have had nothing more to go upon in supposing the island to be volcanic than had McClelland; the accident of configuration led him to go further than McCelland, and assume, not only that the island is volcanic, but that it is an island of the same type as Barren Island, in which there is an inner and an outer cone. And with the accounts and the appearance of Barren Island in his recollection—Kurz disposes cursorily of Barren Island in the sentence immediately preceding the one referred to —the idea is by no means unnatural.

‡ Ball: Records of the Geol. Survey of India, vi, 89.

§ Horsburgh: Indian Directory (ed. v), ii, 56.

Throughout the southern half of the island the coast line has been eaten by the sea into bare cliffs that vary in height from 50 *to* 800 feet. From the appearance these present to any one circumnavigating the island it would seem that these, even at the mouths of the gorges, and even if landing in spite of the heavy swell that usually surges round the island were feasible, must be altogether inaccessible. Much of the northern half of the island is similarly sea-worn, but the northern cliffs are not in many cases very high. The north-west corner of the island is a sharply triangular ness, with a high cliff for its northern, and a sloping hill-side, ending in lower cliffs, for its western seaface. This western slope overlooks a bight half a mile wide, but of only a furlong's recession. This bight, open to the north-west, is divided into two almost equal bays by a small detached islet, between which and the main island stretches a rocky reef. To the south of this islet and reef is a somewhat indifferent anchorage, and landing from a boat is possible on its small shingle beach, behind which a few coco-nut trees grow. This beach is close to the reef and at the mouth of a rather narrow gorge which leads fairly directly to the main peak.

The cliffs that form the east side of this ness overlook a much finer bight bounded on the east by the oblong spit already described, more than half a mile across, and with a recession almost equalling its width. The head of this bight further recedes into a small inviting-looking bay which, however, begins to shoal* about a hundred yards from the shore, and the strong swell that surges round either cape is broken as it crosses the bay into a heavy surf which renders landing neither pleasant nor safe.† This bay, which may be termed Coco Bay, is bounded by a level stretch of turtle-frequented sand, behind which is the only good example of *Pandanus* sea-fence on the island; behind the sea-fence is a fringe of coco-nut trees; beyond the coco-nut zone, and at the mouth of one of the largest gorges in the island, is a small stretch of level land, due, no doubt, like the shallowness of the bay, to the deposition of detritus from the main hill. In this flat patch, immediately behind the coco-nuts and to the west side of the stream-bed, is a grove of plantains.

* Ball: Records of the Geol. Survey of India, vi, 89.

† Hume: Stray Feathers, ii, 109. The landing mentioned by Ball and described by Hume is the only one on record at this bay. Probably, however, it is not the only one that has been effected. Though the *Coco-nuts* that line its margin may have been introduced by the sea, this cannot be said of a grove of *Plantains* that occurs. Landing did not seem possible at the time of the writer's visit, nor was it necessary; the bay, which was visited several times, was reached by cutting a path through the jungle from Anchorage Bay. It is of course possible, though hardly likely, that the individuals who introduced the *Plantains* also cut such a path.

To the south-east of the oblong spit, and therefore on the east side of the island, is a third, much wider bight, three-quarters of a mile from cape to cape, but only receding a furlong and a half. The northern half of this bay, bounded by the hilly spit, is overlooked by steep hill-sides ending in cliffs that, though not lofty, are particularly abrupt. The southern half, limited by the main island-mass, has a beach of rounded boulders; behind this is a straggling sea-fence in which stands a solitary coco-nut tree; a narrow belt of true beach-forest lies beyond. It was with little expectation of being able to land that we put into this bay; we were therefore agreeably surprised to find that—at least at the time of our visit, the end of March—not only could a landing be made without difficulty, but that the bay afforded a more comfortable anchorage than Anchorage Bay itself. The boulder beach slopes rather gradually outwards, and is of a considerable width; probably therefore the surf here is very strong during the north-east monsoon. That the sea-fence is here irregular and thin is no doubt due partly to the surf, and partly to the fact that it has an insecure root-hold among the rounded stones that are piled behind the beach into an embankment which protects the forest beyond. This beach-forest occupies a strip of level land that stretches backwards from 50 to 100 yards to the base of the main hill. Three gorges debouch on this level area and have filled up the interstices of the old beach with the soil on which the trees grow. At the mouth of one of these ravines there is a gap in the beach-forest occupied by a small depression that in March is covered with only a coating of fine sun-cracked mud, but in the rains evidently forms a small lagoon; this appears to be the only spot in the island where water ever lodges.

Though entirely volcanic in structure there is no indication at the summit or elsewhere that the island has recently been active. There is no crater at the top*, and his examination led the writer to think, not that all traces of craterine shape have been obliterated by long erosion, but that there never has been any crater on the peak. The local features, coupled with the nature of the rocks that constitute the island,†

* Mallet: Memoirs of the Geol. Survey of India, xxi, 281.

† Ball: Records of the Geol. Survey of India, vi, 90, only mentions a bed of volcanic agglomerate, (of which several crop out round the coast), at Coco Bay, wherein are embedded trachytic boulders. Mallet—Memoirs of the Geol. Survey of India xxi, 281–283—describes the Narcondam lavas as "compact, or very slightly vesicular "lavas in which crystals of white translucent felspar, and black or dark-brown "hornblende, are disseminated through a ground-mass which is (generally light) "grey in unaltered specimens, but pale red in those that have undergone weathering "and in which the iron has been peroxidised." Farther on, Mallet remarks:—"The "lavas of Narcondam are essentially hornblende andesites, and are of a decidedly "more acid character than those of Barren Island." This character, of acidity

appear to indicate that originally Narcondam may have been a volcano, produced, like the volcano that appeared on the Island of Camiguin in July 1871,* by the extrusion of viscid lava without the accompaniment of crater-forming materials. In any case, the depth of the ravines that plough the flanks of the hill on every side indicates very clearly how remote has been the period of the island's activity.†

The top of the island is frequently bathed in cloud;‡ during the ten days spent in the island in 1891, this cloud-cap seemed to envelope, for the greater part of the day, the last 400 feet of the peak. The appearance, however, was slightly deceptive; for it was noticed that the cloud was only condensed on the western aspect of the hill, and that towards evening the peak always became clear. The nature of the vegetation on the peak,—the trees bearded with moss, and their bark covered with *Trichomanes*—indicates clearly that this is a usual state of affairs.

Save on the sea-cliffs, which are bare, and on the eastern side of the peak near the top, where the jungle is thin and scrubby, the whole island is clothed with dense forest: this consists mainly of lofty trees, with but few climbers, in the beds of the various watercourses. On the intervening ridges the vegetation consists of a tangled mass of shrubby growth overloaded with creepers. Landing at Anchorage Bay one finds on the shingle some plants of *Ipomœa biloba;* immediately behind the shingle, and under the shade of about a dozen coco-nut trees, is an attempt at a sea-fence, composed of *Scævola Koenigii*, *Hibiscus tiliaceus*, *Morinda bracteata*, *Guettarda speciosa*, *Pandanus odoratissimus;* some *Ipomœa grandiflora*, *Convolvulus parviflorus*, and *Wedelia scandens* climb over these. Behind these bushes some trees of *Barringtonia speciosa*, *Terminalia Catappa*, *Erythrina indica*, *Sterculia rubiginosa*, *Thespesia populnea*, *Dracœna angustifolia*, *Ardisia humilis*, and *Ixora brunnescens* represent the beach-forest. There is, however, but scanty room for species of either class, and a few plants of *Eranthemum succifolium* underneath the trees complete the representation of this sort of vegetation in this situation. To the south of this point are some low cliffs, covered at the top with a tangled mass of *Hoya orbiculata*, while at their base plants of *Pluchea indica*, *Blumea glomerata*, *Vernonia divergens*, *Desmodium polycarpon*, *Cyperus pennatus*, and *Thysanolœna acarifera* occur; the last-named,—it is, by the way, the only grass that is found on the island—is the most plentiful and seems to be, besides *Fimbristylis ferruginea* and *Boerhaavia*

strongly supports the conclusion (to which Mallet also inclines) that there never was a crater in Narcondam, and that the island is of the endogenous volcanic type.

* Moseley: "Notes by a Naturalist on the 'Challenger,'" p. 409.

† Mallet: Memoirs of the Geol. Survey of India, xxi, 284.

‡ Ball: Records of the Geol. Survey of India, vi 89.

repens, about the only species that occurs on the rocky sea-cliffs. On the small islet in Anchorage Bay and on the rocks to the north of the reef that connects it with the main island, is a scrubby jungle of *Hibiscus tiliaceus*, *Acacia concinna*, *Dalbergia monosperma*, *Premna integrifolia*, *Glochidion calocarpum*, *Breynia rhamnoides*, *Blachia andamanica*, and *Gelonium bifarium*,—the last-named especially plentiful.

In the denser interior jungle on the hill between Anchorage Bay and the gorge that debouches at Coco Bay, one is struck by the familiar Andaman feature of groves of gregarious Euphorbiaceous treelets forming an under-growth in a forest of lofty trees. Of this forest, *Ficus nitida* and *Ficus Rumphii* are perhaps the chief constituents; the two commonest gregarious species are *Actephila excelsa*—undoubtedly the species on the island represented by the greatest number of individuals, and *Mallotus andamanicus*—also, in many places, very plentiful. The herbaceous species found underneath these treelets are mainly two ferns: *Acrostichum appendiculatum*, which is not very plentiful, and *Asplenium urophyllum*, which is. Among other species, found chiefly on a comparatively level tract on the top of the ridge, where the gregarious feature noted during the ascent from the east coast gives place to a mixed forest, the undergrowth includes *Alsodeia bengalensis*, *Cansjera Rheedei*, *Glycosmis pentaphylla*, *Capparis sepiaria*, *Pisonia aculleata*, *Vitis lanceolaria*, *Leea sambucina*, *Memecylon edule*, *Abrus precatorius*, *Mucuna gigantea*, *Bridelia tomentosa*, *Ficus hispida ; Acrostichum appendiculatum* is here common, while *Asplenium urophyllum* is rare. The trees are also more mixed, and include, besides the two species of *Ficus* already mentioned, a *Bombax*, *Erioglossum edule*, *Diospyros Kurzii*, *Oroxylum indicum*, *Artocarpus Lacoocha*, *Antiaris toxicaria*, *Ficus comosa*, and *Amoora decandra*. Besides the two ferns mentioned, a not infrequent herbaceous species is a fine *Amorphophallus*. Along the ravine that passes northward to debouch at Coco Bay occur the same species; near its mouth, where the ground is flat, the jungle becomes 'scrub'—*Morinda*, *Premna*, and such like shrubs, loaded with tangled masses of *Ipomœa vitifolia*. This type of jungle takes the place of the absent beach-forest; the sea-fence is however well-developed, and is of the usual Malayan type,—*Pandanus*, *Guettarda*, *Morinda*, *Hibiscus tiliaceus*, *Cæsalpinia Bonducella*, *Colubrina asiatica*, *Allophylus Cobbe*, *Vigna lutea*, *Canavalia turgida*, and such like plants. Round this bay the coco-nut zone is well developed; behind it is the plantain grove already referred to.

East Bay, visited subsequently, may be here most conveniently described. On the beach occur both *Ipomœa denticulata* and *Ipomœa biloba ;* along with these occur *Vigna lutea* and *Phaseolus adenanthus ;* the sea-fence is represented by a few examples of *Pandanus odoratissimus*, *Hibiscus tiliaceus*, *Capparis tenera*, *Colubrina asiatica* and *Clerodendron inerme*. The true beach-forest, here well developed, contains much *Pisonia excelsa*, with a number of trees of the far less common *Pisonia alba;* the other trees of the zone are *Terminalia Catappa*, *Calophyllum inophyllum*, *Thespesia populnea*, *Gyrocarpus Jacquinii*, *Ixora brunnescens*, *Ficus brevicuspis*, *Ficus callosa*, *Odina Wodier*, and *Garuga pinnata* ; the two last-named, though commonest in, are not confined to this zone. The single coco-nut tree mentioned as occurring here has probably grown from a nut drifted round from the other bay ; at Coco Bay, however, it is more probable, considering their association with plantains that the trees have been introduced intentionally.* The edges and bed of the dry lagoon already described were covered with *Ipomœa Turpethum.*

Along the edge of the cliff overlooking the west side of Coco Bay some species, not seen elsewhere, were met with : *Entada scandens*, *Acacia concinna*, a *Grewia* (in leaf only, perhaps *G lævigata*), a *Tylophora* (in fruit only, perhaps *T. globifera*), *Pæderia fœtida*, and *Dioscorea sativa*. The steep hill-side overlooking the northern part of Anchorage Bay is covered with a scrub-jungle of *Premna*, *Breynia*, and such like shrubs, with a good deal of *Capparis sepiaria*. All over this hill were seen withered leaves of the *Amorphophallus*.† The hill-side overlooking the southern portion of Anchorage Bay is covered with the same dense

* These coco-nuts are too old and too numerous to have been introduced of recent years ; it seems strange, therefore, that they have never before been mentioned. The recorded visits to Narcondam are :—(1). That of Messrs. Hume and Ball in 1873, when a landing was effected, and no more ; (2). that of Messrs. Mallet and Hobday in 1884, when four days were spent in investigating its geology and topography, and an ascent, probably the first, was made of the peak ; (3). the present visit, when the peak was again ascended. The account of their landing-place shows that it was at Coco Bay that Ball and Hume landed ; at no other bay is there shoal water. Ball mentions some of the plants noticed by him at this place, but neither he nor Hume have recorded the existence of coco-nuts and plantains. Mallet is equally silent, his paper being rigidly confined to the topography and geology of the island. Though these are the only recorded visits, there have been others paid to the island. Hume (*Stray Feathers* ii, 110) mentions a visit by Col. Tytler. Again, Kurz (*Report on the Vegetation of the Andamans*, p. 13.) mentions a deputation that visited Barren Island in 1866, in search of pasture-grasses ; from specimens in the Calcutta Herbarium, however, we learn that this deputation a few days later visited Narcondam and the Coco Group. In connection with the systematic list, occasion will be taken to refer to the acts of the deputation in question : it is sufficient to say here that to its members is probably due the merit of having introduced, *at least* the plantains, and perhaps also the coco-nuts. This would make it certain that both species were present at the time of Hume's visit.

† Corms and seeds of this plant were brought to the Royal Botanic Gardens, Calcutta, where it has sent up leaves and has flowered.

forest, mainly *Ficus*, but has for its undergrowth quantities of *Caryota mitis*, with dense patches of *Pollia Aclisia* underneath.

The ridges between the gorges are tolerably uniform in the nature of their vegetation; *Premna integrifolia* extends a good way up, *Morinda bracteata* is found throughout the island and is as common at the top as it is on the coast; *Trema amboinensis*, *Capparis sepiaria*, and *Acacia concinna*, are common species; not infrequent is *Callicarpa arborea*, though far less common here than on Barren Island. In the gorges patches of *Macaranga Tanarius*, *Trema amboinensis*, *Pipturus velutinus*, *Bœhmeria malabarica*, as gregarious species, are common, and form, especially in the lower part of the hill, the prevalent undergrowth. The trees are those already enumerated, but as additional species, may be mentioned the following, all obtained in the gorge leading from Anchorage Bay to the summit of the peak:—*Amoora Rohituka*, *Apodytes andamanica*, *Semecarpus heterophylla*, *Myristica glauca*, *Ficus glaberrima*—the last mentioned a small tree, at about 2000 feet elevation. The climbers not previously noted were *Anamirta Cocculus*, frequent; *Antitaxis calocarpa*, very common; *Aristolochia Tagala*; *Gouania leptostachya*; *Trichosanthes palmata*; *Anodendron paniculatum*; *Dischidia nummularia*; *Pothos scandens*, and *Strychnos acuminata*, at about 1200 feet elevation. The herbaceous species not before observed were *Blumea myriocephala*, only once at about 1600 feet elevation; *Asplenium nidus*, seen on trees throughout the ascent; *Nephrodium terminans*, not common below 1000 feet, very frequent above that height; *Davallia speluncæ*, here and there throughout the ascent, *Polypodium irioides*, at about 1800 feet elevation; *Polypodium adnascens*, on trees throughout the island, not common; *Bryum coronatum*.

As the summit is neared, and one passes within the area usually moistened by the cloud-cap, the trees are covered with moss (*Neckera rugulosa*), and bear on their bark quantities of *Trichomanes pyxidiferum*. In other respects the jungle on the top does not differ from that lower down, except that, owing to the ridges being of necessity greater in proportion to the gorges than lower down the hill, there is relatively more of scrub jungle than one finds below.

Few *Fungi* were obtained during the visit: doubtless the season of the year was unfavourable. No *Algæ* were found either on the rocks or washed up on the beaches. The ocean-drifts consisted almost entirely of fruits or seeds of species that occur on the island; the only exception noted was a fruit of *Heritiera littoralis* found at East Bay.

Barren Island is situated in the Andaman Sea, in Lat. 12° 15′ N. and Lon. 93° 50′ E., 60 miles to the east of Middle Andaman, 74 miles south-south-west of Narcondam, 80 miles north-north-east of Flat Rock (a submarine peak that reaches the surface, but no more, in Lat. 11° 12′ N. and Lon. 93° 36′ E.), and 320 miles due west of Mergui. As shown in the subjoined table, the island, like Narcondam, rises abruptly out of deep water, especially on its eastern, western and northern sides, to a height of 8000 feet or more* above the floor of the Andaman Sea.

TABLE II.—*Soundings in the vicinity of* Barren Island.

GENERAL DIRECTION OF LINE OF SOUNDINGS.	DISTANCE IN MILES FROM CENTRAL CONE.	DEPTH OF SOUNDING IN FATHOMS.
E. S. E.	1¼ (¼ mile from shore).	118
E. S. E.	2¼	483
E. S. E.	3¼	641
E. S. E.	100	1260
N. N. E.	1¼ (⅓ mile from shore).	217
N. N. E.	2¼	545
N. N. E.	3¾	782
N.	1⅓	325
N.	25⅓	1,140
W. N. W.	1¼ (⅓ mile from shore).	180
W. N. W.	2¼	456
W. N. W.	4⅓	655
W. N. W.	45	1159
W.	1⅜	169
W.	30	1130
S. S. W.	1⅜ (⅜ mile from shore).	47
S. S. W.	3¼	288
S. S. W.	4⅓	413

Physiographical accounts of this island have been given by Ball† and Mallet‡ in whose papers a précis of previous information is also contained; a brief description is therefore all that is here necessary.

Nearly circular in outline and about two miles in diameter, the island consists of a huge crater, of which the mouth is a mile wide and the rim is from three-quarters of a mile thick at the base—throughout its southern half, where it is from 920 to 1160 feet high—to barely half-a-mile thick—along the north where its height is from 630 to 790 feet. The rim is further breached to below sea-level on the west side by a part of the original hill having been at one time blown away, the resulting gap being about a-quarter of a mile wide. In the middle of

* Mallet and Carpenter: Records of the Geol. Survey of India, xx, 46, (*footnote*).

† Ball: Records of the Geol. Survey of India, vi, 81.

‡ Mallet: Memoirs of the Geol. Survey of India, 251, *et. seq.*

the amphitheatre that results, and therefore about a-quarter of a mile to the north of the centre of the island, a newer perfect volcanic cone rises to a height of 1015 feet. At the top there is an ovoid crater, somewhat straighter along its northern than its southern edge, and somewhat higher on these edges than at either extremity. The edges mentioned are nearly 80 feet above the bottom of the cup which is itself sub-divided into two parts. The western, somewhat irregular, is full of loose lava fragments, and has its floor nearly 40 feet higher than the other, which is an almost perfect circle, about 20 yards wide, with a floor of smooth soft sand. At the west end the rim of the crater is about 40 feet lower than along the north and south edges, and is thus very little above the floor of the minor western depression. In the middle of this dip the rim carries a huge lava block, about 20 feet long, 10 ft. wide, and nearly 20 feet high.* This block forms a striking object on the cone as seen from the landing-place. At the eastern end of the crater the rim dips even more, and is about 60 feet below the level of the northern and southern edges, or just over 20 feet above the floor; the edge is here narrower than elsewhere. In and about the crater are several solfataras with crevices whence steam escapes.

The cone itself consists of volcanic ashes, fairly firm on the south, east and north sides, but loose and friable on the western face. The slope is very uniform, being about 30° on every side. The valley between the cones contains, at the base of the inner, two lava streams that have flowed to the sea through the breach in the outer; of these streams the northern overlies the southern. There has also been a third flow to the east, this does not, however, come in contact with either of the others. The sea, it may be remarked, does not enter the breach in the outer cone, the breach, as well as the valley between the cones, being filled to above sea-level by the products of the newer volcano.

The seaward slope of the outer cone is much steeper in the northern than in the southern part of the island, and is furrowed by many nearly meridional ravines, difficult of access where they enter the sea, but more easily traversed further up. The slope of this half of the ancient crater towards the newer volcano is, on the other hand, even and rounded, consisting for the main part of bare, loose black ash, derived from the inner cone. The inner slope of the southern half of the original volcano is, on the other hand, except at its base, steeply precipitous; the seaward slope of this half, besides being much more gradual than that

* The measurements (Mallet: Memoirs of the Geol. Survey of India, xxi, 267) are:—Length, 22 feet; breadth, 11 feet, height, 13 to 19 feet. The greatest height is at the west end, where it is also narrowest; its most striking aspect is to the spectator on the beach at the landing-place, to whom it looks like a huge tooth.

of the northern half, shows a second subconcentric ridge separated from the true rim by a gorge that debouches on the east side of the island. Gorge and ridge owe their origin, however,—like the ridge and ravine of the same nature, but of more imposing proportions, that occur at the south end of Narcondam—to subaërial denudation, not to volcanic action.

The excentric position of the newer cone, with the lesser relative height, and the steeper seaward slope of the northern half of the original crater, seems to point to subsidence of that half. Perhaps the explosive eruption which effected the breach to the west may have had some connection, direct or indirect, with this subsidence. The volcano represented by the outer cone was doubtless at one time much higher than it is now.

At the landing-place in the breach there is a hot spring on the beach; the temperature of this spring is steadily falling, and at the time of the writer's visit was 106° F.* The spring doubtless only represents percolation of rain water through the heated newer materials—the inner cone and lava streams—contained within the circuit of the ancient crater.†

The anchorage in the bay at the breach is of the most uncomfortable description; the safest anchorage is opposite a small bay with a sandy beach, a *Pandanus* sea-fence and a line of Coco-nut trees, on the south-west side of the island. Landing by boat is, however, usually quite easy on the beach at the hot spring to the north of the point where the lava stream falls into the sea; the surf that rolls into Anchorage Bay must make it impossible, as a rule, to land there.

At Landing Bay the boulders and stones on the beach, bathed by the water of the hot-spring, are covered by a species of *Calothrix* which occurs in considerable quantities. Another, *Alga*, also a *Calothrix*, was obtained from bare rocks in one of the gorges; no marine *Algæ* were seen. On the beach itself, behind a small bed of drift, are some examples of *Ipomœa biloba*; the drift contained, in addition to fruits and seeds of species noticed in the island, fruits of *Barringtonia speciosa* and of *Heritiera littoralis.*‡ Close to the beach and to the lava flow is an example of *Pongamia glabra*; a little further inland to the north of the lava is a considerable grove of *Flueggia microcarpa*, with quantities of *Mitreola oldenlandioides*, in the sandy soil beneath. Beyond this grove is

* Prain : Proceedings As. Soc., Bengal, 1891, p. 84.

† Mallet : Memoirs of the Geol. Survey of India, xxi, 274.

‡ *Barringtonia speciosa* occurs in Narcondam, and it may possibly also occur at some of the bays on the south-west and south of Barren Island, where the surf made landing impracticable. But *Heritiera littoralis*, the fruits of which were collected in Narcondam also, does not seem to occur in either island.

a thicket of *Mussuenda macrophylla*—the accident of its situation has converted the species into a straggling shrub and imparted to it a very distinct facies. On the lava itself nothing grows, though further inland and to the south of the stream it is in several places partially covered by beds of *Aganosma marginata*, which, rooted in the adjacent soil, and having no trees on which to climb, prefers sprawling over the bare black lava to spreading along the ground among the grass. This grass, *Ischæmum muticum*, almost completely occupies the plain between the lava flow and the inner wall of the outer cone, which is thus a great meadow in which, however, there are some patches of scrub jungle, the chief constituents being *Dodonæa viscosa*, *Flueggia microcarpa*, *Gelonium bifarium*, *Phyllanthus reticulatus*, *Trema amboinensis*, *Dalbergia tamarindifolia*, and stunted examples of *Callicarpa arborea*.

The inner cone is merely a "cinder-heap," with hardly any vegetation; a few very stunted examples of *Trema amboinensis* on its southern face, about 650 feet up, and small shrivelled tussocks of *Fimbristylis ferruginea* scattered unevenly over all the sides except the western, being the only plants present. The interior of the crater has more vegetation than the whole outside of the cone; near the crevices in the inner wall, and especially on the south side where the soil is moistened by the condensation of escaping steam, occur *Nephrolepis tuberosa* (also obtained elsewhere in the island), *Cheilanthes tenuifolia* (very small and stunted specimens), *Lycopodium cernuum* (all over the stones in the western, more shallow depression of the crater), *Psilotum triquetrum* (also found in Java, on the crater of Gunong Boddas Preanger, by H. O. Forbes), *Pholidota imbricata*, *Vandellia crustacea* and *Oldenlandia corymbosa*; in the sand at the bottom of the deeper eastern craterine depression occur luxuriant patches of *Fimbristylis ferruginea*.

An attempt was made to land at Anchorage Bay; owing, however, to the heavy surf that rolls in this was found to be impossible. The beach in this bay is sandy; behind it could be seen the usual sea-fence of *Pandanus*, a species seen nowhere else on the island. Just within the *Pandanus* fence rise 13 coco-nut trees tall enough to be seen and counted. Judging from the analagous beaches in the Coco Group and Narcondam it may be anticipated that there are many seedlings besides. To verify this surmise an attempt was made later on to cross the outer cone from the amphitheatre and work down to this beach. The attempt did not succeed; the sea was reached at a point too far to the east and the attempt was not considered worth repeating.* Rowing round the island

* Those who have been engaged in similar work will understand how difficult it is under such circumstances to strike the proper ridge or ravine. The results of the journey, which it took a day to accomplish, were not sufficiently remunerative

a landing-place was looked for in bay after bay; to no purpose, however, the heavy south-western swell surged on their beaches in breakers so huge that any attempt to land was precluded. On the east, north, and north-west sides however, landings were effected; in the first case the crest of the outer rim was attained at a point where further progress was barred by its precipitous nature. By the gorge entered from the north it was found impossible even to reach the crest; the north-west landing, after some difficult climbing, led to the edge of the outer cone and permitted an easy descent into the amphitheatre.

The inner walls of the outer cone, where too steep for trees and shrubs, are densely and evenly clothed with *Pogonatherum saccharoideum*, along with which are associated patches of *Desmodium polycarpon*, *Onychium auratum*, *Pteris biaurita*, *Nephrolepis tuberosa* (found also within the crater), and *Fimbristylis diphylla*. On one somewhat damp spot, where there had been recently a small landslip, were found, on the otherwise bare soil, some plants of *Pteris longifolia*, *Oplismenus Burmanni*, *Physalis minima* and *Vandellia crustacea* (this last was also obtained inside the crater). On the inner northern wall of the outer cone, which is heaped with ashes, there is hardly more vegetation than on the inner cone itself, the only species that grows being the *Fimbristylis* found on the cone. At the base of the cliff which forms the inner southern wall there is a uniform but not very dense forest the commonest species in which are *Terminalia Catappa* (certainly the most abundant tree on the island), *Eugenia Jambolana* and *Callicarpa arborea* (both very common), *Semecarpus heterophylla*, *Garuga pinnata*, *Ixora cuneifolia*, *Ardisia humilis*, *Oroxylum indicum*, *Macaranga Tanarius*, *Trema amboinensis*. Quite a feature is the extent to which a wild vine, *Vitis repens*, prevails in this area; among other creepers noted were *Cyclea peltata* (not seen in Narcondam), *Abrus precatorius*, and two *Dioscoreas* (only one apparently occurring in Narcondam). Another noteworthy feature of this forest is the presence, though not in great quantity, of a species of *Dendrobrium*. The bare rocks in the gorges over which water in the rains must pour in cascades are here and there covered with dried-up masses of fresh-water *Alga*, *Calothrix tasmanica*.

The forest on the outside of the outer cone is much like that just described though the trees are more weather-beaten. The species present inside are all met with outside also, but though *Terminalia Catappa* is still undoubtedly the most plentiful tree, and there are many

considering the limited time at the writer's disposal, to justify another attempt. The majority of the gorges on the south side of the Island have an eastward tendency, and are thus unlike those in the north side which are more truly radial; this circumstance led to the selection of a point for descent too far along the rim.

examples of *Ficus Rumphii* and *Ficus nitida*, with a considerable number of *Ficus cuspidifera*. The two *Dioscoreas* are very common climbers; *Capparis sepiaria* is exceedingly common as a climber, or rather as an under-shrub, in the forest; *Gloriosa superba* was seen in the sea-face jungle on the east side of the island; *Adiantun lunulatum*, another species not seen in Narcondam, is very common on the outside of the outer cone. On bare rocks near the sea *Boerhaavia repens* is plentiful, and species of the littoral class noted at the points where landings were effected include *Hibiscus tiliaceus*, *Sterculia rubiginosa*, *Colubrina asiatica*, *Ixora brunnescens*, *Pluchea indica*, *Wedelia scandens*, *Scœvola Koenigii*, *Premna integrifolia*, *Glochidion calocarpum*, *Gelonium bifarium*. *Terminalia Catappa*, a truly littoral species, spreads here from base to top of the outer cone; the same is true of *Morinda bracteata*, another plentiful sea-coast species. *Cocos* and *Pandanus* have been already mentioned as occurring only at Anchorage Bay.

The question regarding the Coco-nut trees on Barren Island is somewhat simpler than in the case of Narcondam, for they have not been deliberately planted: at the same time it cannot be contended that they afford an unequivocal instance of introduction by the sea. It is not clear that any one has ever landed at Anchorage Bay;* it is certain that for the greater part of the year, to attempt to do so would be very dangerous. At the same time when ships call they usually anchor at this place, and it is not improbable that during some such visit a coco-nut dropping overboard has been washed ashore and germinated in the drift collected by the roots of the sea-fence. Man indirectly, rather than the sea, may therefore be supposed to have been the introducing agent.

Fungi were as scarce on Barren Island as in Narcondam, and the only moss met with was *Bryum coronatum*.

To complete the account of these islands mention must be made of Flat Rock, situated, as has been already mentioned, in Lat. 11° 12′ N., and Lon. 93° 86′ E., 80 miles south-south-west of Barren Island, 50

* From the *Report* of the Andamans' Committee already referred to (*Proceedings, As. Soc. Bengal*, 1866, p. 215), it would appear that their experience was quite that of the writer. The passage is interesting and is worth quoting *verbatim*:—"The only "place where there seemed any chance, was on the south-west, where a small "sandy beach, with a heavy surf running, was discovered, *above which four old* "*cocoa-nut trees were seen.* A boat was sent towards the shore and got bottom at 35 "fathoms, but as we had not much time to spare, the whole of the ground could "not be gone over, * * *." The italics are the writer's; the passage will be referred to again in the systematic list of the plants collected. It is strange that though from the year 1866 onwards these coco-nut trees have been used as the guide-mark to the safest anchorage on the coast of this island, neither Hume, Ball nor Mallet, in their accounts of the island, have noted their presence.

miles east-south-east of Rutland Island, and the same distance due east of the opening, Duncan Passage, between Rutland Island and Little Andaman. The rock appears above the surface, and no more; but though so much smaller as a subaërial peak than Barren Island or Narcondam, as a submarine peak it is evidently larger than either, since its summit appears as a long narrow bank that carries from 15 to 80 fathoms of water; this bank does not extend to the east or the west for more than two miles from the Rock, but towards the south extends at least 10 miles, to the north more than 20 miles. Beyond the edge of this bank—the Invisible Bank of the Admiralty maps—the lead sinks at once into deeper water. The Bank itself has been carefully surveyed but of the absolute depths of the soundings just beyond we know little or nothing, so that though this survey is invaluable to navigators, from a hydrographical point of view it leaves much to be desired. Meagre however as its details are it shows that the soundings are deeper towards the east, south, and west than they are towards the north. The following TABLE indicates the soundings shown in the Admiralty maps:—

TABLE III.—*Soundings in the vicinity of* Flat Rock.

GENERAL DIRECTION OF LINE OF SOUNDINGS.	DISTANCE IN MILES FROM ROCK.	DEPTH IN FATHOMS.
N. N. E.	1	14
N. N. E.	10	25
N. N. E.	13	27
N.	5	38
N.	15	80
N. W.	5	16
N. W.	10	59
N. W.	15	168
W	10	90 (no bottom.)
W.	35	500
S. W.	3½	78
S. S. W.	8	35
S. S. W.	16	200 (no bottom.)
S. E.	2	16
S. E.	7	48
S. E.	12	200 (no bottom.)

Along the east side of the bank none of the soundings made have touched bottom, but they show that the edge drops into deep water within 5 miles of a line running from south-south-west to north-north-east through the rock; along this line the soundings show a rather sharp ridge with relatively shallower soundings for the whole length of the bank; this line, it is hardly necessary to repeat, is that on which both Narcondam and Barren Island also show their shallowest soundings, while the axes of all three islands indicated by this direction form very nearly a continuous straight line.

The nature of the bottom on this bank is only mentioned in the case of one sounding; this depth, 25 fathoms, gives, as might be expected, coral: it would be interesting to ascertain whether the subaerial portion, Flat Rock itself, is part of a raised coral reef, or a remnant of an originally larger island of volcanic structure. Raised coral reefs occur in the Andamans to the west, and in the Nicobars to the south; it may therefore be anticipated that here it will be found that the subaerial portion of the bank is weathered coral; at the same time it would be more satisfactory to have the question settled by a visit to the rock. Reasoning from analogy, however, there is little doubt that the basis of this coral bank is a submarine volcanic peak, and that it forms but one of a series to which the others also belong.

Our knowledge of the bottom-contour of the Andaman Sea is not so satisfactory as is that of the Sea of Bengal. English geographers give no attention to the point; German geographers have mapped the sea somewhat hastily and from rather meagre data. Thus Berghaus indicates by the contour lines in a map of "Heights and Depths"* that a deep gap, connecting the Sea of Bengal and the Andaman Sea, exists between Achin Head in Sumatra and the Nicobars. It has however long been known that the ridge in this channel carries only 760 fathoms of water. In a larger map † Berghaus shows deep water as overlying not only the ridge between the Nicobars and Sumatra, but also over that between the Andamans and Nicobars and, what is quite unaccountable, between Preparis and the Coco Group; this last channel has long been known to carry no more than 150 fathoms. As regards that between Little Andaman and the Nicobars, Carpenter had, on grounds of temperature, predicted what Hoskyn has since shown to be true, that the ridge under it could carry at the utmost 740 fathoms; its actual depth is 736 fathoms. In this map also two soundings are shown in the meridian of Lon. 96° 10′ E., one of them in Lat. 11° 35′ N., for

* Stieler's Hand Atlas, Sheet 8, dated 1878.

† Stieler's Hand Atlas, Sheet 67, dated 1881 and revised to 1884; scale 1 : 12,500,000. Perhaps the contour line in this map means the 100 fathom line; this would explain the shading in the straits mentioned. If so, it is too far from land, and coincides with the 1000 fathom line rather than the 100 fathom one.

which 2300 fathoms are indicated; the other in Lat. 12° 30′ N. gives 2097 fathoms. These soundings appear to be devoid of authority; at all events they are quite wrong.*

A more reliable map is, however, to be found in the same work.† This map, designed by Petermann and drawn by Habenicht, is, unfortunately for our purpose, on a smaller scale than Berghaus' map. It shows Carpenter's Ridge jutting southward into the 2000 fathom line immediately to the west of the Andamans; shows comparatively shallow water (between the 100 and the 1000 fathom lines), in the two channels between the Andamans and Sumatra, and indicates a depth of 1137 fathoms in Lon. 96° 11′ E. and in Lat. 12° 24′ N.—practically the situation of Berghaus' 2097 fathom mark; this sounding indicated by Petermann has the advantage of being a real one. Going further into detail however, one finds that not even Petermann's map gives any idea of the true state of affairs within this sea.‡ For the 1000 fathom line is there shewn as enclosing a long and narrow trough half way between the Andamans and Tenasserim; the three peaks that have just been described are therefore shown as springing from a slope that trends upwards from the bottom of this trough to the Andaman ridge. Instead, however, of indicating a line to the eastward of these peaks the 1000 fathom line passes westward between Narcondam and Barren Island to within 30 miles of the east coast of Middle Andaman, where soundings of 1130 and 1159 fathoms have been obtained; these, it may be remarked, close inshore though they be, have proved (with the exception of a veritable sounding of 1284 fathoms 50 miles east of little Nicobar, and of a doubtful sounding that gives 1260 fathoms with no bottom in Lon. 95° 30′ E, and Lat. 11° 45′ N.) the deepest soundings yet obtained in the Andaman Sea, and are more than 100 fathoms deeper than the deepest indicated along the line that connects Barren Island with Narcondam.

There is no doubt that taken collectively these three peaks indicate a northward continuation of the line of volcanic activity known as the "Sunda Range," which stretches up from Sambawa and Flores through Java and Sumatra at least to Barren Island. Von Buch in his work on

* In a previous paper (*Journ. As. Soc. Beng.* lx. pt. 2, p. 284) the writer was misled by these soundings, which he supposed to have some foundation, into giving the depth of the Andaman Sea as over 2,000 fathoms.

† Stieler's Hand Atlas, Sheet 58, dated 1884; scale 1 : 30,000,000.

‡ In criticising these maps the writer would wish it understood that it is from no desire to cavil that he points out their defects; it is only because they are worthy of criticism that reference is made to them. Except the Admiralty maps, which are above reproach, no English map with which the writer is acquainted deserves to be mentioned alongside of those in Stieler's work.

volcanoes did not carry the chain beyond Barren Island, but Griffith, who in passing Narcondam recognised its volcanic nature, suggested to McClelland that here might be seen a northward extension of the same chain. McClelland not only adopted the suggestion but sought a still further extension to the north, in the mud-volcanoes of Ramri and Cheduba, off the Arracan coast;* and other writers, such as Daubeny, Scrope, Mrs. Somerville and Mallett † have adopted the same view.

Ramri and Cheduba lie to the west of a tertiary ridge that composes the Yomah of Arracan, which, in the latitude of Ramri, reaches a height of 4,000 feet. This range is continued southward into and beyond the Andaman group. Thus it passes through Diamond Island to the Alguada reef, beyond this, across a channel less than 60 fathoms deep, to Preparis, and again across another of 150 fathoms to the Coco Group, Great Andaman and Little Andaman. It would appear after this to pass to the westward of the Nicobars, though its precise relationship to that group has not yet been made clear; finally it reappears, not in Sumatra, but in a long line of islands—the Nias group—that stretches south-eastward along the western coast of Sumatra.‡ The line of volcanic activity to which Barren Island and Narcondam presumably belong, lies from Narcondam southwards to the east of this tertiary ridge; if, therefore, Ramri and Cheduba belong to the same line, we have to believe that, after continuing for the whole length of Sumatra and the Andamans parallel to this ridge, the volcanic line at its northern end, where its activity is weaker than elsewhere, crosses the tertiary formations where they have become thicker and stronger. This is in itself a proposition, the truth of which is so hard to accept, that when Blanford§ suggests that the true northern continuation of the Sunda volcanic range is to be found in the extinct Burmese volcano of Popah, and the extinct Yunnan one of Han-shuen-shan, we realise that he must be right, and are surprised that, after all, Mallet is inclined, in a modified sense, to favour the earlier view.‖ The volcanoes of Ramri are of a different type from those of the Sunda Range; they belong to a series of gas vents, all of the same general character, though none of them so active as the Ramri ones. The Sitakund in Chittagong,

* McClelland, Journ. As. Soc. Beng., vii., 77.

† Mallet does this (Records of the Geol. Survey of India, xi., 203) in a different sense from the earlier writers; they, owing to a want of definiteness in the accounts on which they relied, mistook the "gas" volcanoes of the Arracan Coast for true "steam" volcanoes.

‡ Kurz: Journ. As. Soc. Beng., xlv., pt. 2, 105.

§ Manual of the Geology of India, iii., 725.

‖ Mallet: Memoirs of the Geol. Survey of India, xxi., 253.

and the various hot-springs in the valley of Assam, like those in the Namba Forest,* are examples of this series, which forms a continuous line parallel on its western side to the tertiary ridge referred to, just as the true volcanoes, to the line of which Barren Island, Narcondam and Popah belong, are parallel to it on the east.†

Whether they belong to that particular group of volcanoes known as the Sunda Range, or not, there is no doubt that Narcondam and Barren Island belong to the general volcanic system extending from the Kuriles, through Japan and the Philippines, to Malaya—a system of which the Sunda Range itself forms but a portion. Like the other members of this system, these peaks are situated, not on, but just within, the margin of the continental elevation forming Eastern and South-Eastern Asia, wherever this rises abruptly from great ocean-depths; the main difference between them and most of the peaks of the system is that, whereas the space between the edge of the continental area and the line of volcanic activity is in other cases sub-aërial, that space is here for the most part sub-marine. This space forms, in the case of Sumatra, the main body of the island—the volcanic line being much nearer the eastern margin—and the rocks of which it is composed include all those that go to form the islands of the Nicobar Group; these rocks appear once more, not in the main chain of the Andamans, but in the small islands to the east of South Andaman (north east of Port Blair), known as "The Archipelago."‡ Neither in, nor opposite, the Nicobars is there any trace of the complementary volcanic ridge; to the east of this "Archipelago," however, it is indicated by Flat Rock and Barren Island.

Not only is the volcanic line of Sumatra absent from the Nicobars, but no trace has yet been found in that group of the sandstones of the Arracan hills, which are prolonged into the main chain of the Andamans and which re-appear in the Nias. The result, therefore, is that the Arracan-Sumatra chain, in place of constituting a single ridge consists

* Prain: *Proceedings As. Soc. Bengal*, 1887, p. 201.

† The reasons for thinking that the northward prolongation of the Sunda Range has not crossed the Arracan-Andaman ridge are, therefore:—

1. That the volcanoes on the west side of that ridge, which are supposed to continue the Sunda line, are of a different type from the volcanoes of the Sunda Range.

2. That these western volcanoes in Ramri belong to a system of vents of the same type as themselves, characterised by a linear distribution parallel to the western base of the Arracan-Andaman tertiary ridge.

3. That the Sunda Range is continued northward by a series of vents of the same type throughout, the character of linear distribution parallel to the eastern base of the Arracan-Andaman tertiary ridge being maintained unaltered.

‡ Oldham: Records of the Geol. Survey of India, xviii., 141.

of two—a western tertiary ridge most marked in the north and tailing off towards the south, and an eastern volcanic ridge most marked in the south and dwindling into insignificance northwards.

The question whether the line in which Narcondam, Barren Island, and Flat Rock are situated consists of a series of isolated peaks, or if these peaks are only the sub-aërial portions of a continuous ridge, remains to be considered. Such evidence as there is appears to indicate that they are situated on a ridge: it is not, however, at all complete. It has already been remarked that the soundings on a line passing north-north-east from Narcondam are relatively shallower than those on any other line. This has been explained by Carpenter as perhaps indicating that the deltaic shelf of the Irrawady extends as far out as Narcondam.* It may be anticipated that this will not be found a sufficient explanation of the phenomenon. It will be observed that the soundings gradually deepen for a space of $9\frac{1}{2}$ miles, till the bottom carries 362 fathoms, and that beyond this point it gradually shallows till the coast of Pegu is reached. If Narcondam were situated on the edge of a delta-shelf, one would expect that the soundings would not show so great a dip within its margin, and would further expect that soundings on lines carried at right angles to the line under discussion would give some indication of a more or less level area. Yet what we do find is that before four miles to the east or three miles to the west of the island have been reached, greater depths have been obtained than the deepest sounding on the north-north-east line. This appears to indicate that Narcondam is not so much on the edge of a shelf, as at the end of a ridge that runs towards and into the Pegu coast-line. That this ridge is overlaid by the deltaic mud to within ten miles of Narcondam, and that the presence of this mud explains the gentle slope from its deepest point upwards to the Pegu coast is no doubt true; but the steady rise during the last ten miles towards Narcondam, coupled with the more abrupt dips to the east and to the west, indicate the existence of a ridge. The matter is capable of direct demonstration: a few lines of deep-sea soundings co-ordinate to the line of soundings taken towards the north-north-east, will disclose the true state of matters. It would also be equally easy, by making a line of borings along the continuation of its line, and a few co-ordinate lines across in the mud of the Irrawady delta, to demonstrate whether the supposed ridge passes subterraneously into Burma.

The same comparative shallowness is indicated by the line of soundings to the south-south-west of Barren Island, and to explain the fact Mallet† suggests the possibility of eruptions of ash distributed

* Carpenter: Records of the Geol. Survey of India, xxi., 48.

† Mallet: Records of the Geol. Survey of India, xxi., 47.

in this particular direction by the action of currents. It would seem easier, however, to explain these soundings by supposing that Barren Island formed the northern termination of a ridge on which Flat Rock, with Invisible Bank, is situated. Here, too, the matter is easily capable of demonstration: soundings on a line bearing from Barren Island to Flat Rock, with one or two transverse lines of soundings will show whether such a ridge exists.

The hypothesis that in Narcondam we see a continuation of the Sunda line of volcanic activity is not invalidated by the depth of the soundings between it and Barren Island. We know that there is a much deeper gap than this between two members of the same chain: in the well-known rift between Bali and Lombok, though the islands mentioned are only 15 miles apart, the narrow strait between is 2,100 fathoms deep.* And as a matter of fact, though the ridge is here deeper, it is by no means absent, for a sounding on the line bearing from Narcondam on Barren Island gives only 1,010 fathoms, while soundings to the west of that line, and between the supposed ridge and the Andamans, give 1,140, 1,159, and 1,130 fathoms. Though our knowledge of the bottom contour of the southern part of the Andaman Sea—the portion to the east of the Nicobars—is very defective, the little that we know bears out the hypothesis of an eastern as well as a western ridge. At a point 50 miles east of Little Nicobar a sounding of 1,284 fathoms is recorded, while 30 miles further east the bottom is only 1,000 fathoms deep. Then north of Pulo Rondo, in Lon. 95° 10′ E., the depth is 990 fathoms, while 20 miles further east it is only 930 fathoms. These soundings of 930 and 1,000 fathoms not improbably indicate the ridge on which Flat Rock, Barren Island, and Narcondam are situated. The 990 and 1,284 fathom soundings must indicate the trough between the ridges; for to the west of the latter lies the Nicobar Group, and to the west of the former, in Lon. 94° 20′ E., we find a depth of 975 fathoms, doubtless indicative of the western or Indian Ocean slope of the Nicobar-Sumatra ridge, since 25 miles further north, in Lon. 94° 26′ E., we have a sounding of 760 fathoms indicating the crest of that ridge. The soundings referred to are shown on the two maps that accompany this paper.

There is, perhaps, some connection between the depth of the rift separating Narcondam from Barren Island, and the fact that from Barren Island itself southwards the volcanoes either still are, or have till recently, been active, while those from Narcondam northwards have long been extinct. This has a certain bearing on another controverted point. Von Buch, as has been already stated, recognised the Sunda volcanic line

* Wallace, Island Life, 423 (map).

as extending to, but not beyond, Barren Island. To Blanford is due the merit of having upset the fanciful hypothesis of the further extension of the line across the Arracan Yomah, and of having suggested its probably true northern continuation. More recently it has been proposed* by Berghaus and others to sub-divide the extended Sunda line of Blanford into a Sunda Range proper, ending at the northern limit of Sumatra, and a Pegu Range, containing Barren Island, Narcondam, Popah and Han-shuen-shan. But it is obvious that if any sub-division be necessary, the one proposed by Berghaus is erroneous. A sudden deep gap in the line, with the further character of activity to the south of it, and non-activity to the north, is a much more natural cleavage than merely a number of miles of intervening sea, the nature of whose bottom is unknown or has been misunderstood. If therefore Berghaus be justified in differentiating a Pegu Range, it is clear that Barren Island must be excluded from it, and that we must return to Von Buch's view, that Barren Island is the most northerly member of the Sunda Range. The Pegu Range of very old and long extinct volcanoes begins then at Narcondam, and extends at least as far as south-western Yunnan.

The biological interest of these islands is not so great as the physiographical, because, whether the ridge here postulated exists or not, there is little doubt that these sub-aërial portions never have been connected with any of the adjacent lands. If Flat Rock has ever been sub-aërial, and in a fit condition to shelter air-breathing creatures and support vegetation, it is so no longer; how great soever may be the antiquity of the outer cone of Barren Island, it is probable from its configuration, that at one time it has been the scene of a catastrophe like that which in 1883 devastated Krakatau and totally destroyed its animal and vegetable life. The only one that, from its topography, has evidently remained for many ages in its present condition is Narcondam. Already the writer has laid before this society some notes on the Fauna of the islands †; it remains now to be seen whether the biological facts indicated by their Flora are in agreement with the deductions that should follow from their physiographical configuration.

All the plants found in the two islands are enumerated in the list that follows; running numbers are added to the locality so as to show at a glance how many species occur in each. In the discussion that succeeds the list the peculiarities of each island are dealt with before their common characteristics are considered.

* Stieler: Hand Atlas, sheet 8.

† Prain: Proceedings Asiat. Soc., Bengal, 1892, p. 109.

Plants collected in Narcondam and Barren Island.

I. MENISPERMACEÆ. I.

1. Anamirta Cocculus W. & A. Narcondam (1).
India, Indo-China, Malaya.
2. Cyclea peltata H. F. & T. Barren Island (1).
Andamans, Nicobars, Burma,
3. Antitaxis calocarpa Kurz. Narcondam (2), common.
Andamans and Nicobars.

II. CAPPARIDEÆ. II.

4. Capparis sepiaria Linn., *var.* grandifolia Kurz. Narcondam (3); Barren Island (2); common.
Andamans, Burma, Malaya; the variety does not occur in India.
5. Capparis tenera Dalz., *var.* latifolia H. f. & T. Narcondam (4).
Andamans, Tenasserim; the variety does not occur in India.

III. VIOLARIEÆ. —.

6. Alsodeia bengalensis Wall. Narcondam (5).
Assam, Burma, Andamans, Nicobars.

IV. GUTTIFERÆ. —.

7. Calophyllum inophyllum Linn. Narcondam (6); beach-forest.
Mascarene Isds.; S. E. Asia; Australia; Polynesia.

V. MALVACEÆ. III.

8. Hibiscus tiliaceus Linn. Narcondam (7); Barren Island (3).
Cosmopolitan on tropical sea-shores.
9. Thespesia populnea Corr. Narcondam (8).
On tropical coasts throughout the Eastern Hemisphere.
10. Bombax insigne Wall., *var.* polystemon Prain; *var. nov.* caudice armata, foliolis 7–9, sessilibus anguste lanceolatis, subtus glaucescentibus, staminibus plurimis (circa 700); capsula 3·5 – 4 poll. longa: floribus rubris. Narcondam (9); common.
India, Indo-China, Andamans, Malaya; this variety endemic.

There has been some confusion as regards the Asiatic species of *Bombax;* the writer, therefore, takes this opportunity of giving diagnoses of all of them. His excuse for doing so in this place, is that it was the difficulty of localising this tree that led to the study of the genus.

Bombaces Asiaticæ.

Arbores (ordinis Malvacearum) grandes, saltem juniores caudice armatæ foliis digitatis; calyce coriaceo; stylo simplici; fructu capsulari, segmentis 5; seminibus lana endorcarpii involutis.

Fructus segmentis crassissime coriaceis, seminibus sarcinis lanæ propriis distincte involutis; cortice diu viridi: tubo staminali 1-seriali, segmentis 5, 1–3-antheris, petalis alternis; floribus minoribus sordide luteo-albis... *Bombax pentandrum* (*Eriodendron anfractuosum*).

[In India peninsulari et in insulis Andamanensibus, indigena et sylvestris; in India boreali, in Indo-China et præsertim in Malaya late culta et forsan inquilina.]

Fructus segmentis ligneis, lana endocarpii vix in sarcinis distinctis segregata; cortice mox cinerascente; floribus maximis, sæpissime rubris :—

Tubo staminali 5-seriali, serie interiori segmentis 5, 2-antheris, petalis alternis, cum serie altera staminibus simplicibus, 1-antheris, 10 per paria petalis oppositis fascem centralem stylum amplectentem formante; ceteris in phalangibus 2-cruralibus 5, petalis oppositis dispositis, staminibus phalangium singularum sub-12, omnibus binis 1-antheris; foliolis longius petiolulatis, laminis acuminato-caudatis subtus viridibus; stylo longibrachiato; capsula velutina .... *Bombax malabaricum.*

[In India peninsulari et boreali, in China australi et Indo-China, in archipelagine Malayana, insulis Philippinensibus et Australia boreali-orientali frequens.]

Tubo staminali multiseriali, staminibus omnibus binis 1-antheris, serie interiori (forsan cum serie *altera* tantum speciei præcedentis comparanda) staminibus 20 petalis oppositis annulum stylum amplectentem formante; ceteris in phalangibus 2-cruralibus 5, petalis oppositis dispositis, staminibus phalangium singularum numerosis; foliolis breve petiolutatis vel sessilibus, laminis acutis; stylo brevibrachiato; capsula glabra .... *Bombax insigne.*

[In India peninsulari occidentali; in Indo-China et in Malaya.]

Bombax pentandrum and *B. malabaricum* are wonderfully uniform in the number and arrangement of the elements of their staminal whorl; *B. insigne*, while equally uniform as regards the arrangement, varies considerably as regards the number of stamens in its phalanges. The subjoined key shows the distinguishing features and relative position of the most important of these varieties.

Tubo staminali ovario plus duplo longiore foliolis subsessilibus late lanceolatis, subtus viridibus glabris; floribus albis; (capsula ignota) .... *Bombax insigne*, SUB.-SP. *anceps* (*B. anceps* Pierre). *B. malabarici* var. *albiflora* Wall. [Cat. n. 1840/3 et 1840/4] vel ad hanc sub-speciem, vel ad *B. insignis* genuini var. *albam* referenda est.

[Burma (Shan); Cochin-China.]

Tubo staminali ovario vix longiore .... *Bombax insigne*, SUB.-SP *genuina*.

Staminibus phalangium cruralibus utrinque circa 20:—

Staminibus phalangium singularum inter-cruralibus circa 30, capsula (unius ignota), 10–12-pollicari:—

Foliolis subsessilibus late lanceolatis vel obovato-mucronatis, subtus glaucescentibus; floribus rubris .... var. *typica* (*B. insigne* Wall.; *B. festivum* Wall. [Cat. 1841]).

[Chittagong; Arracan; Pegu.]

Foliolis subsessilibus late lanceolatis, subtus viridibus glabris; floribus albis .... var. *alba* (*Salmalia malabarica* Hort. Bogor., *nequaquam* Schott).

[Java, culta; forsan Burma (*vide supra B. anceps*).]

Foliolis breve petiolulatis anguste lanceolatis, subtus glaucescentibus; floribus rubris .... var. *andamanica*.

[Andamans; ins. Cocos].

Foliolis breve petiolulatis anguste lanceolatis, subtus puberulis; (florum colore ab autore neglecto; capsula ignota) .... var. *cambodiensis* (*B. cambodiense* Pierre.

[Cambodia.]

Staminibus phalangium singularum intercruralibus circa 50, capsula 10–12-pollicari, foliolis subsessilibus late lanceolatis, floribus rubris .... var. *Wightii*.

[India; in prov. Kanara, Anamallai, Malabar.]

Staminibus phalangium singularum intercruralibus circa 90; capsula 3–4-pollicari tantum; foliolis sessilibus anguste lanceolatis, subtus glaucescentibus; floribus rubris .... var. *polystemon*.

[Narcondam.]

Staminibus phalangium cruralibus utrinque 10; phalangium singularum intercruralibus circa 30; capsula 10–12-pollicari; foliolis breve petiolulatis

lanceolatis subtus viridibus glabris,
floribus viridescentibus .... var. *larutensis*.

[Perak; prov. Larut: forsan etiam in archipelagine Malayana apud Priaman].

It will be noted that the writer is unable to perpetuate the generic rank (*Eriodendron*) assigned by DeCandolle to the Linnean *Bombax pentandrum*. When the differences in the staminal columns of the three 'species' here recognised are reduced to the simplest possible terms, we observe that in *B. pentandrum* this whorl consists of but one element, the items of which are alternate with the petals; that in *B. insigne*, likewise, there is but one element, the items of which are opposite the petals; that in *B. malabaricum*, on the other hand, both these elements occur. Either, therefore, *Bombax malabaricum* and *Bombax insigne* typify two genera as distinct from each other as *Eriodendron* is from either; or, as is here proposed, all three are congeneric. In another place the writer hopes to show that he is right in thinking, with Schumann, that *Pachira* does not deserve to be removed generically from *Bombax*; that he is justified in further reducing *Chorisia* to *Eriodendron*, and therefore also to *Bombax*; and is entitled to believe, with Willdenow, that the characters which separate *Adansonia* from *Bombax* are too trivial to be generic.

On the other hand, it will be noted that the material of some of the forms included in *B. insigne* is not yet complete, and it will be readily understood that writers who recognise as distinct the 'genera' referred to in the preceding paragraph, will be still more apt to treat as specifically separable the various forms of *B. insigne* here defined. No work on Indian Botany hitherto published notes *B. insigne* as Indian; the tree, when mentioned, is stated to occur only in Indo-China.

VI. STERCULIACEÆ. IV.

11. STERCULIA RUBIGINOSA Vent., *var.* GLABRESCENS King. Narcondam (10); Barren Island (4).

Andamans and Nicobar coasts, general; the variety only.

—. *HERITIERA LITTORALIS* Dryand. Narcondam, fruits on beach, E. Bay; Barren Island, fruits on beach at Landing-place Cove: not found growing in either island.

VII. TILIACEÆ. —.

12. GREWIA LÆVIGATA Vahl. Narcondam (11); in leaf only.

Africa; India, Burma, Malaya; Australia.

VIII. RUTACEÆ. —.

13. GLYCOSMIS PENTAPHYLLA Corr. Narcondam (12).

India, Indo-China, Malaya.

IX. BURSERACEÆ. V.

14. GARUGA PINNATA Roxb. Narcondam (13); Barren Island (5); in both islands common.

India, Burma, Malaya.

—. *CANARIUM EUPHYLLUM* Kurz. Narcondam?

The leaves of this species occur in Herb. Calcutta, and are given as from

Narcondam, on the authority of the Andaman Deputation of 1866, by whom the specimen was collected; the writer did not see the tree in 1891. As the deputation visited the Coco Group (where the species does occur) as well as Narcondam, and as there are many other errors of locality on the tickets of their collection, the species, though here mentioned, is not formally included in the list.

x. MELIACEÆ. —.

15. AMOORA ROHITUKA W. & A. Narcondam (14).
India, Burma, Malaya.

16. AMOORA DECANDRA Hiern. Narcondam (15).
Central and Eastern Himalaya; Malaya.

—. *CARAPA MOLUCCENSIS* Lamk. Narcondam; seeds on beach, E. Bay.

xi. OLACINEÆ. —.

17. CANSJERA RHEEDEI Gmel. Narcondam (16).
India, Burma, Malaya; N. Australia; S. China.

18. APODYTES ANDAMANICA Kurz. Narcondam (17).
Andamans.

xii. RHAMNEÆ. vi.

19. COLUBRINA ASIATICA Brogn. Narcondam (18); Barren Island (6).
Africa; India and Ceylon; Burma, Malaya; N. Australia.

20. GOUANIA LEPTOSTACHYA Brogn. Narcondam (19), very plentiful.
India, Burma, Malaya.

xiii. AMPELIDEÆ. vii.

21. VITIS REPENS W. & A. Barren Island (7), very common.
India, Burma, Malaya.

22. VITIS CARNOSA Wall. Narcondam (20), common.
India, Burma, Malaya.

23. VITIS LANCEOLARIA Roxb. Narcondam (21).
India, Indo-China, Malaya.

24. LEEA SAMBUCINA Willd. Narcondam (22); Barren Island (8).
India, Burma, Malaya.

xiv. SAPINDACEÆ. viii.

25. ERIOGLOSSUM EDULE Bl. Narcondam (23), common; Barren Island (9).
India, Burma, Malaya; N. Australia.

26. ALLOPHYLUS COBBE Bl. Narcondam (24), at Coco Bay.
India, Burma, Malaya.

27. DODONÆA VISCOSA Linn. Barren Island (10), common in the valley south of the lava.
Cosmopolitan in the tropics.

XV. ANACARDIACEÆ. IX.

28. ODINA WODIER Roxb. Narcondam (25), very common.
India, Indo-China.

29. SEMECARPUS HETEROPHYLLA Bl. Narcondam (26); Barren Island (11).
Indo-China, Andamans, Malaya.

XVI. LEGUMINOSÆ. X.

30. DESMODIUM POLYCARPON DC. Narcondam (27); Barren Island (12).
East Africa; S.-E. Asia; Polynesia; Japan and China.

31. ABRUS PRECATORIUS Linn. Narcondam (28); Barren Island (13).
Cosmopolitan in the tropics.

32. ERYTHRINA INDICA Lamk. Narcondam (29), coast, Anchorage Bay.
India, Burma, Malaya.

33. MUCUNA GIGANTEA DC. Narcondam (30), common.
India, Indo-China, Malaya; Polynesia.

34. CANAVALIA TURGIDA Grah. Narcondam (31), Coco and East Bays.
India, Indo-China, Malaya.

35. VIGNA LUTEA A. Gray. Narcondam (32), on coast.
Cosmopolitan in the tropics.

36. PHASEOLUS ADENANTHUS G. F. Mey. Narcondam (33), abundant on beach at East Bay.
Cosmopolitan in the tropics.

37. DALBERGIA TAMARINDIFOLIA Roxb. Barren Island (14).
India, Indo-China, Malaya.

38. DALBERGIA MONOSPERMA Dalz. Narcondam (34), coast north of Anchorage Bay.
India, Indo-China, Malaya; Australia; China.

39. DERRIS SCANDENS Benth. Narcondam (35), East Bay, in sea-fence.
India, Indo-China, Malaya; Australia; China.

40. PONGAMIA GLABRA Vent. Barren Island (15), one tree behind the beach at the landing-place, and close to the lava.
Mascarene Isds; India, Indo-China, Malaya; Australia; Polynesia.

41. CÆSALPINIA BONDUCELLA Flem. Narcondam (36), Coco Bay.
Cosmopolitan in the tropics.

42. ENTADA SCANDENS Benth. Narcondam (37).
Cosmopolitan in the tropics.

43. ACACIA CONCINNA DC. Narcondam (38); Barren Island (16); common.
India, Indo-China; China.

XVII. COMBRETACEÆ XI.

44. TERMINALIA CATAPPA Linn. Narcondam (39); Barren Island (17).
Andamans, Malaya.

This is comparatively scarce in Narcondam, but on Barren Island it is undoubtedly the most numerously represented tree present. Though really a littoral species, it is not here confined to the shore, but extends from base to summit of the outer cone on both sides wherever there is soil suitable for it to grow. Its general dispersal in the island has been largely assisted by the rats; they carry off the fruits in order to eat the fleshy outer portion.

45. GYROCARPUS JACQUINII Roxb. Narcondam (40).
Africa; India, Indo-China, Malaya; Polynesia: not in the Mascarene Islands or E. Africa.

XVIII. MYRTACEÆ. XII.

46. EUGENIA JAMBOLANA Linn. Barren Island (18), very common.
India, Indo-China, Malaya; Australia.

47. BARRINGTONIA SPECIOSA Forst. Narcondam (41).
Ceylon; Andamans, Malaya; Australia; Polynesia.

The fruits of this species were picked up on the beaches in Barren Island, but the tree itself was not found growing.

XIX. MELASTOMACEÆ. —.

48. MEMECYLON EDULE Roxb. Narcondam (42).
Ceylon; Indo-China, Andamans, Malaya; Philippines.

XX. CUCURBITACEÆ. —.

49. TRICHOSÁNTHES PALMATA Roxb. Narcondam (43).
India, Indo-China, Malaya; Australia; Japan and China.

XXI. RUBIACEÆ. XIII.

50. OLDENLANDIA CORYMBOSA Linn. Barren Island (19), in the crater.
America; Africa; India, Indo-China, Malaya.

51. MUSSÆNDA MACROPHYLLA Linn. Barren Island (20), common.
Indo-China, Andamans.

This plant, which is common in the valley between the cones, close to the lava, is one of the species reported by the Deputation of 1866; flowering specimens collected then are preserved in the Calcutta Herbarium, but are noted as being from Narcondam, not Barren Island. The species does not appear to occur in Narcondam, for the plant was carefully looked for there. The mistake on these tickets, which requires to be pointed out, since some of the specimens collected in 1866 may have reached Herbaria in Europe, is nevertheless a fortunate one, as it first called the attention of the writer to the fact that, though this Deputation only reported on Barren Island (*Proc. As. Soc., Beng.*, 1866, 215), it visited Narcondam also. The interest of this fact will be shown in discussing the presence of the Coco-nut.

The species has here, owing to its situation, developed a shrubby habit, but careful examination of the complete material obtained by the writer, leads him to conclude that it cannot be looked upon as even varietally distinct.

52. Guettarda speciosa Linn. Narcondam (44).
Cosmopolitan in the tropics.

53. Ixora brunnescens Kurz. Narcondam (45), and Barren Island (21); common on the coasts.
Andamans.

54. Ixora cuneifolia Roxb. Barren Island (22), within outer cone.
Indo-China.

55. Morinda citrifolia Linn., *var.* bracteata H. f. (sp. Roxb.) Narcondam (46), very common everywhere, from sea-level to the top of the hill, at 2300 feet elev.; Barren Island (23), common.
India, Indo-China, Andamans.

56. Pæderia fœtida Linn. Narcondam (47).
India, Burma, Malaya.

xxii. COMPOSITÆ. xiv.

57. Vernonia divergens Benth. Narcondam (48), on coast.
India, Indo-China.

58. Blumea glomerata DC. Narcondam (49), rocks, west coast.
India, Indo-China, Malaya; China.

59. Blumea laciniata DC. Narcondam (50), rocks east coast.
India, Indo-China, Malaya; China.

60. Blumea myriocephala DC. Narcondam (51), at 1500–1800 feet.
Eastern Himalaya, Indo-China, Andamans.

61. Pluchea indica Less. Narcondam (52), and Barren Island (24), on coasts; common.
India, Indo-China, Malaya; China.

62. Wedelia scandens C. B. Clarke. Narcondam (53), common on coasts; Barren Island (25), coasts.
India, Indo-China, Malaya.

xxiii. GOODENOVIEÆ. xv.

63. Scævola Kœnigii Vahl. Narcondam (54); Barren Island (26).
India, Indo-China, Malaya; Australia; Polynesia.

xxiv. MYRSINEÆ. xvi.

64. Ardisia humilis Vahl. Narcondam (55); Barren Island (27).
India, Indo-China, Malaya; China.

xxv. SAPOTACEÆ. —.

65. Sideroxylon ferrugineum H. & A. Narcondam (56).
Malaya, Andamans; China.

This is another of the species obtained by the Deputation of 1866: on this occasion the labels are correct. The form present here has unusually large leaves—in young trees they are 30 in. long by 12 in. across.

66. Diospyros Kurzii Hiern. Narcondam (57).
Andamans and Nicobars.

xxvi. APOCYNEÆ. xvii.

67. Aganosma marginata G. Don. Barren Island (28), very common in the valley between the cones, to the south of the lava.
Indo-China, Malaya.

68. Anodendron paniculatum A. DC. Narcondam (58).
India, Indo-China, Malaya.

xxvii. ASCLEPIADACEÆ. xviii.

69. Tylophora globifera H. f.? Narcondam (59); in fruit only.
Andamans.

70. Hoya parasitica Wall. Narcondam (60); Barren Island (29).
Indo-China, Malaya.

71. Hoya diversifolia Bl. (*H. orbiculata* Wall.) Narcondam (61); Barren Island (30).
Indo-China, Malaya.

72. Dischidia nummularia R. Br. Narcondam (62).
Indo-China, Malaya; Australia.

xxviii. EBENACEÆ. xix.

73. Mitreola oldenlandioides Wall. Barren Island (31), abundant underneath a thicket of gregarious *Flueggia* to the north of the lava at Landing-place Cove; not seen elsewhere.
India, Burma, Malaya; N. Australia.

74. Strychnos acuminata Wall. Narcondam (63), once at 1600 feet.
Burma, Andamans.

xxix. CONVOLVULACEÆ. xx.

75. Ipomœa grandiflora Lamk. Narcondam (64); Barren Island (32).
East Africa; India, Indo-China; Malaya, Australia, Polynesia.

76. Ipomœa denticulata Choisy. Narcondam (65), at East Bay.
Mascarene Islands; Laccadives and Ceylon; Andamans, Indo-China, Malaya; Australia, Polynesia.

77. Ipomœa turpethum R. Br. Narcondam (66), in the bed and round the edges of a small dry lagoon in the beach-forest at East Bay.
Mascarene Islands; India, Indo-China, Malaya; Australia, Polynesia.

78. Ipomœa biloba Forsk. Narcondam (67); Barren Island (33).
Cosmopolitan in the tropics.

79. Ipomœa vitifolia Sw. Narcondam (68), Coco Bay, abundant.
India, Burma, Malaya.

80. Convolvulus parviflorus Linn. Narcondam (69), Anchorage Bay.
Africa; Indo-China, Malaya; Australia.

—. SOLANACEÆ. XXI.

81. PHYSALIS MINIMA Linn. Barren Island (34), on a small landslip on outer cone, south of Landing-place Bay.
Cosmopolitan in the tropics.

—. SCROPHULARINEÆ. XXII.

82. VANDELLIA CRUSTACEA Benth. Barren Island (35), on the small landslip, and also inside the crater.
Africa; India, Indo-China, Malaya; Australia, Polynesia; China.

XXX. BIGNONIACEÆ. XXIII.

83. OROXYLUM INDICUM Vent. Narcondam (70); Barren Island (36).
India, Indo-China, Malaya.

XXXI. ACANTHACEÆ. XXIV.

84. ERANTHEMUM SUCCIFOLIUM Kurz. Narcondam (71); Barren Island (37).
Andamans, Nicobars.

XXXII. VERBENACEÆ. XXV.

85. CALLICARPA ARBOREA Roxb. Narcondam (72); Barren Island (38).
India, Burma, Malaya.
86. PREMNA INTEGRIFOLIA Linn. Narcondam (73); Barren Island (39).
India, Indo-China, Andamans.
87. CLERODENDRON INERME Gærtn. Narcondam (74), at East Bay.
India, Indo-China, Andamans.

XXXIII. NYCTAGINEÆ. XXVI.

88. BOERHAAVIA REPENS Linn. Narcondam (75); Barren Island (40); common on rocks on the coast.
Cosmopolitan in the tropics.
89. PISONIA ACULEATA Linn. Narcondam (76), not very plentiful.
Cosmopolitan in the tropics.
90. PISONIA ALBA Span. Narcondam (77), beach-forest, E. Bay.
Laccadives, Ceylon; Andamans, Malaya.
91. PISONIA EXCELSA Bl. Narcondam (78), abundant, E. Bay.
Andamans, Malaya.

XXXIV. ARISTOLOCHIACEÆ. —.

92. ARISTOLOCHIA TAGALA Cham. & Schlecht. Narcondam (79).
India, Indo-China, Malaya; China.

XXXV. MYRISTICACEÆ. —.

93. MYRISTICA GLAUCA Bl. Narcondam (80).
Indo-China, Andamans, Malaya.

XXXVI. EUPHORBIACEÆ. XXVII.

94. BRIDELIA TOMENTOSA Bl. Narcondam (81).
India, Indo-China, Malaya, Australia, China.

95. ACTEPHILA EXCELSA Muell.-Arg. (*A. javensis* Miq.) Narcondam (82); gregarious and plentiful, the commonest species in the island.
India, Burma, Malaya.

96. PHYLLANTHUS RETICULATUS Poir. Barren Island (41), to the south of the lava, near inner base of outer cone.
Africa; India, Burma, Malaya; China.

97. GLOCHICHON CALOCARPUM Kurz. Narcondam (83), and Barren Island (42); common on rocks on the coast.
Andamans and Nicobars.

98. FLUEGGIA MICROCARPA Bl. Barren Island (43); gregarious and plentiful between the cones to the north of the lava.
Africa; India, Indo-China, Malaya; Australia; China.

99. BREYNEA RHAMNOIDES Muell.-Arg. Narcondam (84).
India, Burma, Malaya; China.

100. CYCLOSTEMON MACROPHYLLUS Bl. Narcondam (85).
India, Andamans, Malaya.

101. CYCLOSTEMON ASSAMICUS Hook. f. Narcondam (86).
Eastern Himalaya, Assam; Andamans.

102. BLACHIA ANDAMANICA Hook. f. Narcondam (87), Anchorage Bay.
Andamans.

103. MALLOTUS ANDAMANICUS Hook. f. Narcondam (88), gregarious and common, but less so than *Actephila excelsa.*
Andamans.

104. MACARANGA TANARIUS Muell.-Arg. Narcondam (89); Barren Island (44).
Andamans, Malaya.

105. GELONIUM BIFARIUM Roxb. Narcondam (90), plentiful on the coast; Barren Island (45).
Andamans, Malaya.

XXXVII. URTICACEÆ. XXVIII.

106. TREMA AMBOINENSIS Bl. Narcondam (91), common on rocky coasts and inland also; Barren Island (46), general, some stunted examples occur even on the bare inner cone.
Eastern Himalaya, Indo-China, Andamans, Malaya.

107. FICUS GIBBOSA Bl., *var.* CUSPIDIFERA King. Barren Island (47).
India, Indo-China, Malaya.

108. FICUS GLABERRIMA Bl. Narcondam (92); one of the tallest trees.
Himalaya, Indo-China, Malaya.

109. Ficus Benjamina Linn. Narcondam (93); seeds brought have germinated at Calcutta.

India, Indo-China, Malaya.

110. Ficus retusa Linn., *var.* nitida King (*sp.* Thunbg). Narcondam (94), and Barren Island (48); very common on both islands.

India, Indo-China, Malaya; Australia; New Caledonia; China.

111. Ficus nervosa Roth. Narcondam (95), at 1,800 feet elevation.

India, Indo-China, Malaya; China.

112. Ficus Rumphii Bl. Narcondam (96), and Barren Island (49); very plentiful.

India, Indo-China, Malaya.

113. Ficus callosa Willd. Narcondam (97), beach-forest at East Bay; a very tall tree.

India, Indo-China, Malaya.

114. Ficus brevicuspis Miq. Narcondam (98), very common; Barren Island (50); this is one of those species in which many of the branchlets are hollow and afford homes for species of ants.

Andamans, Malaya.

115. Ficus hispida Linn., *var.* typica. Barren Island (51), in the valley between the cones, at the inner base of the outer cone.

India; Indo-China, Malaya.

var. dæmonum King (*sp.* Kœnig.). Narcondam (99), and Barren Island (51); frequent.

India, Indo-China, Malaya.

116. Ficus variegata Bl. Barren Island (52); on the hill at the west end of southern part of outer cone, overlooking Landing-place Bay.

Indo-China, Malaya.

117. Antiaris toxicaria Leschen. Narcondam (100), not common.

India, Burma, Malaya.

The leaves of the form present here exactly match those of Malayan specimens named *A. rufa* by Miquel.

118. Artocarpus Lakoocha Roxb. Narcondam (101).

India, Indo-China, Malaya.

119. Bœhmeria malabarica Wedd. Narcondam (102); very plentiful.

India, Indo-China, Malaya.

120. Pipturus velutinus Wedd. Narcondam (103), plentiful.

Nicobars, Malaya; Polynesia.

—. ORCHIDACEÆ. xxix.

121. Dendrobium sp. Barren Island (53), rather common on trees on inside of outer cone.

122. Pholidota imbricata Lindl. Barren Island (54), inside crater.
India, Burma, Malaya.

XXXVIII. SCITAMINEÆ. —.

123. Musa sapientum Linn. The *Plantain*. Narcondam (104), a large grove behind the Coco-nut trees at Coco Bay.
Cosmopolitan in the tropics, cultivated.

No doubt deliberately introduced for the benefit of possibly ship-wrecked mariners, though it is not quite clear who planted it; probably (see under *Cocos nucifera*) it has been introduced from the Andamans, and perhaps dates from 1866.

XXXIX. DIOSCOREACEÆ. XXX.

124. Dioscorea sativa Linn. Narcondam (105) Barren Island (55).
India, Burma, Malaya; Australia.

125. Dioscorea glabra Roxb. Barren Island (56); common.
India, Burma, Malaya.

XL. LILIACEÆ. XXXI.

126. Dracæna angustifolia Roxb. Narcondam (106), Anchorage Bay.
Indo-China, Malaya, Australia.

127. Gloriosa superba Linn. Barren Island (57), E. coast near sea.
Africa; India; Indo-China, Malaya.

XLI. COMMELINACEÆ. —.

128. Pollia Aclisia Hassk. Narcondam (107), very abundant on slopes overlooking south end of Anchorage Bay.
Eastern Himalaya, Indo-China, Malaya.

XLII. PALMEÆ. XXXII.

129. Caryota mitis Lour. (*C. sobolifera* Wall.) Narcondam (108).
Indo-China, Malaya.

130. Cocos nucifera Linn. Narcondam (109), many at Coco Bay, a few at Anchorage Bay, one, not yet bearing, at E. Bay; Barren Island (58), thirteen trees counted from the offing, behind the *Pandanus* fence at Anchorage Bay; none seen elsewhere.
India; Malaya; Polynesia; America.

The introduction of this tree into these islands is a question of some interest. The tree at E. Bay, Narcondam, has no doubt been produced from a nut washed round from Coco Bay; in all likelihood the trees at Anchorage Bay have been derived from the same source. The trees at Coco Bay itself may have originated from nuts brought from the Coco Group by a surface-current sweeping from the Sea of Bengal, through the Preparis Channels, from N.-E. to S.-W. across the Andaman Sea; but as they are associated, where they occur, with a grove of *Musa sapientum* (which must have been deliberately introduced), it is not unreasonable to suppose that the two species were introduced together.

The question is, when did they first appear? Hume and Ball landed in 1873 at the very spot where they are now so plentiful, yet no mention is made by either writer of their presence. As Ball speaks of some of the species observed at this Bay, and as Hume describes the Coco-nuts seen by him, shortly after, at the Cocos, it is hard to believe that the trees were there in 1873. Again, Mallet makes no reference to them in 1884; the maps accompanying his account indicate that he and Hobday landed at Anchorage Bay, and he may not therefore have seen the large grove at Coco Bay; but those at the beach where he landed should have been evident to him. Mallet's paper is however confined to the geology and topography of the island, and hardly alludes to its vegetation. But Hume, Ball, and Mallet are equally silent regarding the Coco-nuts on Barren Island which we know to have been present in 1866, for they were seen by the Andaman Deputation—whose report has been already referred to (p. 56)—behind a beach, to which they still seem confined. As these three writers failed to notice Coco-nuts in Barren Island, where we know they existed at the time of these visits, there is no reason why Coco-nuts should not have been present then in Narcondam also. The Andaman Deputation in their Report (*Proc. As. Soc., Beng.*, 1866, 215)., say: "We brought from Port Blair with "us a number of Cocoa-nuts, Plantain trees, and Pine-apple cuttings, and these "we planted on the ground from which the grass had been cut, in hopes that "they might be of use to some future visitors."* We have seen, in connection with some of the species in this list, that the same deputation visited Narcondam also, though it did not report on that island; nothing therefore is more probable than that the deputation did there what it had done on Barren Island, and that to its members belongs the credit of having introduced, at least, the Plantains. But the Coco-nut trees are so much more numerous, and so much larger on Narcondam than on Barren Island, that one finds it difficult to think they only date from 1866. It is unfortunate that the deputation did not find it necessary to report on Narcondam as well as on Barren Island; had they done so, there is little doubt the report would have mentioned any Coco-nuts that were present. However, even if the Coco-nut trees were already there in 1866, the writer is inclined to think that their origin must still be due to introduction by some previous visitor.

The Coco-nuts on Barren Island may be supposed to have originated from nuts swept up by a strong surface-current that flows from the south-west, and that therefore would bring drift from the Nicobars where Coco-nuts are plentiful. But it is more likely that the trees have been introduced, though involuntarily, by man. For though there is reason to believe that no one has ever landed at this particular beach, this bay affords the only safe anchorage in the island, and it is therefore more probable that these trees have sprung from nuts that have fallen overboard from

* There was no trace of any of these in the locality indicated during the writer's visit, a circumstance not surprising; because, in the first place, the situation is not over-suitable for such species, and, besides, goats have been since then introduced into the island! It may be mentioned that no one at Port Blair in 1891 knew of the existence of Coco-nuts in Narcondam, and the writer consequently took a number with him in order to plant them, only to find the act unnecessary. And, bearing in mind the state of affairs in Great Coco (*Journ. As. Soc., Beng.*, lx, pt. 2, 315), he also took fruits of *Carica Papaya* for the same purpose. Should, therefore, subsequent visitors find this species established in the island, they are hereby relieved of the necessity of inventing an hypothesis to explain the circumstance.

some craft lying off this beach, than that they have been brought by the sea from the Nicobars, or that they have been deliberately introduced by man.

XLIII. PANDANACEÆ. XXXIII.

131. PANDANUS ODORATISSIMUS Linn. f. Narcondam (110), common at Coco Bay and elsewhere; Barren Island (59), at Anchorage Bay.

India, Indo-China, Malaya.

XLIV. AROIDEÆ. —.

132. AMORPHOPHALLUS (*Candarum*) REX Prain, *sp. nov. tubere* magno depresso-globoso; *cataphyllis* 4, oblongo-lanceolatis; *folii* petiolo parum asperato vix maculato, lamina trisecta segmentis irregulariter dichotomis iterumque pinnatisectis, pinnulis (imis nonnunquam exceptis) ad costulas decurrentibus, ovato-oblongis, caudato-acuminatis, nervis supra impressis, subtus prominentibus, sinubus angustis; *pedunculo* crasso florifero brevi, fructigero elongato; *spatha* juniore cataphyllis obtecta, matura tubo infundibulari crasso in laminam late campanulatam margine tandem reflexa undulato-plicatam postice acuminatam expanso; *spadice* spatha subduplo longiore, erecto, stricto, crasso; *inflorescentiis* tubo spathæ subinclusis, *fœminea* sursum parum angustata quam *masculam* parum obconicam dimidio longiore, *appendice* crassa conico-pyramidali inflorescentiis dimidio longiore et, saltem prope basin, quam eas triplo latiore. Narcondam (111), very common.

Tubere diam. 9–18-poll.; *cataphyllis* spiraliter dispositis, imo exteriore 3 poll., altero 9 poll., tertio 12 poll, summo interiore 19 poll. longis, omnibus 2 poll. latis, pallide viridibus maculis olivaceis, demum tamen subconcoloribus luteis; *petiolo* 2·5–6-pedali basi ipsa 4·5 poll. crasso, sursum spatio brevi ita incrassato ut loco supra solum 4 poll. alto crassitudinis 5-pollicaris, deinde paullatim se coartante et apud trifurcationem diam. 3·5 poll. tantum, pallide viridi, maculis olivaceis, demum subconcolore olivaceo; *lamina* diam. 5·5-ped., supra olivacea subtus prasina, segmentis singulis 36 poll. longis, pinnulis ultimis 8–10 poll. longis, his 3–3·25 poll. latis; pedunculo florifero brevi, 2·5 poll. tantum longo, fructigero ad 30 poll. elongato, 1·5–2 poll. crasso, juniore pallide viridi maturo purpurascente; spatha a latere 16 poll., a basi ad apicem versus 19 poll. longa, infra substantiæ carnosæ sursum tenuescente, extus concolore pallide viridi, intus ad basin verruculosam lutea, supra pallide viridi ibi tamen margine excepto cito flavescente; *spadice* tota 21·5 poll. longa, parte *fœminea* 4·5 poll. longa, basi 2·25 poll. apice 1·75 poll. crassa, (fructigera 7 poll. longa et 3·5 poll. crassa) ex ovariis globosis 0·2 poll. diam. viridibus, 2-(rarissime 3-)locularibus, sessilibus, subcontiguis, in stylos 0·3 poll. longos, luteos contractis, stigmatibus plicatim 2–3-lobis, loculis 1-ovulatis, ovulis semianatropis decurvis, funiculo elongato angulo interiore parum supra basin affixis, in ala placentali circa basin funiculo exoriente et loculum fere totum complente innixis eademque amplexis; parte *mascula* 3 poll. longa, basi 1·75 poll., apice 2·5 poll. crassa, e floribus 4–5-antheris spiraliter dispositis, antheris singulis subsessilibus connectivo sursum parum producto, ellipsoideis sursum angustatis apice rimis lunulatis 2-porosis; *appendice* 14 poll. longa, hac basi 6 poll. crassa, post anthesin caduca, spongiosa, rugosa, valleculosa, lutea et brunneo-maculata: *bacca* 1–2-sperma, 0·75 poll. longa, hac 0·25–0·35 poll. lata, ovata, versus apicem angustata, carnosa, lutea; *seminibus* pendulis ovatis, triente basilari e funiculo incrassato spongiosis, ceterum embryone corneo semini subconformi cartilageneis.

This species resembles the Java form, or a variety, of *Amorphophallus campanulatus* (*A. campanulatus* Blume, Rumphia, i, 139. t. 32, 33, as opposed to *Arum campanulatum*, Roxb, Hort. Beng., 66) in the conic-pyramidal shape of the appendix, but differs in other respects, more particularly in the leaf. It agrees with *A. virosus* Brown (*Bot. Mag.*, 6978) in having the male and female inflorescence of about equal length, but in other respects is very distinct, for *A. virosus* has the dense flowered turbinate male inflorescence, and the short oblong appendix characterstic of Roxburgh's *Arum campanulatum* of which it is probably only a form. The following brief diagnosis † may assist in indicating how very distinct the present plant is from the forms hitherto known :—

Petiole hardly verrucose; male flowers disposed spirally on an inflorescence not wider than the female: yellow pyramidal appendix (twice as long as broad, and) one-half longer than the combined inflorescences: (male and female inflorescences of equal length; spathe green concolorous) .... *A. rex*

Petiole very verrucose; male flowers disposed spirally on an inflorescence much wider than the female: purplish-brown appendix not so long as the combined inflorescences :—

Male and female inflorescences of equal length, spathe green suffused with purple, externally white spotted (oblong appendix not longer than broad) .... *A. virosus.*

Male inflorescence much shorter than the female, spathe purple concolorous .... *A. campanulatus.*

Oblong appendix, not longer than broad .... *Arum campanulatum* Roxb. (India).

Pyramidal appendix twice as long as broad *Amorphophallus campanulatus* Bl. (Java).‡

† In connection with this, it may be mentioned that the *Amorphophallus* from the Coco Group, mentioned (*Journ. As. Soc., Beng.*, lx, 2, 338) as related to *A. bulbifer* and *A. tuberculiger*, has since flowered at Calcutta, and has proved, as was then anticipated, to be a very distinct species. As the authors of the other species, have indicated by the specific name the tubercle-bearing habit of the species, the writer proposes for this one the name 'AMORPHOPHALLUS ONCOPHYLLUS' *Prain.* The diagnosis between it and the two species for which it might be mistaken, is as follows :—

Stigma sessile, spathe unconstricted, appendix equal in length to the combined inflorescences :--

Female inflorescence shorter than the male .... *A. tuberculiger.*

Female inflorescence as long as the male .... *A. bulbifer.*

Style distinct, spathe constricted slightly opposite the male inflorescence, appendix twice as long as the combined inflorescences .... *A. oncophyllus.*

‡ As this paper has been passing through the press, the writer has learned from Sir Joseph Hooker, that he identifies *A. rex* with Blume's Java *A. campanulatus.*

133. Pothos scandens Linn. Narcondam (112), on trees; common.
India, Indo-China, Malaya.

xlv. CYPERACEÆ. xxxiv.

134. Cyperus pennatus Lamk. Narcondam (113); Barren Island (60).
Africa, India, Indo-China, Malaya.

135. Fimbristylis diphylla Vahl. Barren Island (61).
America; Africa; India, Indo-China, Malaya; Australia; China.

136. Fimbristylis ferruginea Vahl. Narcondam (114), rocks on coast; Barren Island (62), tussocks outside inner cone, also inside crater.
India, Indo-China, Malaya.

xlvi. GRAMINEÆ. xxxv.

137. Oplismenus Burmanni Roem. & Schult. Barren Island (63).
India, Indo-China, Malaya; China, Japan.

138. Thysanolæna acarifera Nees. Narcondam (115) coasts.
India, Indo-China; Malaya.

139. Pogonatherum saccharoideum Beauv. Barren Island (64); common.
India, Indo-China, Malaya; China.

This species is very abundant on the rocky slopes forming the inner side of the outer cone; it is one of the plants collected by the Deputation of 1866; it was also collected in 1846 by Kamphövener, botanist on the Danish Frigate "*Galatea*," whose visit is commemorated by the name '*Galatea*' having been marked on the large block on the crater. Kamphövener's specimens are in the Herbarium at Copenhagen.

140. Ischæmum muticum Retz. Barren Island (65); common.
India, Indo-China, Malaya; Australia; Western Polynesia.

Usually a coast species, this here extends inland and fills the valley between the cones, covering all the bottom of this except the lava streams.

—. LYCOPODINEÆ. xxxvi.

141. Lycopodium cernuum Linn. Barren Island, (66), interior of crater.
Cosmopolitan in the tropics.

142. Psilotum triquetrum Sw. Barren Island (67), interior of crater.
Cosmopolitan in the tropics.

xlvii. FILICES. xxxvii.

143. Davallia solida Sw. Narcondam (116), on trees in beach-forest.
Andamans, Malaya, Polynesia; Australia.

144. Davallia speluncæ Bak. Narcondam (117), common.
Africa; India, Indo-China, Malaya; Australia; Polynesia.

145. Adiantum lunulatum Burm. Barren Island (68), common.
Cosmopolitan in the tropics.

146. Trichomanes pyxidiferum Linn. Narcondam, (118), at 2330 feet.
Cosmopolitan in the tropics.

147. CHEILANTHES TENUIFOLIA Sw. Barren Island (69), dwarf specimens, plentiful within the crater.
India, Indo-China, Malaya; Australia; Polynesia; China.

148. ONYCHIUM AURATUM Kaulf. Barren Island (70), occasional.
Himalayas, Indo-China, Malaya; China.

149. PTERIS LONGIFOLIA Linn. Barren Island (71), a few plants.
Cosmopolitan in tropical and sub-tropical countries.

150. PTERIS BIAURITA Linn. Barren Island (72), occasional.
Cosmopolitan in the tropics.

151. ASPLENIUM NIDUS Linn. Narcondam (119), on trees, rather common.
Mascarene Islands; India, Indo-China, Malaya; Polynesia.

152. ASPLENIUM FALCATUM Lamk., *var.* UROPHYLLUM Bak. Narcondam (120), very common on stony hill-sides; Barren Island (73).
Africa; India, Indo-China, Malaya; Australia; Polynesia.

153. NEPHRODIUM TERMINANS J. Sm. Narcondam (121), common.
India, Indo-China, Malaya; Australia; Polynesia; China.

154. NEPHROLEPIS TUBEROSA Presl. Barren Island (74).
Cosmopolitan in the tropics.

155. POLYPODIUM IRIOIDES Lamk. Narcondam (122), at 1800 feet.
Africa, India, Indo-China, Malaya; Australia; Polynesia.

156. POLYPODIUM ADNASCENS Sw. Narcondam (123); Barren Island (75).
Africa, India, Indo-China, Malaya; Polynesia.

157. POLYPODIUM QUERCIFOLIUM Linn. Narcondam (124); Barren Island (76).
India, Indo-China, Malaya; Australia.

158. ACROSTICHUM APPENDICULATUM Willd., *var.* SETOSA Bak. Narcondam (125), common.
India, Indo-China, Malaya.

159. ACROSTICHUM COSTATUM Wall., *var.* DELTIGERA. Narcondam (126); exactly = Wallich's *Meniscium deltigerum*.
E. Himalayas; Indo-China, Malaya.

160. ACROSTICHUM AUREUM Linn. Narcondam (127); and Barren Island (77); common on rocks on the coast.
Cosmopolitan in the tropics in salt marshes.

161. ACROSTICHUM SCANDENS J. Sm. Barren Island (78), near sea.
India, Indo-China, Malaya; Australia; Polynesia.

XLVIII. MUSCI. XXXVIII.

162. NECKERA RUGULOSA Mitt.* Narcondam (128), at 2330 feet.
Ceylon.

* Examined, and kindly named for the writer by Dr. Brotherus, Helsingfors.

163. BRYUM CORONATUM Schwægr. Narcondam (129); Barren Island (79). Cosmopolitan in the tropics.

XLIX. LICHENES. XXXIX.

164. COLLEMA NIGRESCENS Achar. Narcondam (130), rather common; Barren Island (80), plentiful.
Cosmopolitan.

L. FUNGI.* XL.

165. POLYPORUS AUSTRALIS Fries. Narcondam (131); Barren Island (81). Cosmopolitan in the tropics.

166. POLYPORUS XANTHOPUS Fries. Narcondam (132). Cosmopolitan in the tropics.

167. LENZITES PLATYPHYLLUS Cooke, *Grevillea* xiii. 1. Narcondam (132). Malay Peninsula.

168. DEDAELEA GRISECINA Fries. Narcondam (134); Barren Island (82). Cosmopolitan.

169. PENIOPHORA PAPYRINA Mont. Narcondam (135); Barren Island (83). Cosmopolitan in the tropics.

170. HIRNEOLA POLYTRICHA Mont. Narcondam (136); Barren Island (84). Cosmopolitan in the tropics.

171. THELEPHORA INCRUSTANS Pers. Narcondam (137); Barren Island (85).
Cosmopolitan.

172. RHYTISMA, sp. Narcondam (138); Barren Island (86); on leaves of *Ficus brevicuspis.*
Andamans.

ALGÆ. XLI.

173. CALOTHRIX PULVINATA Ag. Barren Island (87); on stones in the hot spring on the beach at Landing-place Cove.
Cosmopolitan.

174. CALOTHRIX TASMANICA Kg. Barren Island (88); on rocks in bed of torrent on inside of outer cone to the south of the lava.
Indo-China, Malaya; Australia.

§§§ NATURE AND ORIGIN OF THE FLORA.

The list includes 174 species, of which 138 occur in Narcondam and 88 in Barren Island; 86, or $62\frac{1}{3}$°/。, of the Narcondam plants are absent from Barren Island, while 36, or 41°/。, of the Barren Island species do not occur in Narcondam; only 52 species—making $37\frac{3}{4}$°/。 of

* Examined, and kindly named for the writer by Mr. G. Masseé.

the Narcondam, 59°/₀ of the Barren Island flora—are common to the two islands. Of the genera, 111 occur in Narcondam and 75 in Barren Island, but only 48,—$43\frac{1}{4}$°/₀ of the Narcondam ones, 64°/₀ of those in Barren Island—are found in both places. Eleven natural orders present in Narcondam are unrepresented in Barren Island; five present in Barren Island are not found in Narcondam.

As regards *Cryptogams*, the two floras seem very similar, each having the same total number; the natural orders, however, indicate greater diversity of character among Barren Island than among Narcondam *Cryptogams*. There are two *Lycopodineæ*, and two *Algæ*, not represented in Narcondam; on the other hand, in Narcondam, at the top of the hill are a *Trichomanes* and a *Neckera*, absent from Barren Island. Of the thirteen ferns on Narcondam and 12 on Barren Island, 5 only are common to the two places; the Narcondam ferns belong to 6 genera, the Barren Island ones represent 8 genera. In Narcondam, one of the features of the vegetation is the presence of large beds of ferns; in Barren Island, ferns are scarce.

All the *Cryptogams* are herbaceous, and may all have their presence credited to wind-agency; *Acrostichum aureum*, however, in both islands, and *Acrostichum scandens* in Barren Island, grow only near the sea; both are denizens of mud-flats in the Sunderbuns, the Andamans and throughout Malaya and possibly therefore are sea-introduced.

Of the 46 natural orders of *Phanerogams* in Narcondam, 23 are represented by one species, 12 by two species, 3 by three species, and 3 by four species each; the only orders represented by more than four species, are *Compositæ* and *Convolvulaceæ*, each 6 sp.; *Euphorbiaceæ*, 10 sp.; *Leguminosæ*, 12 sp. and *Utricaceæ*, 13 sp. In the 35 natural orders in Barren Island we find that 21 are represented by one species, 8 by two species, and 2 by three species; the only orders represented by more than three species are *Leguminosæ*, *Rubiaceæ* and *Euphorbiaceæ*, 5 sp. each, and *Urticaceæ*, 7 sp. *Urticaceæ* is thus in both islands the leading natural order; this hegemony is due to the facilities that fruits of the order offer for introduction by frugivorous birds.

Of the 115 Narcondam *Phanerogams*, 33 are trees, 31 are shrubs, 37 are climbing species—woody climbers 16, herbaceous climbers 21; only 5 climbers being armed—and 14 are herbs. Of the 65 Barren Island species, 15 are trees, 17 are shrubs, 16 are climbers—woody 6, herbaceous 10; only 3 armed—and 17 are herbs. There are roughly speaking twice as many trees, shrubs and climbers in Narcondam as in Barren Island; the number of herbaceous species in the latter island is, however, slightly in excess of the number in the former. Of the herbaceous *Phanerogams* seven species are common to both islands; all are plants that may have been introduced by the sea. Of inland herbaceous species which may have been introduced by fruit-eating or marsh birds, or by the wind, the islands do not have one in common.

In Narcondam there are four *Compositæ* most probably introduced by wind; a grass, *Thsyanolæna*, may conceivably have been introduced in the same way. The two remaining herbs are the *Amorphophallus* which, even if in this island it has developed into a distinct form, *must* have originally been introduced by some fruit-eating bird, and the *Pollia*, which most probably has been introduced by the same agency.

In Barren Island, the wind-introduced species are two orchids and one grass, *Pogonatherum; Ischæmum muticum* has probably been introduced by the sea. The others have been introduced by birds; *Physalis* and *Mitreola* probably by fruit-eating birds; *Oldenlandia*, *Vandellia* and *Oplismenus* by birds to whose feet or feathers seeds have clung. Except *Pogonatherum*, *Ischæmum* and *Mitreola*, the Barren Island herbs are scarce.

The paucity of armed climbers in both islands is striking. The proportion of climbers to erect species is considerably higher in Narcondam, where they form one-third of the whole Phanerogamic flora, than in Barren Island, where they form only one-fourth, and partly in consequence of this, the jungle in Barren Island is opener than in Narcondam. Of the thirty-seven climbers in Narcondam, twelve have undoubtedly been introduced by fruit-eating birds, while one has most probably been introduced by its fruits having stuck to the feathers of some bird; fourteen have been introduced by the sea; six by winds. Of the remaining four species, which are more doubtful, two may be safely assumed to be here sea-introduced species also; one may be put down to the agency of birds, and only one species, the *Dioscorea*, is quite doubtful; perhaps the sea is on the whole the most likely agency.

Similarly, of the sixteen climbers on Barren Island, five are clearly species introduced by fruit-eating birds; to these a sixth probably should be added. Four are species certainly sea-introduced; to these another should probably, and two more should perhaps be added; of wind-introduced species there are three.

Very few of these species are common to both islands, only nine, or about half the Barren Island and one-fourth of the Narcondam climbers being so; of these four are again sea-shore species, and the *Dioscorea* found in both islands may be a fifth of the sea-introduced class. Two, the *Hoyas*, are wind-introductions; one, *Capparis sepiaria*, is certainly; another, the *Abrus*, is probably, a bird-introduced species.

Of the thirty-one Narcondam shrubs, one (*Musa*) has been introduced by man; on the other hand not a single shrub owes its presence to the agency of wind. As many as seventeen are unequivocally bird-introduced species; and ten are unequivocally sea-introduced species; the remaining three, which are all capsular-fruited *Euphorbiaceæ* (*Actephila*, *Macaranga* and *Mallotus*), though not unequivocally sea-introduced, are in all probability species of this class.

Of the seventeen Barren Island shrubs, seven are undoubtedly bird-introduced species; nine are sea-introduced species; one species, *Dodonæa*, is, though somewhat equivocally, to be looked upon as wind-introduced.

There is much greater conformity between the floras as regards this class; thirteen of the Barren Island shrubs occur also in Narcondam, only four being peculiar; all but one of the sea-shore, and all but two of the bird-introduced shrubs in Barren Island occur in Narcondam also.

The trees in the two islands have last to be considered. Of the thirty-three in Narcondam twenty-one, or more than three-fifths, have been introduced by birds; two from their fruits having been attached to the feet or feathers, the others, by fruit-eating birds: ten may have been sea-introduced; for seven this mode of introduction is undoubted, as regards *Caryota* it is rather equivocal, and the Coco-nut may have been deliberately introduced; two species are wind-introduced.

Of the fifteen Barren Island trees, nine are bird-introduced species; five are sea-introduced; one has been introduced by wind.

Here again great conformity between the floras is observable; of the fifteen Barren Island trees, ten occur in Narcondam: these include all the bird-introduced ones except four, and all but one of the sea-introduced species; one wind-introduced species is common to the two islands.

Among herbaceous species, where the equality of numbers promised most agreement, there is therefore greater diversity between the two floras than among the others.

Of the 75 species of *Phanerogams* peculiar to Narcondam, 22 have been introduced by the sea, 42 by birds, and 10 by winds; one species (*Musa*) has been introduced by man. Of the 25 species peculiar to Barren Island, on the other hand 5 have been introduced by the sea, 15 by birds, 5 by winds. Of the 40 Phanerogams common to the two islands; 24 are sea-introduced, 13 are bird-introduced, 3 wind-introduced. In the common element of the two floras, the sea-introduced species form the dominant class, being nearly double the bird-introduced species and six times as numerous as the wind-introduced ones. In the special elements, on the other hand, the bird-introduced species form in both instances the dominant class; in Narcondam they are nearly twice as numerous as the sea-introduced and four times as numerous as the wind-introduced species; in Barren Island, they are three times as numerous as either of these kinds.

Materials for a Flora of the Malayan Peninsula.—By George King, M. B., LL. D., F.R.S., C.I.E., *Superintendent of the Royal Botanic Garden, Calcutta.*

[Read June 7th].

No. 5.

Order XVI. DIPTEROCARPEÆ.

Resinous trees, rarely climbing shrubs. *Leaves* alternate, simple, quite entire, rarely sinuate-crenate, penni-nerved, the main nerves bold; stipules usually small and inconspicuous, sometimes larger and persistent, or fugitive, leaving an annular scar, (absent in *Ancistrocladus*). *Flowers* in few- or many-flowered, axillary and terminal racemes or panicles. *Bracts* usually minute or 0, rarely larger and persistent. *Sepals* free, or cohering into a tube surrounding but free from, or more or less adnate to, the base of the ovary and fruit. *Petals* contorted, connate at the base, or free. *Stamens* ∞, 15, 10 or 5, hypogynous or sub-perigynous, free, connate, or adnate to the petals; filaments short, often dilated at the base; anthers 2-celled, the outer valves sometimes larger, connective often aristate or with an obtuse appendage. *Ovary* slightly immersed in the torus, usually 3- rarely 2- or 1-celled; style subulate or fleshy, entire or with 3 minute stigmatic lobes; ovules anatropous, 2 in each cell, pendulous or laterally affixed (solitary and erect in *Ancistrocladus*). *Fruit* usually nut-like, its pericarp leathery or woody, 1- rarely 2-seeded, surrounded by the variously accrescent calyx of which two or more sepals or lobes are usually developed into linear wings. *Seed* exalbuminous (albumen fleshy and ruminate in *Ancistrocladus*); cotyledons fleshy, equal or unequal, straight or more or less plaited and crumpled, sometimes lobed; radicle directed towards the hilum, usually included between the cotyledons.—Distrib. Confined (except a few Tropical African species) to Tropical Eastern Asia; genera about 18, species about 250.

Sect. I. Eu-Dipterocarpeæ. *Ovaries* 3-celled, each cell 2-ovuled: stigmas united, more or less 3-lobed: seeds usually exalbuminous the outer segments of the fruiting calyx usually enlarged: trees or erect shrubs, mostly stipulate.

Fruiting calyx with 2 or more of its segments or sepals produced into long membranous, reticulate, nerved wings much longer than the fruit; pericarp leathery, (woody in some sp. of *Shorea*).

Fruiting calyx with a distinct tube.
Calyx-tube quite free from the fruit ... ... 1 *Dipterocarpus.*
Calyx-tube adherent to the fruit 2 *Anisoptera.*
Sepals united at the base only, the short calyx-tube either quite free from the fruit or slightly adherent to it, the calyx-segments or sepals valvate or nearly so.
Stamens with a single, long apical, appendage from the connective 3 *Vatica.*
Stamens with 4 apical appendages from the anthers and 1 from the connective ... 4 *Pentacme.*
Sepals free, imbricate.
The three outer sepals always, and one or both of the inner two occasionally, winged in the fruit; anthers with a short apical appendage from the connective . ... 5 *Shorea.*
The two outer sepals winged in the fruit, the three inner not longer than the fruit and closely embracing it; stamens with a terminal appendage from the connective longer than the anther ... ... 6 *Hopea.*
Sepals of fruiting-calyx all enlarged but not exceeding, or only slightly exceeding, the fruit; pericarp leathery or woody.
Fruiting calyx embracing the fruit but not adherent to it.
Sepals of fruiting calyx slightly thickened.
Sepals of fruiting-calyx oblong, nearly equal, usually shorter than the fruit, reflexed or erect ... 7 *Retinodendron.*
Sepals of fruiting-calyx rotund, unequal (the inner two smaller), reflexed ... 8 *Isoptera.*

Sepals of fruiting calyx much thickened and woody at the base.

Calyx forming a cup at the base of the fruit, but not adhering to it: pericarp woody ... ... 9 *Balanocarpus.*

Calyx adherent to the fruit: pericarp thickly leathery ... ... 10 *Pachynocarpus.*

Sect. II. ANCISTROCLADEÆ. *Ovary* 1-celled with a single ovule; stigmas 3, distinct: *Seeds* with copious ruminate albumen. Exstipulate climbers. ... ... 11 *Ancistrocladus.*

1. DIPTEROCARPUS, Gærtn. f.

Lofty trees, stellately pubescent or more or less clothed with fascicled hairs. *Leaves* coriaceous, entire or sinuate-crenate; lateral nerves connected by marginal loops and transverse reticulations; stipules large, valvate, enclosing the terminal bud, finally caducous and leaving an annular scar. *Flowers* large, white or reddish. *Calyx-tube* free. *Petals* usually pubescent externally, especially on the outer margin. *Stamens* ∞; anthers linear, equivalved, acuminate. *Ovary* 3-celled; style filiform; ovules 2 in each cell. *Fruit* nut-like, 1-seeded, enclosed in the accrescent calyx-tube, free; accrescent calyx-lobes 2, erect. *Seed* adnate to the base of the pericarp; cotyledons large, thick, unequal; radicle inconspicuous.—DISTRIB. Tropical E. Asia; species about 60.

Ripe fruit sphæroidal or ellipsoidal, neither angled nor winged.

Young branches, petioles, under surfaces of the midribs, and nerves of the leaves covered with coarse stiff fasciculate hairs.

Fruit glabrous ... ... 1. *D. crinitus.*

" stellate-pubescent ... ... 2. *D. Scortechinii.*

Young branches deciduously pubescent.

Leaves with 12 or more pairs of nerves.

Leaves oblong-elliptic, their under surfaces sparsely stellate-pubescent ... 3. *D. Skinneri.*

Leaves elliptic or ovate-elliptic, their under surfaces puberulous or quite glabrous ... ... 4 *D. turbinatus.*

Leaves with 8 to 10 pairs of nerves.

All parts quite glabrous ... ... 5. *D. Kerrii.*

Ripe fruit with 5 angular tuberosities on its upper portion ... ... 6. *D. cornutus.*
Ripe fruit 5-angled :
Calyx-tube glabrous; leaves 2·5 to 3·25 in. long ... ... 7. *D. fagineus.*
Calyx-tube densely stellate-tomentose; leaves 6 to 8 in. long ... ... 8. *D. oblongifolius.*
Ripe fruit with its 5 angles produced into wings :
Leaves glabrous :
Young branches at first scurfy-puberulous, ultimately quite glabrous : buds ovoid, minutely pale canescent ... 9. *D. grandiflorus.*
Young branches as in the last, but with conspicuous tawny-tomentose, oblique annuli; buds cylindric, hoary-canescent ... ... 10. *D. Kunstleri.*
Young branches minutely tawny-pubescent, not annulated and never glabrous; buds ovoid, densely sericeous 11. *D. Griffithii.*
Leaves minutely stellate-pubescent on the lower surface :
Flowers about 1 in. long; leaves with rounded or sub-cordate bases; young branches very stout, with ovoid buds : the accrescent lobes of the calyx 1·5 in. broad ... ... 12. *D. incanus.*
Flowers 1·5 in. long; leaves with rounded or cuneate, not sub-cordate, bases: young branches moderately stout with cylindric buds : accrescent calyx-lobes ·7 to ·8 in. broad .... 13. *D. alatus.*

1. Dipterocarpus crinitus, Dyer in Hook. fil. Fl. Br. Ind. I. 296. A tree 90 to 150 feet high : young branches, petioles, under surface of midrib and nerves, pedicels and outer surface of bracts of inflorescence clothed with stiff yellowish-brown fascicled hairs. *Leaves* very coriaceous, ovate or more usually obovate, acute, the base rounded or sub-acute; the edge entire, fringed with fascicled hairs, recurved (at least when dry); both surfaces sparsely hispid when young, glabrescent when old; main nerves 12 to 18 pairs, spreading, rather straight, very prominent on the lower, depressed on the upper, surface; length 3 to 5 in., breadth 1·75 to 2·75 in., petiole 1 to 1·25 in. *Racemes* about 6-flowered. *Flowers* nearly 2 in. long. *Calyx* glaucous, glabrous. *Petals*

puberulous, linear, blunt. *Stamens* 15. *Fruit* (immature) ellipsoid, wingless, glaucous, smooth; the enlarged calyx-lobes linear-oblong, blunt, 3-nerved, inconspicuously reticulate, shining, 3·5 in. long and ·6 to ·8 in. broad. Dyer in Journ. Bot. 1874, p. 103. *D. hirtus*, Vesque, Comptes-Rendus, 1874, 78, p. 627; Journ. Bot. 1874, p. 151; Dyer l. c. 154.

Malacca; Maingay (Kew Distrib.) No. 196.

Perak; Scortechini, No. 1955. DISTRIB. Borneo: (fide Dyer), Beccari, 779, 1883.

Burck (Ann. Jard. Bot. Buitenzorg, Vol. 6, p 196) reduces this to *D. Tamparan*, Korth. Korthals however describes the fruit of that species as having accrescent calyx-lobes 13 inches long by 3 broad.

2. DIPTEROCARPUS SCORTECHINII, King, n. sp. A large tree: young branches rather stout, densely clothed, (as are the short cylindric buds, the petioles and racemes) with large tufts of coarse, brownish, shining hairs. *Leaves* coriaceous, elliptic-ovate, or sometimes elliptic-sub-ovate, sub-entire, abruptly and shortly acuminate, slightly narrowed to the rounded base; upper surface glabrous or glabrescent, the nerves sparsely stellate-pubescent, the midrib tomentose; under surface sparsely stellate-pubescent, the nerves (and especially the midrib) with long silky hairs intermixed: main nerves 16 to 18 pairs, straight, oblique, very prominent beneath: length 6 to 7·5 in., breadth 3 to 3·5 in, petiole 1 to 1·2 in. *Racemes* few-flowered, short. *Fruit* (? immature) ovoid, contracted under the mouth, glaucous, stellate-pubescent, ·75 in. long and ·5 in. in diam; accrescent calyx-lobes linear-oblong, reticulate, slightly narrowed in the lower half, the apex obtuse, obscurely 3-nerved (the middle nerve bold, the two lateral faint), 4 to 5 in. long and ·8 to 1 in. broad.

Perak; Scortechini, No. 1813.

This is closely allied to *D. crinitus*, Dyer, to which Scortechini doubtfully referred it. It differs from *D. crinitus* in its larger leaves and stellate-pubescent fruit. It has also a different time of flowering; for, as Scortechini remarks in his field notes, this is in immature fruit in the beginning of March, while *D. crinitus* does not come into flower until the end of April.

3. DIPTEROCARPUS SKINNERI, King, n. sp. A tall tree; young branches thin, deciduously tawny-pubescent. *Buds* cylindric, narrow, golden-sericeous. *Leaves* oblong-elliptic, narrowed in the upper half or third to the acute or shortly acuminate apex, slightly narrowed to the rounded base, upper surface glabrous or sparsely adpressed-pubescent, the midrib tomentose, the lower sparsely stellate-pubescent, the midrib and 16 to 19 pairs of straight oblique nerves adpressed-sericeous; nerves prominent on the lower, faint on the upper, surface when dry:

length 5 to 8 in., breadth 2·25 to 3 in.; petiole ·7 to ·9 in., tomentose. *Racemes* simple, short, 2- or 3-flowered, pubescent. *Flowers* 2·5 in. long. *Calyx* with narrowly campanulate tube, covered outside with minute, pale, stellate tomentum. *Petals* linear-oblong, blunt, more or less pubescent outside. *Fruit* (? immature) globular-ovoid, glabrous, ·65 in. in diam.: accrescent calyx-lobes glabrous, reticulate, linear, blunt, contracted at the very base, nearly 5 in. long and about ·75 in. broad.

Penang; at the back of West Hill, at an elevation of 1,000 feet. Curtis No. 1403.

A very distinct species known only by Mr. Curtis' scanty specimens. I have named it in honour of Mr. Skinner, Resident Councellor of Penang.

4. Dipterocarpus turbinatus, Gaertn. f. Fruct. III. 51, t. 188. A tree 80 to 100 feet high: young shoots rather slender, at first minutely velvety, pale grey, afterwards glabrous: buds cylindric, softly pale pubescent *Leaves* thinly coriaceous, elliptic or ovate-elliptic, acute or shortly acuminate, the base rounded or sub-cordate, the edges slightly undulate, sometimes sub-crenate; both surfaces glabrous, or the lower puberulous especially on the midrib and nerves: main nerves 12 to 18 pairs, straight, oblique, prominent on the lower surface; length 4·5 to 11 in., breadth 2·5 to 5·25 in.; petiole 1 to 1·5 in., glabrous or pubescent: stipules tawny-velvety in the lower part but pubescent towards the apex. *Racemes* 3- to 5-flowered. *Flowers* 1·25 to 1·5 in. long. *Calyx*-tube obconic, glabrous, smooth, not winged. *Petals* linear-oblong, obtuse, more or less canescent. *Fruit* ellipsoid-ovoid, tapering to each end when young: globular when ripe and ·75 in. in diam., with neither wings nor ridges; the two accrescent calyx-lobes glabrous, conspicuously reticulate, obscurely 3-nerved, oblong-lanceolate, obtuse, 4 to 4·5 in. long and 1·25 in. broad; the three small lobes of the calyx deltoid, very short. Roxb. Hort. Beng. 42; Fl. Ind. II. 612; Corom. Plants III. 10 t. 213. Ham. in Mem. Wern. Soc. VI. 300: Wall Cat. 952; A. DC. Prod. XVI. 2, 607; W. and Arn. Prod. 85; Dyer in Hook. fil. Fl. Br. Ind. I, 295: Journ. Bot. 1874, p. 102 t. 143, fig. 13: Kurz. For. Fl. Burm. I. 114. *D. laevis*, Ham. l. c. 299.; A. DC. l. c. 607. W. and A. Prod. 85: Kurz, l. c. 114. ?*D. indicus*, Bedd. Forest. Rep. 1864-5, ·17 cum tab.; Flora Sylvat. t. 94.

Assam, Cachar, Chittagong, Burmah, S. India.

Var. *andamanica*: enlarged calyx-lobes linear-oblong, not oblanceolate, ·75 in. broad; leaves broadly ovate, sub-cuneate at the base.

South Andaman: common.

Following Dyer, I have included under this the plant named *D. laevis* by Buchanan Hamilton in the Memoirs of the Wernerian Society, Vol. VI. p. 299. Hamilton distinguishes his species *D. laevis* by its flattened branchlets, and perfectly glabrous leaves and petioles, while *D. tuberculatus* Gaertn. has terete branches and pubescent leaves and petioles. The former (called *Dulia Garjan*, by the natives of Chittagong) yields, he says, no wood-oil; while the latter (called *Telia Garjan*) does. The materials before me do not enable me to differentiate the two as species. Moreover, specimens sent to me by Dr. E. Thurston, Reporter on Economic Products to the Government of India, (and which had been collected by the Forest Officer of Chittagong under the vernacular names *Dulia* and *Telia Garjan*) appear exactly alike. Careful investigation in the field may however prove that there is some better basis for Hamilton's view than the trifling differences which he has noted in the outline of the branchlets and the pubescence of the leaves. I am not at all satisfied that the Southern Indian tree named *D. indicus* by Beddome is rightly reduced here. Better Herbarium specimens than any which I have seen, and investigation in the field, are I think required to settle this point also.

5. Dipterocarpus Kerrii, King, n. sp. A tall tree; all parts, except the petals, glabrous; young branches thin, slightly flattened at the tips, not annular. *Buds* narrow, cylindric. *Leaves* coriaceous, ovate-elliptic, acute or very shortly and bluntly acuminate, the edges undulate, the base cuneate; main nerves 8 to 11 pairs, oblique, straight, bold and shining on the lower surface; length 3 to 4 in., breadth 2 to 2·5 in., petiole ·9 to 1·1 in. *Panicles* short, spreading, few-flowered. *Flowers* 1·5 in. long. *Calyx-tube* glaucous. *Petals* linear-oblong, obtuse, more or less pubescent or tomentose towards their middle externally. *Fruit* turbinate, smooth, 1 to 1·15 in. in diam.; accrescent calyx-lobes linear-oblong, blunt, reticulate, 3-nerved, 4·5 to 5 in. long, and 1·25 to 1·5 in. broad: minor lobes very short, broad, rounded.

Malacca; Maingay (Kew Distrib.) No. 199, Griffith 727, Derry 1032. Pangkore; on Gunong Yunggal, Curtis No. 1561.

Mr. Curtis describes this as a very large tree yielding an oil. It resembles *D. Hasseltii*, Bl., but has much smaller leaves.

I have named this species in honour of Dr. Kerr, an enthusiastic Botanist much interested in the Malayan Flora. Closely allied to this, and perhaps identical with it, is the tree represented by Mr. Curtis' specimen (Waterfall, Penang) No. 1653. The young wood of the latter is however paler than that of *D. Kerrii* from Pangkore and Malacca, and the leaves are puberulous, not glabrous, beneath. I have seen no flowers of it.

6. Dipterocarpus cornutus, Dyer in Hook. fil. Fl. Br. Ind. I, 296. A tree 50 to 70 feet high: young branches stout, compressed, minutely

rufous-tomentose with a few scattered longer hairs. *Leaves* large, coriaceous, oblong, blunt at each end, the edges undulate or obscurely sinuate-crenate: upper surface glabrous, the midrib and nerves pale when dry: under surface densely covered with minute, pale, stellate tomentum: main nerves 16 to 20 pairs, prominent, spreading, straight, the transverse veins rather distinct: length 9 to 14 in., breadth 5 to 8 in., petiole 2 to 3 in.; stipules rufous-sericeous, the hairs fascicled. *Racemes* 7- or 8-flowered. *Flowers* 1·75 in long. *Calyx-tube* 5-winged, canescent, the short lobes very obtuse. *Petals* oblong or sub-spathulate, stellate-canescent. *Fruit* about 1 in. long, sub-globular, with 5 thick short wings in its upper half; enlarged calyx-lobes linear, obtuse, 5 or 6 in. long and 1·25 to 1·75 in. broad, shining, boldly 3-nerved, reticulate. Dyer in Journ. Bot. 1874, p. 103, t. 143. fig. 15. *Parinarium dillenifolium*, R. Br. Wall. Cat. No. 7520. *Petrocarya dillenifolia*, Steud. Nomencl. II, 309.

Singapore: Wallich. Malacca: Maingay (Kew Distrib.) No. 197. Penang: Curtis No. 1402. Perak: Wray, No. 4160.

It was Sir Joseph Hooker who first pointed out that the Wallichian plant No. 7520, issued as *Parinarium*, belongs really to this species.

7. Dipterocarpus fagineus, Vesque in Comptes-Rendus, tome 78, p. 626: Journ. Bot. for 1874, p. 149. A tree 40 to 80 feet high: young branches slender, at first minutely pulverulent tawny-pubescent, ultimately glabresent or glabrous and dark-coloured, the buds cylindric. *Leaves* coriaceous, elliptic-ovate to elliptic-lanceolate, acute, the edges entire or sub-undulate-crenulate, the base cuneate, both surfaces puberulous especially on the midrib and nerves; main nerves 10 to 13 pairs, straight, oblique, prominent on the sub-glaucous lower surface; length 2·5 to 3·25 in., breadth 1·3 to 1·75. *Racemes* slender, 1- to 4-flowered. *Flowers* about 1·25 in. long. *Calyx-tube* campanulate, not constricted at the mouth, 5-angled. *Ripe fruit* ellipsoid, tapering more at the base than at the apex, 5-angled, glaucous, 1 in. long: accrescent calyx-lobes linear-oblong, obtuse, contracted at the base, 3-nerved, 2·5 to 3 in. long and about ·75 in. broad. *D. prismaticus*, Dyer Journ. Bot. 1874. pp. 104, 152. t. 144 fig. 17. *Dipterocarpus*, sp. Hook. fil. in Linn. Trans. XXIII, 161.

Perak: King's Collector No. 3527, Scortechini. Penang; Curtis No. 1401.

D. fagineus, Vesque, has been collected hitherto only in Borneo (Beccari No. 3008 and Motley No. 143,) and the leaves are described by Dyer as being papyraceous in texture and having about 8 pairs of lateral nerves. The leaves of the Perak tree which I now refer to this species, are coriaceous and have 10 to 13 pairs of nerves. The Perak plant may therefore belong to a distinct, but closely allied, species. Curtis' Penang specimens (No. 1401) are quite glabrous in all parts except the petals.

8. DIPTEROCARPUS OBLONGIFOLIUS, Blume, Mus. Bot. Lugd. Bat. II, 36. A tall tree: young branches glabrous, dark-coloured, sparsely lenticellate; buds cylindric. *Leaves* coriaceous, oblong or elliptic-oblong, shortly and bluntly acuminate, the edges sub-undulate, the base cuneate; both surfaces shining, glabrous, the midrib and 13 to 16 pairs of straight bold nerves with a few stellate hairs along their sides: length 6 to 8 in., breadth 2 to 2·75 in., petiole ·9 to 1·1 in. *Racemes* slightly supra-axillary, densely tawny-tomentose, bifurcating, each branch with 3 to 5 flowers and several linear membranous deciduous bracts. *Flowers* about 2·5 in. long. *Calyx-tube* fusiform, slightly contracted at the mouth, 1 in. long, boldly 5-angled, densely stellate tawny-tomentose as are the 3 minor calyx lobes; the 2 larger linear-oblanceolate lobes sparsely stellate-pubescent, boldly 1-nerved and with 2 obscure lateral nerves. *Ripe fruit* unknown. Miq., Fl. Ind. Bat. I. pt. 2, p. 498; A.DC. Prod. XXI. 2, 614; Dyer in Journ. Bot. 1874, 105. *D. stenopterus*, Vesque, Comptes-Rendus, tome 78, p. 625; Journ. Bot. 1874, p. 150.

Perak, Scortechini. DISTRIB. Borneo, Sumatra.

Except as regards inflorescence, the Perak specimens of this are practically glabrous. In Bornean specimens, however, the young parts, buds and petioles are fusco-tomentose. (Dyer l. c.)

9. DIPTEROCARPUS GRANDIFLORUS, Blanco, Fl. Filipp. Ed. 2, 314. A tree 80 to 120 feet high: young branches rather stout, sub-compressed, at first hoary-puberulous, but finally quite glabrous, nearly black when dry; leaf-buds shortly ovoid, minutely pale-canescent. *Leaves* coriaceous, ovate-elliptic, shortly acuminate; the base broad, rounded or sub-truncate, sub-cordate; the edges entire or obscurely undulate-crenate, both surfaces glabrous; main nerves 14 to 16 pairs, spreading, rather straight, prominent on the lower, obsolete on the upper, surface; length 6 to 9 in., breadth 3·5 to 5 in.; petiole 2 to 3 in. long, glabrous. *Racemes* about 4-flowered. *Flowers* articulated to the rachis, 2 in. long. *Calyx-tube* 5-winged from base to apex. *Petals* linear-oblong. *Fruit* oblong, 2·5 in. long, wings stout, ·5 in. or more in width; the 2 accrescent lobes of the calyx oblong, obtuse, glabrous, reticulate, 3-nerved, the mesial nerve the longest and most distinct, 7 to 9 in. long and 1·5 to 2 in. broad, the smaller calyx lobes sub-orbicular. A.DC. Prod. XVI., 2 p. 612; Dyer in Journ. Bot. 1874, p. 106, t. 145, fig 19; Burck in Ann. du Jard. Bot. Buitenzorg, vol 6, 201. *D. Blancoi*, Bl., Mus. Lugd. Bat. II.

35. *D. Motleyanus*, Hook. fil. in Trans. Linn. Soc. XXIII. 159. A.DC. in DC. Prod. XVI., pt. 2, 611. *D. pterygocalyx*, Scheff. Obs. Phyt. II. 35; Dyer in Hook. fil. Fl. Br. Ind. I, 298. *Mocanera grandiflora*, Blanco, Fl. Filipp. Ed. I, 451. *Anisoptera?* Turcz. in Bull. Soc. Nat. Mosc. 1858, I, 233.

Malacca: Maingay (Kew Distrib.) No. 198. Penang: Curtis 424. Perak: Scortechini 152 b. DISTRIB. Bangka, Teysmann. (?) Philippines.

The late Father Scortechini's field notes contain the following account of the flower: "The petals of this are red inside in the middle, but pale towards the margins; the stamens are numerous, 2-seriate, united in a ring by their enlarged bases, falling off together: staminodes many, short, adpressed to the ovary. Ovary pubescent, scaly towards the base. Fruiting-calyx reddish." The species comes near *D. Griffithii*: but is distinguished from it by the characters which I have noted under that species. Flowers of *D. Griffithii* are, however, wanting for comparison.

10. DIPTEROCARPUS KUNSTLERI, King, n. sp. A tree 80 to 120 feet high; young branches flattened, at first sparsely covered with minute scurfy deciduous pubescence, ultimately glabrous, but always with oblique tawny-tomentose annuli. *Buds* narrowly cylindric, hoary-canescent. *Leaves* elliptic or sub-rotund-elliptic, very shortly acuminate, the base rounded or sub-cuneate, the edges undulate or sub-crenate, both surfaces glabrous: main nerves 16 to 18 pairs, oblique, straight, prominent on the lower surface: length 7·5 to 11 in., breadth 4·5 to 7 in., petiole 1·5 to 2 in. *Racemes* 6 to 8 in. long, often bifid, 4- to 6-flowered, glabrous. *Flowers* 2·5 to 3 in. long, glaucous. *Calyx-tube* narrowly obconic, 5-winged, glaucous. *Petals* linear, obtuse, glaucous. *Fruit* sub-globular, an inch or more long, with 5 wings about 25 in. wide: accrescent calyx-lobes oblong, obtuse, slightly narrowed towards the base, glabrous, reticulate, 3-nerved, 6 or 7 in. long and about 1·25 in. broad.

Perak: King's Collector, Nos. 3638, 3798, 7508 and 7606.

Allied to *D. grandiflorus;* but with larger leaves, smaller fruit and different buds. Allied also to *D. Griffithii* but with smaller fruit and different buds. This species has leaves like *D. trinervis* Bl. and *D. retusus* Bl., but differs from these in having winged fruit: it also resembles *D. Dyeri*, Pierre, which, however, has longer leaves with hairy petioles and more narrowly winged fruit.

11. DIPTEROCARPUS GRIFFITHII, Miq. Ann. Mus. Lugd. Bat. I, 213. A tree 100 to 125 feet high: young branches stout, sub-compressed, minutely tawny-canescent; the leaf buds ovoid, densely covered with

yellowish-brown shining hair. *Leaves* coriaceous, broadly ovate, usually slightly narrowed to the rounded base, but sometimes the base truncately sub-cordate, the apex acute or shortly acuminate, both surfaces glabrous, the upper shining; main nerves 12 to 14 pairs, spreading, straight, slightly prominent on the lower surface: length 5 to 11 in., breadth 3 to 5·5 in., petiole 2·25 to 3·5 in. *Racemes* 3- or 4-flowered. *Flowers* 1·5 in. long. *Calyx* ob-conic, sub-glabrous, 5-winged. *Fruit* oblong, 2·5 in. long, the wings extending from base to apex, stout, ·5 in. or more broad: accrescent lobes of calyx oblong, obtuse, glabrous, reticulate, boldly 3-nerved, 5 to 7 in. long and about 1·75 in. broad. A. DC. in DC. Prod. XVI, Pt. 2, 611; Dyer in Hook. fil. Fl. Br. Ind. I, 299: Journ. Bot. 1874, 107. Kurz For. Flora Burm. I, 116. *D. grandiflorus* Griff. Notul. IV, 515 (not of Blanco).

S. Andaman: Kurz, King's Collector.

This closely resembles *D. grandiflorus*, Blanco, but the two may be readily distinguished by their young branches and leaf-buds. The young branches of this species are pale canescent and its leaf-buds broad and golden sericeous; while the branchlets of *D. grandiflorus* are quite glabrous and dark-coloured and the buds are narrow and pale canescent.

12. Dipterocarpus incanus, Roxb. Hort. Beng. 42; Fl. Ind. II. 614. A tall tree: young shoots terete, stout, densely but minutely tawny-tomentose; the buds short, ovoid, thick, with longer tomentum than the branchlets. *Leaves* coriaceous, broadly ovate, acute or sub-acute, the base rounded or sub-cordate, the edges undulate; upper surface glabrous, the midrib alone slightly pubescent: under surface uniformly pale, shortly but softly stellate-pubescent, the midrib and nerves tomentose. main nerves 12 to 15 pairs, oblique, straight, prominent on the lower surface; length 5 to 8 in., breadth 2·5 to 4·75 in.; petiole ·8 to 1·25 in., pubescent. *Flowers* about 1 in. long, usually in racemes but occasionally in short 7- or 8-flowered panicles. *Calyx-tube* ob-conic, 5-winged, minutely tomentose. *Petals* oblong, obtuse. *Fruit* sub-globose, about 1 in. in diam., 5-winged from base to apex; the wings thin, from ·25 to ·5 in. broad; the 2 accrescent lobes of the calyx narrowly oblong, obtuse, glabrous, much reticulate, 3-nerved in the lower half, when mature 5·5 in. long and nearly 1·5 in. broad; the 3 minor lobes sub-orbicular. Wight & Arn. Prod. 84; A. DC. Prod. XVI. 2, 611; Dyer in Hook. fil. Fl. Br. Ind. I, 298; Journ. Bot. 1874, p. 106.

S. Andaman: common. Distrib. Burmah, Kurz, Herb. No. 2109 (in part).

The plant here described under the name *D. incanus* closely resembles *D. alatus*, Roxb.; but its flowers are shorter, the leaves are more broadly ovate, and have rounded or cordate, not cuneate, bases, while the pubescence of the lower surface is paler and more uniform and the young branchlets and leaf-buds are stouter. Moreover the accrescent lobes of the calyx are longer and nearly twice as broad: the 5 wings of the calyx-tube are also broader. Roxburgh's description of his species *D. incanus* is very brief; he left no drawing of it at Calcutta; and no authentic specimens of his own naming appear to exist. It is therefore impossible to decide with absolute certainty what Roxburgh's *D. incanus* is. At Kew Mr. Dyer accepts Kurz's Pegu specimen No. 2109 as belonging to it, and the specimens recently brought from the S. Andaman by my collectors agree with that number of Kurz's.

13. Dipterocarpus alatus, Roxb. Hort. Beng. 42; Fl. Ind. II 614. A tree 80 to 125 feet high: young branches terete, rather stout, softly and minutely pubescent; the buds narrow, rufous-sericeous. *Leaves* coriaceous, ovate-elliptic, the apex acute, the base cuneate, the edges undulate: upper surface glabrous except the minutely tomentose nerves and midrib: lower sparsely and minutely stellate-pubescent, the 10 to 14 pairs of oblique rather straight prominent main nerves densely tomentose; length 5 to 8 in., breadth 2·75 to 4·5 in.; petiole 1 to 1·5 in, pubescent: stipules sericeous-pubescent. *Panicles* 6- or 7-flowered. *Flowers* about 1·5 in. long. *Calyx-tube* ob-conic, 5-winged, stellate-pubescent, as are the linear-oblong petals. *Fruit* globose, 1 in. in diam., puberulous, 5-winged from base to apex; the wings glabrous, thin and about ·5 in broad; the 2 accrescent lobes of the calyx linear-oblong, obtuse, glabrous, much reticulate, 3-nerved in the lower half, 4·5 in. long and ·7 or ·8 in. broad: the 3 unenlarged lobes obtuse. Wall. Cat. 953: A. DC. Prod. XVI. 2, 611 *in part*: Dyer in Hook. fil. Fl. Br. Ind. I, 298; Journ. Bot, 1874, p. 106 (excl. syn. *D. costatus*, Gaertn.) Kurz For. Flora Burm. I. 116; Pierre Flore Forest. Coch-Chine, t. 212. *Oleoxylon balsamiferum* Wall. Cat. p. 157.

Burmah: Wallich, Brandis, Helfer No. 730, Kurz. Andamans ?

Gærtner's figure and description of his *D. costatus* are confined to the fruit only. The former is that of a *Dipterocarpus* with the elongated calyx-lobes of *D. alatus*, Roxb., but with the 5 wings on the tube of the calyx very narrow, whereas those of Roxburgh's *D. alatus* are very broad. Dyer (F. B. I. i, 298) expresses his belief that Gaertner's figure is a bad representation of *D. alatus*, Roxb., and he reduces Gaertner's *D. costatus* to Roxburgh's *D. alatus*. M. De Candolle, on the other hand, retains *D. costatus*, Gaertn. as a good species and in this he is followed by Kurz; but Messrs. Dyer and De Candolle agree that the *D. costatus* described by Roxburgh is a different plant from Gaertner's. For Mr. Dyer it is still a doubtful species; while M. De Candolle reduces it to *D. angustifolius* W. & A., which for Dyer is in its turn a doubtful species. A careful examination of the material now collected at Calcutta and at Kew leads me to believe that *D. costatus*, Gaertn., is a perfectly good species, and that the best character to distinguish it from Roxburgh's *D. alatus* is the narrowness of the wings of the calyx-tube. Specimens collected in Burmah by Kurz (No. 113 of his Herbm.) and by Brandis, have fruits exactly like that figured by Gaertner. Moreover I see no reason for thinking that the tree described by Roxburgh (Fl. Ind. II; 614) as *D. costatus*, Gaertn., is anything else than Gaertner's plant. Mr. Dyer (Journ. Bot. 1874, p. 153) expresses the opinion that *D. Lemeslei*, Vesque—a species collected on the island of Pulo Condor off the Cambodian coast—is reducible to *D. alatus*, Roxb.

It is very doubtful whether *D. alatus*, Roxb., occurs in the Andamans. I have seen no specimens of it from these islands, and I give it as an Andaman plant on the authority of the "Flora of British India."

Besides the preceding, there are various other species of *Dipterocarpus* in the Calcutta Herbarium from localities within the British Malayan region which, for want of sufficient materials, I am unable to describe. Chief amongst these are :—

(1) Curtis No. 1560 from Penang, a species with winged calyx-tube.

(2) A species from Perak, represented in Scortechini's collection (without number) by fruits resembling those of *D. Lowii* H., f., *D. intricatus*, Dyer, and *D. lamellatus*, Hook. fil.

(3) A species from the Andamans with leaves resembling those of *D. Griffithii*, Miq., but with globular fruit which has neither angles nor wings on the calyx-tube. This possibly may be a form of *D. pilosus*, Roxb.

(4) A Perak species (Herb. Scortechini mixed with No. 1478) represented by fruits something like those of *D. fagineus*, Vesque, but with the calyx-tube winged, not angled.

(5) A Perak species represented by leaf-twigs and loose fruit of a species resembling both *D. fagineus*, Vesque, and *D. gracilis*, Bl., but differing from both.

(6) A species from Perak (Wray No. 4031) having leaves like *D. Griffithii*, Miq., but with shorter petioles, and having also fruit rather like *D. Griffithii*, but the calyx-tube with narrower wings, and the minor calyx-lobes smaller.

2. Anisoptera, Korth.

Resinous trees. *Leaves* coriaceous, entire, feather-veined and finely reticulate; stipules small, fugacious or inconspicuous. *Flowers* in lax terminal panicles *Calyx-tube* very short, adnate to the base of the ovary; the segments imbricate, then subvalvate. *Stamens* ∞; anthers ovoid with a long subulate connective, outer valves larger. *Ovary* 3- (rarely 4- 5-) celled; style fleshy, ovoid or oblong, with an attenuate 3–5-fid apex; ovules 2 in each cell. *Fruit* adnate to the calyx-tube, indehiscent, 1-seeded, crowned by the accrescent calyx-segments, of which 2 form linear-oblong lobes. *Cotyledons* fleshy, unequal; radicle superior. —Distrib. Malay Peninsula and Archipelago to New Guinea. Species about 6.

1. Anisoptera Curtisii, Dyer MSS. A tree 80 to 120 feet high: young branches slender, minutely scurfy-tomentose. *Leaves* oblong, tapering to both ends, the apex sub-acute or acute, the base narrowed but rounded; the upper surface glabrous, shining, the lower densely ochraceous-lepidote and sparsely stellate-pubescent; main nerves 18 to 20 pairs, spreading: length 2 to 3·5 in., breadth ·75 to 1 25 in., petiole ·5 to ·75 in. Accrescent calyx-lobes 3·5 to 4·5 in. long, linear-spathulate, shining, 3-nerved: the transverse veins bold and numerous.

Penang: Curtis. Perak: King's Collectors.

Var. latifolia: leaves broadly elliptic, blunt, the bases rounded but narrowed.

Penang: Curtis, No. 1400.

The vernacular name of this in Penang is *Ringkong.*

3. Vatica, Linn.

Large or moderately sized resinous trees. *Leaves* coriaceous, entire, feather-veined and finely reticulate; stipules small, fugacious or inconspicuous. *Flowers* in axillary and terminal panicles, usually tomentose before expansion. *Calyx-tube* short, free, or adnate to the base of the ovary; segments somewhat acute, imbricate, then sub-valvate. *Stamens* 15; anthers oblong, external valves larger, connective apiculate. *Ovary* 3-celled; style short, subulate, or apex clavate or capitate; stigma entire or 3-toothed; ovules 2 in each cell. *Fruit* leathery, indehiscent, 1-seeded, surrounded by and sometimes partly adnate to the accrescent, membranous, nerved and reticulate calyx-lobes, two of which expand into narrow wings 2 or 3 in. long, the other three being much smaller. *Cotyledons* fleshy.

Distrib. Tropical Asia and chiefly Malaya; species about 10.

Synaptea is a genus established by Griffith (Notulæ IV., 516, Tab. 585 A, fig V.) for a tree collected at Mergui, and named by him *Synap-*

tea odorata. This plant has been named *Synaptea grandiflora* by Kurz, (Journ. A.S., Beng., 1870, 2, 65), and *Anisoptera odorata* Kurz, (For. Flor. Burm. I, 112), while Dyer has identified it with *Hopea grandiflora*, Wall, Cat. 958, and reduced it to *Vatica grandiflora* (F.B.I., i., 301).

The characters of the genus *Synaptea*, as given by its author, are practically those of *Vatica*, Linnæus (Mantissa II., p. 152-3, No. 1311), except that, whereas in the Linnæan description nothing is said about the fruit or its relation to the calyx, Griffith distinctly explains that he has given the name *Synaptea* because the ovary is adnate to the calyx. He does not say to what extent adnate, but, in fruiting specimens of his *Synaptea odorata*, the adhesion extends to the lower part only. In the "Mantissa" of Linnæus, only one species of *Vatica* is described, *viz.*, *V. chinensis;* and of the specimen thus named in the Linnæan Herbarium, Sir J. G. Smith publishes a figure (Smith Ic., ined., t. 36.). This figure however does not show clearly whether the base of the ovary is, or is not, adherent to the calyx, and the fruit is not figured at all. A reference to Linnæus' specimen ought to settle what *V. chinensis* really is; but unfortunately it has not settled it. I have not myself examined the actual Linnæan specimen; but the opinions of botanists who have examined it vary as to its identity. The plant is generally admitted not to be of Chinese origin, for no Dipterocarp is known to inhabit China. Wight and Arnot are of opinion (Prod. 84) that *Vatica chinensis* is the same as *Vatica laccifera*, W. A. (*Shorea Talura*, Roxb.—*fide* Dyer). Alph. De Candolle (Prod. XVI., 2, p. 619) keeps up the species *V. chinensis*, while Dyer (Fl. Br. Ind., I, 302) reduces it to *Vatica Roxburghiana*, Blume (Mus. Bot. Lugd. Bat. II, 31. t. 7.), Blume's *Vatica Roxburghiana*, being, as the citations and figure given by that author show, the *Vateria Roxburghiana* of Wight's Illustrations, p. 87, and Icones t. 26. It cannot be demonstrated, therefore, either from Linnæus' description or specimen, or from Smith's figure of the latter, whether Linnæus intended his genus *Vatica* to include only plants with the ovary and fruit free from the calyx, or whether plants in which there is such partial adhesion might not also be admitted. If the latter were the case there would be no occasion to keep up the genus *Synaptea*. This is the view adopted by Messrs. Hooker and Bentham, who remark of *Synaptea*, "*ex descriptione auctoris verisimiliter ad Vaticam referenda est.*" This view is also adopted by Dyer, in "Hooker's Flora of British India," where he reduces *Synaptea odorata*, Griff., to the genus *Vatica*, Section *Eu-Vatica*. This view is also to a certain extent adopted by Burck who (Ann. Jard. Bot. Buitenzorg) makes *Synaptea* a section of *Vatica*, characterised by having the lobes of the fruiting calyx unequally accrescent, two of them being much elongate, and *the fruit being partly inferior*; while the section *Eu-Vatica*, as proposed by Bentham and Hooker originally, and adopted by Burck, is characterised by having the same fruiting calyx as *Synaptea*; nothing being said about the adhesion between the calyx and the fruit. Pierre, on the other hand, keeps up *Synaptea* as a genus on account of the presence of albumen and the structure of the embryo (characters not easily worked in herbarium specimens of this family). In my own opinion it appears advisable to admit *Synaptea* as a section of *Vatica*, but to exclude *Isauxis*, *Retinodendron*, and *Pachynocarpus*, retaining these as distinct genera. *Vatica* would, according to this scheme, be divided into two sections:—

I. *Eu-Vatica*:—Fruit free from the accrescent calyx, *i.e.*, fruit superior.

II. *Synaptea*:—Fruit adnate in its lower part to the accrescent calyx, *i e.*, fruit half inferior.

Sect. I. Eu-Vatica.—Fruit quite free from the calyx.	
Inflorescence and ripe fruit pale tomentose; flowers ·4 in. long	1. *V. perakensis.*
Inflorescence and ripe fruit rusty-tomentose.	
Flowers ·25 in. long; nerves of leaves 13 to 15 pairs; petioles ·3 to ·4 in. long ...	2. *V. Lowii.*
Flowers ·45 in. long; nerves of leaves 9 to 12 pairs; petioles ·6 to 1·5 in. long...	3. *V. Maingayi.*
Sect. II. Synaptea—Calyx-wings adherent to the ripe fruit for nearly half its length.	
Leaves 9 to 10 in. long and with 18 to 20 pairs of nerves	4. *V. nitida.*
Leaves 2·5 to 7 in. long, with 6 to 13 pairs of nerves.	
Larger lobes of calyx of fruit obovate and very blunt.	
Leaves with 6 to 8 pairs of faint nerves	5. *V. cinerea.*
Leaves with 11 to 13 pairs of bold nerves	6. *V. Curtisii.*
Larger lobes of calyx narrowly oblong.	
Leaves oblong or elliptic-oblong, with 9 to 11 pairs of nerves; petals narrowly oblong ...	7. *V. faginea.*
Leaves broadly elliptic, with 11 to 13 pairs of nerves; petals broadly elliptic	8. *V. Dyeri.*

Leaves 2·5 to 3·5 in. long, with about 7 or 8 pairs of faint, main nerves, minutely reticulate. 9. *V. reticulata.*

1. VATICA PERAKENSIS, King, n. sp A tree 60 to 80 feet high; young branches slender, deciduously scurfily stellate-pubescent, the bark rather pale. *Leaves* thinly coriaceous, oblong-lanceolate, rarely oblanceolate, more or less bluntly acuminate, sometimes caudate, the base cuneate; both surfaces glabrous, the midrib on the upper puberulous; main nerves 10 to 12 pairs, rather prominent beneath; length 2·5 to 4 in., breadth ·8 to 1·3 in., petiole ·4 to ·5 in. *Panicles* axillary and extra-axillary, crowded near the ends of the branches, 1 to 2 in. long, minutely pale tomentose, as are the ovate-lanceolate calyx-lobes. *Flowers* ·4 in. long. *Petals* narrowly oblong, obtuse, glabrous. *Stamens* slightly apiculate. *Ovary* minutely tomentose; stigma conical. *Ripe fruit* ·3 in. in diam., globose, the style persistent, minutely tomentose, quite free from the calyx; the two accrescent calyx-lobes oblong-ob-lanceolate, obtuse, obscurely 5-nerved, 2·5 in. long and ·5 in. broad; minor lobes unequal, lanceolate-acuminate, the largest about ·85 in long.

Perak: King's Collector, Wray; a common tree. Pangkore: Curtis.

The nearest ally of this is *Vatica Bantamensis*, Benth. and Hook.; but that has rather larger and more coriaceous leaves, which are perfectly glabrous; larger flowers with petals scaly externally and a more scurfy inflorescence; moreover the whole of the accrescent calyx-lobes of its fruit are more coriaceous and the minor lobes are blunter.

2. VATICA LOWII, King, n. sp. A tree 60 to 80 feet high: young branches, petioles, inflorescence and calyx densely rusty, scurfy-tomentose with stellate hair intermixed, the branches ultimately glabrous and with dark bark. *Leaves* coriaceous, oblong, sub-acute, the base rounded; both surfaces glabrous, the midrib puberulous on the upper; main nerves 13 to 15 pairs, spreading, slightly prominent beneath; length 2·5 to 3·5 in., breadth 1 to 1·5 in., petiole ·3 to ·4 in. *Panicles* axillary and terminal, much crowded towards the ends of the branches; ·75 to 1·5 in. long. *Flowers* ·25 in. long. *Calyx-lobes* lanceolate, acuminate, oblique. *Petals* narrowly oblong, obtuse, almost glabrous. *Stamens* short, unequal-sided, apiculate. *Ovary* depressed, tomentose, style capitate. *Ripe fruit* globular, ·25 in. in diam, deciduously rufous-scurfy; the style persistent, quite free from the calyx. Two large calyx-wings narrowly oblong, sub-acute, scarcely narrowed at the base, 5-nerved, 2·75 to 3 in. long, and ·6 in. broad; the three smaller lobes sub-equal, about ·5 or ·6 in. long, lanceolate, obtuse.

Perak: Scortechini, No. 2108; King's Collector, No. 7496.

This species is closely allied to *V. Maingayi*, Dyer; but has smaller flowers, and rather larger leaves with considerably longer petioles.

3. VATICA MAINGAYI, Dyer, in Hook. fil., Fl., Br., Ind. I, 302. A tall tree: young branches slender, ultimately glabrous, but at first rusty furfuraceous-tomentose, as are the inflorescence, calyx and ripe fruit. *Leaves* coriaceous, oblong or obovate-oblong, shortly acuminate, the base rounded, glabrous on both surfaces; main nerves 9 to 12 pairs, slender, curving, spreading; length 3 to 4·5 in., breadth 1 to 1·75 in., petiole ·6 to 1·5 in. *Panicles* short, few-flowered. *Flowers* ·45 in. long. *Calyx-segments* oblong-lanceolate. *Ovary* depressed, rufous-tomentose. *Ripe fruit* globose, ·25 in. in diam., the style persistent, rufous-tomentose; free from the calyx; the two large wings linear-oblong, sub-acute, not contracted at the base, 5-nerved (the lateral nerves faint) 2 in. long and ·35 to ·5 in. broad; the 3 smaller lobes ovate, sub-acuminate, ·75 in. long, all glabrous.

Malacca: Maingay (Kew Distrib.) No. 209.

Of this I have seen only Maingay's specimens, which are not good.

4. VATICA NITENS, King, n. sp. A tree 40 to 50 feet high: young branches and petioles densely covered with coarse deciduous scaly stellate tomentum, ultimately cinereous. *Leaves* coriaceous, narrowly oblong, acuminate, slightly narrowed to the rounded base; both surfaces, but especially the upper, shining, glabrous, the base on the lower sparsely scaly-tomentose when young, finely reticulate; main nerves 18 to 20 pairs, spreading, prominent on the lower surface: length 9 to 10 in., breadth 2 in.; petiole ·5 in., stout. *Ripe fruit* globular, crowned by the persistent style, reticulate, ·5 in. in diam., adnate for half its length to the calyx; the two large wings of the calyx oblong, slightly ob-lanceolate, obtuse, 3 in. long and ·8 to ·9 in. broad, the 3 shorter wings ovate-acuminate, ·8 in. long; all boldly 5-nerved and shining.

Penang: Curtis, No. 1404.

This fine species is known only by Mr. Curtis' imperfect specimens. It is very distinct, being at once recognisable amongst the Indian species of *Vatica* by the size of its leaves and calyx-wings.

5. VATICA CINEREA, King, n. sp. A tree about 40 feet high: young branches rufescent-puberulous at the very tips, otherwise glabrous and cinereous. *Leaves* thinly coriaceous, ovate-oblong to ovate-lanceolate, sub-acute, the base rounded or sub-cuneate; both surfaces glabrous, finely reticulate when dry; main nerves 6 to 8 pairs, spreading, faint; length 2·25 to 3·5 in., breadth ·75 to 1·5 in., petiole ·3 to ·5 in. *Panicles* mostly axillary, spreading, rusty scurfy-tomentose, 1·25 to 2 in. long. *Flowers* ·45 in. long. *Calyx-lobes* sub-equal, lanceolate, sub-acute, tomentose on both surfaces. *Petals* oblong-lanceolate, sub-acute, the half of the outer surface which is outside in æstivation pubescent, other-

wise glabrous. *Stamens* obtusely apiculate. *Ovary* depressed, minutely tomentose; stigma capitate. *Fruit* (not quite ripe) globular, umbonate, attached for half its length to the calyx. The two larger calyx-wings ob-lanceolate-oblong, obtuse or sub-acute, 5-nerved, flocculent-puberulous near the base when young, ultimately glabrous, 2 in. long and ·5 in. wide; the 3 smaller wings lanceolate, obtuse, ·5 in. long.

Langani: Curtis, Nos. 2797 and 2798. Kedah: Curtis, Nos. 2096 and 2514.

When dried, the leaves of this are of a dull gray colour—hence the specific name. Its fruit resembles that of the next species, but the leaves have fewer and less prominent nerves.

6. Vatica Curtisii, King, n. sp. A tree about 40 feet high: young branches, petioles, inflorescense and calyx brownish scurfy-pubescent, ultimately glabrous. *Leaves* ovate-oblong, sub-acute, the base rounded, both surfaces quite glabrous, reticulate; main nerves 11 to 13 pairs, oblique, rather prominent beneath; length 3 to 5 in., breadth 1·3 to 2·5 in., petiole ·3 to ·45 in. *Racemes* axillary, few-flowered, 1 to 1·25 in. long. *Flowers* ·35 in. long. *Calyx-lobes* unequal, the 2 longer narrowly oblong, obtuse; the 3 shorter lanceolate-acuminate. *Petals* elliptic, slightly oblique, blunt, glabrous except the pubescent edge which is external in the bud. *Ripe fruit* globular, ·3 in. in diam., adherent to the calyx for half its length, the larger calyx-lobes oblong-obovate, usually obtuse, rarely sub-acute, 5-nerved, 1·75 to 2 in. long, and ·7 in. broad; the smaller wings about ·4 in. long.

Penang: Curtis, No. 1579.

7. Vatica faginea, Dyer in Hook. fil. Fl. Br. Ind., I., 301. A tree 80 to 100 feet high: young branches slender, minutely cinereous stellate-tomentose as is the inflorescence. *Leaves* coriaceous, oblong or elliptic-oblong, finely reticulate, glabrous; main nerves 9 to 11 pairs, spreading, curving, thin but prominent when dry; length 4 to 5 in., breadth 1·5 to 2 in. *Panicles* 2·5 in. long; flowers ·5 in. long. *Calyx-tube* ribbed, minutely scurfy tomentose, the lobes unequal. *Petals* narrowly oblong, blunt, glabrous except the pubescent outside edge. *Ovary* hemispheric, minutely tomentose; stigma capitate, lobed. *Ripe fruit* globular, adherent for half its length to the calyx, about ·25 in. in diam., the style persistent; the 2 larger calyx-wings narrowly oblong, or oblong-oblanceolate, obtuse, obscurely 5-nerved, 2 to 2·5 in. long, and ·5 to ·7 in. broad near the apex; the three smaller wings unequal, sub-spathulate, less than ·5 in. long. *Hopea faginea*, Wall. Cat. 963 *Shorea pinangiana*, Wall., Cat. p. 157. *Synaptea faginea*, Pierre, For. Flore Coch.-Chine, t. 242.

Penang: Wallich. Perak: King's Collector, Nos. 3686 and 3765.

8. VATICA DYERI, King, n. sp. A tree 80 to 130 feet high: young branches, panicles, and calyx on both surfaces densely rufous-flocculent-tomentose, with stellate hairs intermixed, the branches ultimately glabrous and their bark pale. *Leaves* membranous, usually broadly elliptic, rarely elliptic-oblong, sub-acute or very shortly and bluntly acuminate, the base rounded, both surfaces quite glabrous, finely reticulate: main nerves 11 to 13 pairs, spreading, rather prominent beneath: length 3·5 to 7 in., breadth 1·6 to 3 in.; petiole ·35 to ·5 in., flocculent-tomentose. *Panicles* axillary or terminal, cymose, 1·5 to 3 in. long. *Flowers* ·4 in long. *Calyx lobes* unequal, the two larger oblong and obtuse; the three smaller lanceolate, acuminate. *Petals* broadly elliptic, very obtuse, slightly narrowed to the truncate base, much larger than the calyx-lobes, glabrous, except one of the outside edges which is adpressed-pubescent. *Stamens* short, unequal-sided, bluntly apiculate *Ovary* depressed-pubescent, the stigma capitate. *Ripe fruit* conical, the two large accrescent calyx-wings narrowly oblanceolate-oblong, blunt, 5-nerved, 1·25 in. long and ·25 in. broad; the three smaller wings one-fourth of the size of the larger, lanceolate, obscurely 5-nerved. *Synaptea Dyeri*, Pierre Fl. Forest. Coch-Chine, t. 241.

Perak: King's Collector, No. 7662. DISTRIB., Cambodia, Lower Cochin-China, Pierre.

The Perak specimens are not in fruit: but in flowers and leaves they agree with Pierre's specimens from Cambodia and Cochin-China.

9. VATICA RETICULATA, King, n. sp. A tree 60 to 80 feet high: all parts except the inflorescence glabrous; young branches slender, dark-coloured. *Leaves* coriaceous, oblong to ovate-lanceolate, tapering from the middle to each end; the apex bluntly acuminate, the base very cuneate and slightly unequal-sided, the edges sub-undulate; both surfaces finely reticulate when dry, the lower paler; main nerves 8 or 9 pairs, little more prominent than the secondary; length 2·5 to 3·5 in., breadth 1 to 1·25 in., petiole ·4 in. *Panicles* axillary or terminal, puberulous, 2·5 to 3·5 in. long, lax, few-flowered. *Flowers* on long pedicels. *Calyx-lobes* unequal, lanceolate, more or less obtuse, densely pubescent on both surfaces. *Ovary* hemispherical, ridged, densely tomentose; style short, glabrous; stigma minute. *Young fruit* sub-globular; fruiting calyx with 2 accrescent linear-oblong wings, the other smaller; all attached to the lower part of the fruit.

Perak: King's Collector, No. 6969.

The only specimens which I have seen of this are without corolla, stamens, or ripe fruit. The species is, however, a very distinct one, and it is an unmistakeable *Vatica*. I have therefore ventured to name it in spite of the imperfection of the material.

4. Pentacme, A. DC.

Glabrous or puberulous resinous trees. *Leaves* broad, entire, penninerved, with obtuse or cordate bases. *Flowers* large, panicled. *Calyx-tube* short, the lobes imbricate, 2 being quite external. *Stamens* 15, the filaments short, dilated; anthers much larger than the filaments, elongate, linear; the valves 4, sub-equal, each subulate at its apex, the connective also prolonged into a stiff deflexed arm as long as the appendages of the anther-valves. *Ovary* free; the style filiform, the stigma slightly lobed. *Fruit* enclosed within the imbricate calyx-lobes, of which two or more have elongated membranous reticulate many-nerved wings. Species 3,—Burmese, Siamese, and Malayan.

1. Pentacme malayana, King, n. sp. A tree 40 to 50 feet high: young branches rather stout, dark-coloured, glabrous. *Leaves* sub-coriaceous, rotund-ovate to broadly elliptic, the apex shortly and bluntly acuminate, the base rounded or slightly emarginate; both surfaces glabrous, pale when dry; main nerves 15 to 18 pairs, spreading, prominent on both surfaces; length 5 to 7 in., breadth 2·75 to 4·5 in., petiole ·75 to 1·1 in. *Panicles* axillary, lax, few-flowered, 2·5 to 5 in. long. *Flowers* ·75 in. long and about as much in diameter when open, pedicelled. *Calyx-lobes* more or less broadly ovate, acuminate, minutely tomentose outside. *Petals* three times as long as the calyx, elliptic, spreading, puberulous on one-half outside, and glabrous on the other, quite glabrous inside. *Stamens* 15, equal, erect, the filaments short and broad; the anthers elongate, narrow, with 5 apical awns, one of which is deflexed and rather shorter and thicker than the other four. *Ovary* ovoid, sub-glabrous, much shorter than the filiform style: stigma minute. *Ripe fruit* ovate, apiculate, 1 in. long, glabrous; calyx-wings all enlarged and reticulate except at the base; the three outer narrowly oblong, obtuse, and narrowed to the concave base, 9-nerved, 4 to 4·5 in. long, and ·65 to ·75 in. broad; the two inner lobes much narrower and fewer-nerved, about 2·5 in. long, or even shorter.

Langkani: Curtis, No. 2095.

The petals of this species are spreading, and the flower has quite an unusual *facies* for the order. It is at once distinguished by its curiously 5-awned anthers. Four of these awns are the produced apices of the anther cells, the fifth (the thicker and deflected one) is a prolongation from the connective.

5. Shorea, Roxb.

Glabrous, mealy, or pubescent resinous trees. *Leaves* entire or sub-repand, pinnate-veined; stipules large, coriaceous and persistent, or minute and fugacious. *Flowers* in axillary or terminal, lax, cymose panicles; bracts persistent, caducous, or 0. *Sepals* ovate or lanceolate, imbricate, 3 being external and 2 internal. *Stamens* 15 or 20, or 30; anthers ovate or oblong, rarely linear; connective subulate-cuspidate, rarely inappendiculate; valves obtuse, rarely cuspidate, equal, or the outer slightly larger. *Ovary* 3-celled, cells 2-ovuled; style subulate, stigma entire or 3-toothed. *Fruit* with leathery, rarely with woody, pericarp, 1-celled, 1-seeded, closely surrounded by the bases of the persistent, usually accrescent, sepals, the 3 outer, or more rarely, all, and sometimes none, of which are developed into 7- to 10-veined reticulate membranous linear-oblong wings. *Cotyledons* fleshy, unequal, usually enclosing the superior radicle. DISTRIB—Tropical Asia and chiefly the Malayan Archipelago: species about 60.

Sect. I. EU.-SHOREA. Fruit little more than ·5 in. long, its pericarp leathery: three of the persistent sepals developed into membranous wings many times longer than the fruit.

Anthers without apical appendages.

Lower surface of adult leaves minutely stellate-tomentose, not scaberulous ... 1. *S. leprosula.*

Lower surface of adult leaves glabrescent, the axils of the nerves scaly ... 2. *S. scutulata.*

Lower surface of adult leaves quite glabrous, of young leaves glaucous ... 3. *S. Curtisii.*

Anthers mostly inappendiculate, a few with a minute apical appendage from the connective.

Stamens 30 ... ... 4. *S. sericea.*

Anthers with very short apical appendages from the connective; flowers sessile.

Leaves 2·5 to 4 in. long, the lower surfaces minutely pubescent: flower ·25 in. long; fruit ovoid-globose, its largest wings 2·5 in. long 5. *S. parvifolia.*

Leaves 3 to 4·5 in. long, glabrous beneath: flower ·3 in. long: fruit turbinate, its largest wings 3·5 in. long ... ... 6. *S. acuminata.*

Leaves 4 to 6 in. long, glabrescent or glabrous beneath; fruit narrowly ovoid, its longest wings 3·5 to 4·5 in. long. ... 7. *S. macroptera.*

Apical appendage from the connective much longer than the anther.

Leaves glabrous on both surfaces, the lower not pale.

Stamens 10 (?) ... ... 8. *S. Maxwelliana.*

Stamens 20 ... ... 9. *S. gratissima.*

Stamens 15

Flowers ·2 to ·25 in. long.

Main nerves of leaves 9 to 10 pairs, faint; petals not saccate at base; ovary ovoid-conical, tomentose, style short ... ... 10. *S. Ridleyana.*

Main nerves 6 or 7 pairs; petals saccate at base; ovary hemispheric, style long and slender ... 8. *S. Maxwelliana.*

Flowers ·4 in. long, main nerves 9 to 11 pairs; style 3 times as long as the globose ovary ... ... 11. *S. pauciflora.*

Flowers ·5 in. long, main nerves of leaves 6 to 8 pairs; ovary elongate-conic, style short, petals linear-oblong ... ... 12. *S. Kunstleri.*

Flowers ·65 in. long: nerves of leaves 12 to 16 pairs; ovary ovoid, style long, filiform, petals ovate-lanceolate 13. *S. bracteolata.*

Leaves glaucous beneath ... ... 14. *S. glauca.*

Apical appendage of the connective with 3 to 5, or many ciliæ.

Stamens 30: ciliæ radiating from the tip of the apical process of all the anthers 15. *S. ciliata.*

Stamens 20: apical appendages of all the anthers with numerous ciliæ; petals broad, spreading ... ... 16. *S. utilis.*

Stamens 15: anthers of outer row with ciliate apical appendages ... ... 17. *S. costata.*

Anthers with a single apical appendage from each cell, and a short one from the connective; sepals imbricate at their bases only ... 18. *S. stellata.*

Species imperfectly known.

Bracteoles large, persistent, scaberulous, stellate-pubescent ... ... 19. *S. Maranti.*

Stipules large, paired, persistent ... 20. *S. eximia.*

Sect. II. Pachychlamys, (Dyer). Fruit more than 1 in. long, its pericarp thick and woody, embraced in its lower half by a cup formed of the enlarged sepals, the bases of which are thickened woody and concave, the apices of the outer three produced into membranous wings as long as, or slightly longer than, the fruit.

Anthers of inner row inappendiculate, those
of the other two rows appendiculate ... 21. *S. Thiseltoni.*

1. SHOREA LEPROSULA, Miq. Fl. Ind. Bat. Suppl. I., 487. A tree 100 to 150 feet high: young branches rather slender, lenticellate, minutely and deciduously pale stellate-tomentose. *Leaves* coriaceous, elliptic to oblong, acute or sub-acute, the base rounded; upper surface glabrous, harsh from the prominent minute reticulations, the midrib and nerves sometimes puberulous; lower surface minutely fuscous-tomentose, with numerous densely stellate hairs on the midrib nerves and veins; main nerves 10 to 13 pairs, straight, oblique, prominent beneath; length 3 to 6 in., breadth 1·25 to 3·25 in., petiole ·35 to ·75 in. *Panicles* axillary and terminal, 1·5 to 4 in. long, rachis and branches stellate-tomentose, the short flower-bearing branchlets sericeous. *Flowers* in two rows, secund, ·3 in. long, sessile. *Sepals* ovate, minutely velvety outside. *Petals* three times as long as the sepals, sericeous outside, oblong-spathulate. *Stamens* about 15; the filaments dilated, much longer than the short ovate inappendiculate anthers. *Ovary* ovoid, minutely tomentose, tapering upwards into the long slender style; stigma minute. *Ripe fruit* narrowly ovoid, apiculate, minutely tomentose, 6 in. long. *Calyx-wings* all enlarged and membranous, concave at the base so as to embrace the ripe fruit, but not adnate to it; the three outer narrowly oblong, sub-acute at the apex, narrowed at the base, 7-nerved, reticulate, 3 in. long and about ·7 in. broad; the two inner smaller, about 1 in. long, ovate, caudate-acuminate, not nerved. A. DC. Prod. XVI. 2, 631. Scheff. in Tijdschr. Ned. Ind. XXXI, 350: Hook. fil. Fl. Br. Ind., I., 305. Burck in Ann. Jard. Bot. Buitenzorg, VI, 215. *Shorea astrosticta*, Scortechini MSS.

Malacca: Maingay (Kew. Distrib.), No. 203. Perak, King's Collector, Nos. 7646, 7905, 8182; Scortechini, No. 2063. DISTRIB. Sumatra.

2. SHOREA SCUTULATA, King, n. sp. A large tree; young branches with dark lenticellate bark and minute white stellate pubescence. *Leaves* elliptic, shortly abruptly and bluntly acuminate; the base broad, rounded, almost truncate: upper surface glabrous, minutely reticulate; the lower, and especially the midrib, sparsely stellate-puberulous when young, glabrescent when old, the sides of the midrib, and especially the pits in the axils of the nerves, with numerous minute brownish pale-edged scales; length 3 to 3·5 in., breadth 1·5 to 1·75 in., petiole ·3 in. *Panicles* axillary and terminal, 3 to 4 in. long, the branches short, each bearing 2 or 3 bracteolate flowers; bracts broadly ovate, concave, blunt, hoary-puberulous, deciduous. *Flowers* ·4 in. long, shortly pedicelled. *Sepals* broadly lanceolate, obtuse, tomentose outside, glabrous inside. *Petals* oblong, obtuse, the base expanded

at one side, glabrous inside and on one half outside, pubescent on the other. *Stamens* 15, in 3 rows; all the filaments broad, those of the outer two rows shorter than those of the inner: anthers short, broadly ovate, inappendiculate. *Ovary* conical, pale tomentose: style short, stigma small. *Fruit* (perhaps not mature) ovoid, apiculate, minutely pale tomentose, ·6 in. long. *Sepals* all enlarged, membranous, reticulate, concave at the base; the three outer narrowly oblong, obtuse, very little narrowed to the base, 7-nerved, 2·75 in. long and ·75 in. broad; the two inner ·8 in. long, linear, about 1-nerved.

Penang: Curtis, No. 1396.

A species known only from Penang, and collected only by Mr. Curtis: remarkable for its almost racemose inflorescence, and curiously glandular leaves.

3. Shorea Curtisii, Dyer MSS. in Herb. Kew. A tree 100 to 150 feet high; young branches slender, at first minutely stellate-puberulous, ultimately dark-coloured and glabrous. *Leaves* coriaceous, oblong-lanceolate, bluntly acuminate; the base sub-cuneate, or almost rounded; upper surface of young leaves minutely pubescent, of adults glabrescent or quite glabrous, the lower uniformly covered with very minute rufescent (young), or pale (adult) tomentum: main nerves 10 to 14 pairs, ascending, rather straight, prominent beneath: length 3 to 4 in., breadth 1·2 to 1·4 in., petiole ·4 to ·6 in. *Panicles* axillary or terminal, 2 to 3 in. long, the rachis slender, glabrous. *Flowers* about ·3 in. long, in distichous secund rows of 4 or 5, on the short lateral branchlets, enveloped while in bud by broad deciduous puberulous bracts. *Sepals* ovate, tomentose outside, glabrous inside, slightly unequal. *Petals* twice as long as the calyx, linear-oblong, obtuse, stellate-pubescent outside, glabrous inside. *Stamens* 15, in three rows; the filaments elongate, broad (those of the outer row longest); anthers short, ovoid-globose, not apiculate. *Ovary* elongated ovoid, tomentose in the upper, glabrous in the lower half: *style* short, *stigma* small. *Ripe fruit* narrowly ovoid, apiculate, ·75 in. long, pale tomentose; *calyx-wings* all enlarged and membranous, free from the fruit: the three outer linear-oblong, 8-nerved, 2·25 in. long, and about ·5 in. broad; the two inner about 1 in. long, bluntly spathulate and with fewer nerves.

Penang: Curtis, Nos. 427, 1394 and 1395.

Perak: King's Collector, No. 8143.

The vernacular name of this in Penang is *Maranti Tai.*

4. Shorea sericea, Dyer in Hook. fil. Fl. Br. Ind., I., 306. A tree 50 to 60 feet high; young branches rugulose, warted and scurfily

rufous-tomentose as are the inflorescence and petioles. *Leaves* coriaceous, oblong or elliptic-oblong (rarely slightly ob-ovate), very shortly acuminate or sub-acute, slightly narrowed to the rounded or sub-cuneate base; upper surface shining, sparsely stellate-tomentose, the depressed midrib and nerves puberulous; lower surface scaberulous, more densely stellate-pubescent, especially on the bold midrib and 20 to 22 pairs of stout spreading main nerves; length 3·5 to 6·5 in., breadth 1·5 to 2·75 in., petiole ·6 to ·8 in. *Panicles* axillary and terminal, 3 to 7 in. long, the ultimate branches bearing 4 or 5 distichous, secund, bracteate, sessile flowers; bracts broadly ovate, puberulous outside. *Sepals* ovate, the two inner smaller, all densely golden-sericeous outside, glabrous inside. *Petals* like the sepals and of about the same length, the inside and one-half of the outer glabrous, the other half adpressed-sericeous. *Stamens* about 40, in several rows; the filaments of the outer shorter, all longer than the anthers; anthers ovate, mostly inappendiculate, a few with a minute appendix. *Ovary* elongated, conic, sericeous; the style short, glabrous; stigma small. *Fruit* (immature) narrowly ovoid, ·5 in. long, embraced by, but not adnate to, the accrescent membranous calyx-wings: the outer 3 calyx-wings linear-oblong obtuse, narrowed to the base, 3·5 in. long and ·6 in. broad, 10-nerved; the 2 inner 2·5 in. long and much narrower and fewer-nerved, sparsely pubescent.

Malacca: Maingay (Kew. Distrib.) No. 202. Penang: Curtis, No. 431. Perak: King's Collector, No. 3511.

This resembles *S. lacunosa* Scheff., but differs in not having persistent stipules. Its vernacular name in Penang is *Seraya.*

5. SHOREA PARVIFOLIA, Dyer in Hook. fil. Fl. Br. Ind., I., 305. A tree 100 to 150 feet high; young branches slender, pale tomentose at first, ultimately glabrous, dark-coloured and lenticellate. *Leaves* coriaceous, ovate to ovate-lanceolate, caudate-acuminate, the base sub-cuneate or almost rounded; upper surface glabrous (when young the midrib tomentose or pubescent); under surface sparsely scaly-pubescent when young, when adult minutely pubescent, the transverse veins thick; main nerves 9 to 12 pairs, oblique, rather straight, prominent beneath: length 2·5 to 4 in., breadth 1 to 1·8 in.; petiole ·35 to ·45 in., tomentose when young. *Panicles* axillary and terminal, crowded near the ends of the branches, 2 to 4 in. long, rather lax, spreading, many-flowered, minutely tomentose, the branches distichous. *Flowers* ·25 in. long, secund, distichous, deciduously bracteate. *Sepals* slightly unequal, ovate, acute, tomentose outside, glabrous inside. *Petals* twice as long as the sepals, obliquely elliptic, obtuse, glabrous, except on one-half outside which is silky. *Stamens* 15, or fewer: the filaments flatten-

ed, about 4 times as long as the broad short anthers; apiculus of connective very slender, about as long as the anther, deflexed. *Ovary* elongate, puberulous; style rather short; stigma small. *Ripe fruit* ovoid-globose, ·4 in. long, thinly adpressed pale tomentose. *Sepals* all enlarged and membranous, concave at the base so as to embrace the ripe fruit, but not adnate to it: the three outer narrowly oblong, obtuse at the apex, slightly narrowed to the base; 7-nerved, 2·5 in. long; the two inner from one-half to one-third shorter, narrower and fewer nerved. *Shorea disticha*, Scortechini MSS. in Herb. Calcutta.

Malacca: (Kew Distrib.) No. 206. Penang: Curtis, No. 201. Perak: Scortechini, No. 1965. Wray, No. 1282.

6. Shorea acuminata, Dyer in Hook. fil. Fl. Br. Ind., I., 305. A tree 100 to 150 feet high; young branches minutely greyish tomentose, ultimately dark-coloured and glabrescent. *Leaves* coriaceous, ovate to lanceolate, acuminate, the base often unequal-sided, rounded or sometimes emarginate; upper surface glabrous except the puberulous midrib; the flower glabrous, with a few scattered stellate hairs: main nerves 7 to 9 pairs, spreading, slightly prominent beneath: length 3 to 4·5 in, breadth 1·75 to 2·5 in.; petiole ·3 to ·4 in., tomentose. *Panicles* axillary and terminal, crowded near the extremities of the branches, 2 to 3 in. long, minutely stellate-pubescent, many-flowered. *Flowers* ·3 in. long, distichous, secund, about 5 on each lateral branch, bracteolate. *Sepals* ovate, unequal, tomentose outside, glabrous inside. *Petals* twice as long as the calyx, spreading, broadly ovate, puberulous outside, glabrous inside. *Stamens* 15, in three rows, the inner row shorter: filaments broad, much larger than the short, ovate, minutely appendiculate anthers. *Ovary* ovoid, tapering, pubescent: style short, stigma small. *Ripe fruit* turbinate, with 3 slightly vertical grooves, apiculate, puberulous, ·5 in. in diam., attached by its base to the calyx: *sepals* all enlarged, concave at the base so as completely to cover the fruit, membranous and reticulate; the 3 outer narrowly oblong obtuse, contracted towards the base, 10- or 11-nerved, 3·5 in. long, and 7 in. broad; the two inner 1 to 1·5 in. long, under ·25 in. broad, 3- to 4-nerved.

Malacca: Maingay (Kew Distrib.) No. 205 (?). Griffith, No. 1762. Perak: King's Collector, No. 8009.

7. Shorea macroptera, Dyer in Hook. fil. Fl. Br. Ind. I, 308. A tree 60 to 80 feet high: young branches with dark-brown bark, minutely lenticellate and puberulous. *Leaves* coriaceous, oblong (usually narrowly), shortly acuminate, the base sub-cuneate or rounded: upper surface glabrous, shining, the midrib and nerves puberulous: lower

surface glabrescent or glabrous, chocolate-coloured when dry: main nerves 10 to 12 pairs, curved, spreading, prominent on the lower surface; length 4 to 6 in., breadth 1·35 to 1·75 in.; petiole ·4 to ·5 in., rugose. *Panicles* axillary or terminal, 4 to 7 in. long, lax, branching, few-flowered, puberulous, sparsely scaly. *Flowers* about ·5 in. long, sessile, solitary, not secund. *Sepals* distinct almost to the base, slightly unequal, broadly-ovate, acute, more or less yellowish-tomentose outside, glabrous inside. *Petals* narrowly oblong, slightly oblique at the base, the apex blunt, glabrous except one-half of the outer surface which is sericeous. *Stamens* 15, in two rows; filaments broad except at the apex, those of the outer two rows by much the shorter: anthers short, ovate, the connective minutely awned. *Ovary* elongated-ovoid, sericeous in its upper half; style short, stigma small. *Ripe fruit* ·6 to ·75 in. long, narrowly ovoid, pale puberulous, apiculate: *sepals* all enlarged and reticulate, slightly concave at the base and embracing, but not adnate to, the fruit; the three outer narrowly oblong, obtuse, tapering slightly to the auricled base, 7-nerved, 3·5 to 4·5 in. long, and ·8 to 1 in. broad; the two inner variable, but shorter, narrower and fewer nerved. *Shorea auriculata*, Scortechini MSS. in Herb., Calcutta.

Malacca: Maingay. Singapore: Ridley. Penang: Curtis, No. 1392. Perak: very common, King's Collector, Scortechini.

A species from Borneo which closely resembles this appears to me to differ specifically. Its leaves are longer with sparser nerves, and its calyx-wings are longer.

8. Shorea Maxwelliana, King, n. sp. A tree 60 to 80 feet high: young branches dark-coloured, almost glabrous. *Leaves* coriaceous, ovate-lanceolate, acuminate (caudate-acuminate when young), the base unequal-sided, cuneate; both surfaces quite glabrous, the upper shining, the lower chocolate-coloured when dry: main nerves 6 or 7 pairs, curved, spreading, thin and inconspicuous: length 3 to 4 in., breadth 1·3 to 1·5 in., petiole ·4 in. *Panicles* axillary and terminal, 2·5 to 3 in. long, stellate-puberulous, their lateral branches very short and few-flowered. *Flowers* shortly pedicelled. *Sepals* unequal, oblong, blunt, with enlarged concave bases, more or less pubescent, but glabrous in the concavity of the base inside. *Petals* oblong, concave and saccate at the base, tomentose outside, glabrous inside. *Stamens* 10 (?), the filaments short, broad; the anthers elongate, erect, pointed, the connective ending in an awn as long as the anther. *Ovary* hemispheric; the style long, slender; stigma minute. *Fruit* (not mature) globular, minutely tomentose, closely invested by, but not adnate to, the concave bases of the sepals: *sepals* all enlarged, membranous, narrowly oblong, obtuse;

the three outer 7-nerved, 1·5 in. long and ·4 in. broad; the two inner similar in shape, but fewer-nerved and only ·5 in. long.

Perak: King's Collector, Nos. 3601 and 3744.

The only flowers of this species which I have seen are in an early stage of bud, and from them I am unable to make out the characters of the petals properly. The stamens appear to be only 10 in number: but of this I cannot now be quite certain.

9. SHOREA GRATISSIMA, Dyer in Hook. fil. Fl. Br. Ind. I, 307. A tree: younger branches slender, glabrescent, dark-coloured. *Leaves* coriaceous, elliptic, acuminate, the base broad and rounded, the margins sub-undulate, both surfaces glabrous: main nerves 12 to 14 pairs, faint; length 2·5 to 4 in., breadth 1·25 to 1·5 in., petiole ·6 to ·75 in. *Panicles* axillary and terminal, lax, few-flowered, 3 to 6 in. long, sub-puberulous. *Flowers* secund, pedicelled, ·25 in. long. *Sepals* lanceolate, sub-acute; minutely tomentose outside, glabrous inside in the lower, adpressed-pubescent in the upper, half. *Petals* twice as long as the calyx and much broader, elliptic, obtuse, glabrescent. *Stamens* about 20; the filaments short, unequal, dilated. *Anthers* elongated-ovate, truncate, each with a terminal awn from the connective twice as long as itself. *Ovary* ovoid, sub-glabrous; stigma small. *Ripe fruit* unknown. *Hopea gratissima*, Wall. Cat. 960.

Singapore: Wallich.

This is known only by Wallich's specimens. He referred it to *Hopea*, of which genus it certainly has the *facies:* the æstivation of the sepals is moreover that of *Hopea*, and so is the apiculus of the connective of the stamens. The petals in shape, however, resemble those of *Shorea*. I retain it in *Shorea* in deference to the opinion of Mr. Dyer.

10. SHOREA RIDLEYANA, King, n. sp. A tree 60 or 80 feet high: young branches slender, dark brown, lenticellate, nearly glabrous. *Leaves* ovate-lanceolate, shortly acuminate, the base rounded: both surfaces glabrous, the upper shining: main nerves 9 or 10 pairs, curved, spreading, thin but slightly prominent beneath: length 2·5 to 4 in., breadth 1·1 to 2 in.; petiole ·4 to ·5 in., rugulose. *Panicles* axillary and terminal, 1·5 to 2 in. long, densely stellate-puberulous. *Flowers* ·2 in. long, pedicellate. *Sepals* sub-equal, oblong, obtuse, tomentose outside, glabrous inside. *Petals* oblong, slightly oblique, obtuse, glabrous inside, puberulous outside on one half, glabrous on the other. *Stamens* 15, sub-equal, the filaments dilated in the lower half: anthers shorter than the filaments, ovate, the connective produced into an awn longer than the anther. *Ovary* ovoid-conical, minutely tomentose. *Style* short; stigma minute. *Fruit* (immature) ovoid, apiculate, minutely

pale tomentose: *sepals* all enlarged, membranous, reticulate and concave at the base; the three outer linear-oblong, obtuse, slightly narrowed to the concave base, 5-nerved, 2·25 in. long and ·4 in. broad; the two inner of the same shape, but only 1-nerved, narrower and only 1·5 in. long.

Perak: King's Collector, Nos. 3571 and 3617.

This a good deal resembles *S. Maxwelliana*, King; but its leaves have more nerves, its slightly oblique petals are not saccate at the base, its ovary is ovoid-conical, and minutely tomentose with a short style; whereas in *S. Maxwelliana* the petals are saccate at the base, and the ovary is hemispheric with a long style.

11. Shorea pauciflora, King, n. sp. A tree 50 to 90 feet high: young branches slender, their bark brown puberulous and lepidote. *Leaves* thinly coriaceous, from oblong to elliptic, shortly acuminate; the base abruptly cuneate, slightly unequal-sided, or (in the elliptic forms) almost rounded: main nerves 9 to 11 pairs, oblique, straight, prominent beneath: length 4 to 5 in., breadth 1·8 to 2·5 in., petiole ·6 to ·7 in. *Panicles* few, axillary or terminal, few-flowered, 1·75 to 4 in. long, rather coarsely pubescent. *Flowers* ·4 in. long, secund, shortly pedicellate, each subtended by an ovate, solitary, puberulous, deciduous bract. *Sepals* broadly ovate, tomentose outside, glabrous inside. *Petals* broadly elliptic, obtuse, concave at the base, veined, inside glabrous, the outside half glabrous and half adpressed-sericeous. *Stamens* 15, in 3 rows: the outer row smaller and with filiform filaments, the inner rows with filaments longer and expanded in the lower half; the anthers of all shortly ovate, the connective produced into an awn twice as long as the stamen. *Ovary* hemispheric, tomentose; style nearly 3 times as long, puberulous; stigma small. *Ripe fruit* unknown.

Penang: Curtis, No. 1537.

A species known only by Mr. Curtis' specimens which have no fruit.

12. Shorea Kunstleri, King, n. sp. A tree 60 to 100 feet high: young branches slender, rusty-puberulous, their bark brown. *Leaves* coriaceous, elliptic, abruptly and shortly acuminate, the base rounded or slightly cuneate, both surfaces glabrous, the lower with a few stiff white hairs on the midrib and nerves; main nerves 6 to 8 pairs, curved, ascending, prominent on the lower surface; length 4 to 5 in., breadth 2 to 2·4 in., petiole ·5 in. *Panicles* axillary and terminal, 4 to 6 in. long, lax, few-flowered, scaly-puberulous. *Flowers* ·5 in. long, sub-sessile, 4 or 5 together on the short branches of the panicles, secund, bracteate: the bracts broadly ovate, puberulous. *Sepals* sub-equal,

broadly ovate, acute, tomentose outside; the edges ciliate, glabrous inside. *Petals* linear-oblong, obtuse; the bases obliquely expanded, sericeous externally, glabrous internally. *Stamens* 15, sub-equal, the filaments as long as the anthers, flattened; anthers ovate, short, the connective terminated by a curved awn much longer than the stamen. *Ovary* elongate-conic, puberulous; style short. *Ripe fruit* hemispheric, tapering into a cone and crowned by the style, adpressed pale tomentose. *Sepals* membranous, reticulate: the three larger narrowly oblong, obtuse, tapering to the concave non-reticulate base, 9-nerved, 3·5 in. long and ·7 in. broad: the two inner 2 in. long, linear, 3-nerved.

Perak: King's Collector, Nos. 3474 and 3705.

This species is allied to *S. bracteolata*, Dyer, but its leaves have fewer nerves, smaller flowers, narrower petals, and a short style.

13. Shorea bracteolata, Dyer in Hook. fil. Fl. Br. Ind. I, 305. A tree 50 to 150 feet high; young branches minutely furfuraceous-puberulous, speedily glabrescent, their bark dark-coloured. *Leaves* coriaceous, elliptic-oblong, shortly acuminate (often sub-obtuse when old), narrowed slightly to the rounded or emarginate base; upper surface quite glabrous; the lower yellowish furfuraceous-puberulous to glabrous; main nerves 12 to 16 pairs, spreading, prominent beneath: length 4 to 6 in., breadth 1·6 to 2·5 in., petiole ·45 to ·6 in. *Panicles* axillary, few-flowered, 2·5 to 6 in. long, glabrous. *Flowers* ·65 in. long, shortly pedicellate, each subtended by 2 elliptic, obtuse, 3-nerved, puberulous, deciduous bracts ·35 in long. *Sepals* lanceolate, obtuse, minutely tomentose outside, the two inner smaller. *Petals* ovate-lanceolate, obtuse; the bases expanded, glabrous. *Stamens* 15, in two rows, the filaments less than half as long as the ovate obtuse anthers; appendix of connective subulate, twice as long as the anther, decurved when old. *Ovary* ovoid, attenuated upwards, sub-glabrous; the style long, filiform; stigma small. *Ripe fruit* ovoid, apiculate, ·6 in. long, embraced by, but (except at the very base) free from the calyx; *sepals* accrescent, membranous, reticulate and concave at the base: the three outer narrowly oblong, blunt, slightly narrowed above the concave base, 10-nerved, 3·5 in. long, and ·6 in. broad; the two smaller about 2 in. long, and ·2 in. broad, about 3-nerved. *Shorea foveolata*, Scortechini MSS. in Herb. Calcutta.

Malacca: Maingay (Kew Distrib.) No. 204. Penang: Curtis, Nos. 322 and 1405. Perak: King's Collector, Nos. 7583, 7591, 7717; Scortechini, No. 1939. Distrib.—Sumatra. Forbes, No. 3050.

14. Shorea glauca, King, n. sp. A tree 80 to 100 feet high; young branches slender, dark-coloured, puberulous. *Leaves* coriaceous, ovate-lanceolate, acuminate; the base broad, rounded; upper surface

glabrous, the lower glaucous (except the midrib and nerves) especially when young; main nerves 7 to 9 pairs, ascending, rather straight: length 3·5 to 4·5 in., breadth 1·4 to 1·8 in.; petiole ·45 to ·6 in., rugulose, glaucous. *Panicles* axillary, few-flowered, shorter than the leaves, hoary, the *flowers* on short pedicels. *Sepals* slightly unequal, oblong, obtuse, tomentose on both surfaces. *Ovary* conical, tomentose; the style very short, glabrous; stigma small, 3-lobed. *Fruit* (immature) ovoid-globose, apiculate, minutely tomentose; accrescent sepals membranous, free from the fruit; obscurely 7- to 12-nerved, strongly reticulate, blunt, slightly narrowed to the concave base, at first puberulous but ultimately glabrous; the longer 2·25 in. long, and ·6 to ·75 in. broad, the others smaller.

Penang: Curtis, No. 372. Malacca: Maingay (Kew Distrib.), 212.

In this species the two inner fruiting wings of the calyx are nearly as large as the three outer; the leaves are very white underneath when young, but much less conspicuously so when adult. It is known, only by Curtis' and Maingay's specimens, none of which have complete flowers. Maingay's specimens from Malacca have in fact no flowers; but there is no mistaking their leaves as being exactly like those of Mr. Curtis' from Penang. The vernacular name of this is *Dammar laut dhan lesor*.

15. Shorea ciliata, King, n. sp. A medium-sized tree; young branches slender, dark-coloured, deciduously hoary-puberulous. *Leaves* coriaceous, lanceolate or oblong-lanceolate, acuminate, the base cuneate; both surfaces glabrous, minutely reticulate, the lower whitish when young, pale brown when dry; main nerves 8 or 9 pairs, ascending, curved, shining on the lower surface: length 3 to 3·5 in., breadth ·8 to 1·5 in., petiole ·75 to ·9 in. *Panicles* 2 to 2·5 in. long, axillary and terminal, little-branched, few-flowered, hoary. *Flowers* ·5 in. long, secund. *Sepals* ovoid-deltoid, obtuse, outside tomentose, inside glabrous. *Petals* three times as long as the sepals, narrowly oblong, obtuse, slightly expanded at the base, adpressed-sericeous outside, glabrescent inside. *Stamens* 30, in fascicles of 3, unequal, the shorter with undilated filaments, the longer with filaments dilated in the lower half; all with the connective produced into an apical process crowned by 3 to 5 spreading ciliæ. *Ovary* ovoid-conic, sericeous, with a short glabrous style. *Fruit* (immature) ovoid, apiculate, pale-tomentose, ·5 in. long; accrescent sepals membranous, reticulate: the three outer narrowly oblong, reticulate, 7-nerved: the two inner 2 in. long, and ·3 in. broad, narrowed to above the concave base: the two inner 1 in. long, linear-lanceolate, few-nerved.

Penang: Curtis, No. 1578.

Known only by Curtis' specimens, and readily recognisable by its beautifully ciliate-crested anthers.

16. SHOREA UTILIS, King, n. sp. A large tree; all parts except the inflorescence glabrous: young branches slender, dark-coloured. *Leaves* coriaceous, ovate-lanceolate, caudate-acuminate, or shortly and abruptly acuminate, the base slightly cuneate; main nerves about 7 pairs, oblique, not prominent on either surface; length 2·5 to 3 in., breadth ·9 to 1·2 in., petiole ·4 in. *Panicles* axillary, stellate-puberulous, about as long as the leaves; their lateral branches distant, very short, minutely tomentose, 3- or 4-flowered. *Flowers* sub-sessile, globular in bud, under ·2 in. long. *Sepals* ovate-orbicular, blunt, the outer 3 very tomentose outside, the inner 2 less so; all glabrous inside. *Petals* broadly oblong, blunt, more or less sericeous in both surfaces. *Stamens* 20; filaments slightly dilated, about as long as the ovate anthers; apical process of connective about as long as the anther, ciliate. *Ovary* sericeous, elongated-conic, gradually tapering into the short glabrous style; stigma minute. *Ripe fruit* ovoid, apiculate, pale, adpressed-sericeous, ·4 in. long, closely invested by, but free from, the concave bases of the accrescent sepals. *Sepals of fruiting calyx* all enlarged, membranous, reticulate, deciduously puberulous; the 3 outer oblong, very obtuse, 5-nerved, 1·25 in. long, and ·4 in. broad; the inner 3 half as long, or less, and much narrower.

Penang: Curtis, No. 423.

This species, which Mr. Curtis describes as yielding the most durable timber in Penang, was at one time quite common there, but it is now almost extinct. Its vernacular name is *Dammar laut.*

17. SHOREA COSTATA, King, n. sp. A tree; young branches dark-coloured, lepidote-puberulous. *Leaves* thinly coriaceous, oblong, sub-acute, slightly narrowed to the rounded or sub-cuneate base; both surfaces glabrous, the transverse veins distinct, especially on the lower: main nerves 11 to 13 pairs, oblique, rather straight, slightly prominent beneath; length 3 to 4·25 in., breadth 1·2 to 1·5 in., petiole ·8 to 1 in. *Panicles* axillary and terminal, 1·5 to 2·5 in. long, scaly-puberulous, the lateral branches very short and few-flowered. *Flowers* small. *Sepals* broadly ovate, yellowish-tomentose outside, glabrous inside. *Stamens* 15; all with dilated filaments longer than the ovate anthers, those of the inner row with the apical process of the connective short and glabrous, those of the outer rows with longer ciliate apical connectives. *Ovary* ovoid-conical, densely yellowish-tomentose; style very short. *Ripe fruit* ovoid, apiculate, sparsely puberulous, ·75 in. long; sepals all enlarged, concave and dilated at the base, membranous and reticulate; the three outer narrowly oblong, obtuse, much

narrowed to the base, 7-nerved, 2·75 in. long, and ·45 in. broad; the two inner of the same shape, but few-nerved, only 1·5 in. long, and ·25 in. broad.

Penang: Curtis, No. 199.

A species known only by Mr. Curtis' solitary specimen. The connectives of the inner anthers are ciliate, somewhat in the fashion of *S. ciliata*, King; but the leaves of that species are very different.

18. SHOREA STELLATA, Dyer in Hook. fil. Fl. Br. Ind. I, 304. A tree 100 to 150 feet high; young branches slender, at first stellate-puberulous, but speedily glabrous, with bark dark-coloured and sparsely lenticellate. *Leaves* thinly coriaceous, ovate-lanceolate, the base rounded: upper surfaces glabrous, the lower very minutely lepidote on the reticulations; main nerves 8 to 11 pairs, rather straight, oblique, prominent on the lower surface; length 4 to 5·5 in., breadth 1·75 to 2·25 in., petiole ·7 to ·9 in. *Panicles* axillary or terminal, crowded at the extremities of the branches, many-flowered, 4 to 6 in. long; minutely stellate-pubescent. *Flowers* ·25 in. in diam. *Calyx* minutely greyish-tomentose, the segments ovate-oblong, sub-acute, valvate, erect. *Petals* broadly ovate, obtuse, pubescent outside, spreading. *Stamens* 15, the filaments short, broad; the anthers linear-elongate, shortly bi-mucronate, the connective also shortly mucronate. *Ovary* ovate-globular, grooved, very tomentose; the style short; the stigma ovoid, small. *Ripe fruit* ovoid, apiculate, tomentose, ·5 in. long; sepals all enlarged, sub-equal, membranous, linear-oblong, sub-acute, much narrowed at the base, quite free from the fruit, 5-ribbed, reticulate, 4·5 in. long, and about ·6 in. broad. *Parashorea stellata*, Kurz, Journ. As. Soc., Bengal, for 1870, pt. 2, p. 66. For. Flora Burm., I, 117; Pierre Flore Forest. Coch-Chine, t. 224.

Perak: King's Collector, No. 7505. DISTRIB. Burmah.

None of the Perak specimens are in fruit; but in leaves and flowers they agree absolutely with Kurz's Burmese specimens. The calyx in all is quite valvate, and it was on this character chiefly that Kurz based the genus *Parashorea*.

19. SHOREA MARANTI, Burck in Ann. Jard. Bot. Buitenzorg, VI. 217. A small tree: young branches dark-coloured, stellate-puberulous. *Leaves* thinly coriaceous, more or less broadly elliptic or elliptic-oblong, shortly abruptly and bluntly acuminate; the base broad, rounded, or almost truncate; upper surface glabrous, the midrib and nerves minutely tomentose or pubescent when young; lower surface more or less sparsely minutely stellate-puberulous, the sides of the midrib, especially at the axils of the main nerves, glandular and densely covered with masses of brown pale-edged scales: main nerves 12 to 16 pairs, oblique,

slightly curved, thin but prominent beneath when dry, as are the transverse veins; length 3·5 to 6·5 in., breadth 1·5 to 2·25 in.; petiole ·35 in., densely stellate-pubescent, scurfy. *Stipules* deciduous, ovate-lanceolate, nerved, stellate-puberulous. *Panicles* axillary and terminal, few-flowered, tawny-tomentose, (shorter than the leaves [?]); the bracts in pairs, unequal, elliptic-oblong, blunt, nerved, pubescent on both surfaces. "Segments of calyx (fide Burck) unequal, the three outer larger, imbricate. *Petals* minutely tomentose inside. *Stamens* 15, in two rows." *Hopea? Maranti*, Miq. Fl. Ind. Bat. Suppl., 489; A. DC. Prod. XVI, 2, p. 635.

Perak: King's Collector, No. 880. Malacca: Derry, No. 952. Distrib. Sumatra, Bangka.

The Perak specimens are not in flower; and I have seen none from elsewhere that are. The above imperfect description of the flower has therefore been copied from Burck (Ann. Jard. Bot. Buitenzorg, VI. 217). The Perak specimens perfectly agree, as to leaves, with an authentic specimen of Miquel's from Sumatra, in the Calcutta Herbarium. Miquel never saw either flower or fruit. In fact, of the twenty new species of *Dipterocarpeæ* described by this author in the supplement to his Flora of the Netherlands India, the flowers are described in only two, and in these but partially!

20. Shorea eximia, Scheff. in Nat. Tijdschr. Ned. Ind. XXXI, 349. A shrub or small tree; young branches petioles and undersurfaces of leaves stellate-setulose. *Leaves* coriaceous, elliptic-oblong, or ob-lanceolate-oblong, acuminate, narrowed to the rounded or subcuneate base: upper surface glabrous except the tomentose midrib, shining, the nerves depressed: under surface scabrid, pale brown, the reticulations midrib and 17 to 21 pairs of spreading nerves prominent: length 6·5 to 11 in., breadth 2·25 to 3·25 in., petiole ·25 to ·35 in. Stipules in pairs, persistent, ovate, acuminate, longer than the petioles, reticulate, laxly pubescent and warted. "*Wings of fruiting-calyx* linear-lanceolate, obtuse: the three larger narrow at the base, 3·2 to 3·6 in. long, ·5 in. broad, sparsely pubescent, 9-nerved; the two shorter and narrower 1·6 in. long. *Fruit* elongated-ovoid, acuminate, minutely whitish-tomentose." Burck in Ann. Jard. Bot. Buitenzorg VI, 218. *Vatica? eximia*, Miq. Fl. Ind. Bat. Suppl. 486; A. DC. Prod. XVI 2, 623. *Vatica sub-lacunosa?* Miq. Fl. Ind. Bat. Suppl. 486. *Shorea sub-lucunosa*, Scheff. in Nat. Tijdschr. Ned. Ind. XXXI, 350: A. DC. Prod. XVI, 2623.

Malacca: Griffith, No. 5018. Penang: King. Perak King's Collector, 10998. Distrib. Sumatra, Bangka.

This plant is very imperfectly known. I have copied the description of the fruit from Dr. Burck (l. c.). Miquel, who first described the plant as a probable *Vatica*, had seen nothing but a leaf-twig. Specimens brought from Perak by the Calcutta collectors bear, instead of flowers, curious cones, 1·5 in. long, of distichous imbricate bracts, concerning which Griffith, in his field note on his specimen No. 5018, wrote,—"irregular growth caused by an insect; each of the scales of these cones bears on its dorsum at its base a number of eggs." Griffith's No. 5019 appears to belong to a closely allied, but distinct, species; as also does the indeterminate plant issued by Wallich as No. 6635 of his catalogue, under the designation, "*Dilleniacea* [?] *nervosa*."

21. SHOREA THISELTONI, King, n. sp. A tree 60 to 80 feet high: young branches rather stout, the bark dark-coloured and lenticellate, but covered at first by a pale-grey, deciduous pellicle. *Leaves* coriaceous, elliptic-oblong to elliptic, rarely oblong, sometimes slightly obovate, obtuse, slightly narrowed to the rounded base; both surfaces glabrous, the lower when very young sparsely lepidote, puberulous especially on the midrib and nerves, brown when dry: main nerves 8 or 9 pairs, ascending, slightly curved, bold and prominent on the under surface like the midrib; length 5 to 7 in., breadth 2·5 to 3·25 in.; petiole ·6 to ·8 in., stout. *Panicles* axillary and terminal, 2 to 3 in. long, velvety, few-flowered, apparently ebracteolate. *Flowers* sessile, ·6 or ·7 in. long. *Sepals* ovate, sub-acute, unequal; the 3 outer tomentose outside, glabrous inside; the 2 inner smaller, nearly glabrous, the edges ciliate. *Petals* much longer than the sepals, linear-oblong, obtuse, expanded at the base, glabrous, except one-half of the outer surface which is adpressed-pubescent. *Stamens* 15, in 3 rows, the filaments of all dilated, unequal: the anthers shortly ovate, those of the inner and longer row inappendiculate, those of the other two rows with a short apical appendage from the connective. *Ovary* narrowly conical, tomentose, tapering into the short glabrous style; stigma minute. *Ripe fruit* narrowly ovoid, apiculate, minutely pale-tomentose, substriate, 1·2 in. long, and ·6 in. in diam., the pericarp thick and woody. *Persistant sepals* with much thickened concave woody bases, forming a cup embracing the lower half of the fruit, the apices of the outer three prolonged into membranous linear-oblong obtuse wings exceeding the fruit and sometimes 1·5 in. long; one of the inner sepals shortly winged, the other often broad, obtuse and not winged.

Perak: common. King's Collector.

In this plant the fruit is much larger than in any of the other species of *Shorea* here described, and its pericarp is hard and thick. The bases of the sepals are greatly thickened and concave, and they form a cup which embraces closely, but does not adhere to, the lower half of the fruit, the apices of some of them being winged as above described. In these respects the species resembles certain other Malayan species of *Shorea*, e. g., *S. Martiniana* Scheff, *S. scaberrima*, and *S. stenoptera*, Burck. Judging from the leaf-specimens on which Miquel founded his *Hopea Singkawang*, that plant must be a close ally of this. A species (flower only) collected by H. O. Forbes in Sumatra (Herb. No. 2952) must also be closely allied to this. It differs however by its conspicuously bracteolate inflorescence. Beccari's Nos. 2681 and 3507, which form the types of Heim's species *S. brachyptera*, are also allied to this.

6. Hopea, Roxb.

Glabrous or hoary-tomentose resinous trees. *Leaves* quite entire, firm, feather-veined; stipules small, deciduous or inconspicuous. *Flowers* sessile or shortly pedicelled, ebracteate, in lax panicles of unilateral racemes. *Sepals* inserted on the receptacle, two being quite external and three for the most part internal, obtuse, imbricate. *Petals* falcate, their apices inflected in bud. *Stamens* 15, or rarely 10, slightly connate; the connective subulate-cuspidate, the anthers ovate, their valves obtuse, equal. *Ovary* 3-celled, the cells 2-ovuled: style shortly cylindric or subulate. *Fruit* 1-seeded, closely surrounded by the bases of the accrescent sepals, the 2 external of which are developed into linear wings, the three internal not longer than the ripe fruit. *Embryo* as in *Shorea*.—Distrib. of *Shorea*; species about 35.

Sect. I. Eu-hopea, Main nerves of leaves bold and prominent.

Nerves of leaves 16 to 18 pairs; accrescent sepals 4 to 4·5 in. long, 10-nerved ... 1 *H. nervosa.*

Nerves of leaves 10 to 13 pairs; accrescent sepals 1·75 to 2·5 in. long, obscurely 5-nerved 2. *H. Curtisii.*

Sect. II. Dryobalanoidea, Miq. Main nerves not distinct.

Petals sericeous: the filaments longer than the anthers; ripe fruit ·3 in. long, the accrescent sepals 7-nerved, 1·75 to 2 in. long, and ·2 to ·25 in. broad; leaf-petioles ·25 to ·4 in. long, minutely tomentose... ... ... 3. *H. micrantha.*

Petals densely sericeous; the filaments shorter than the anthers; ripe fruit ·2 in. long; accrescent sepals obscurely 5- to 7-nerved, 1·25 to 1·5 in. long, and ·25 in. broad; leaf-petioles ·35 to ·6 in. long, slender, puberulous, finally glabrous ... ... 4. *H. intermedia.*

1. Hopea nervosa, King, n. sp. A tree 50 to 70 feet high: young branches dark-coloured, glabrous. *Leaves* coriaceous, oblong to elliptic-oblong, shortly acuminate, the base rounded or very slightly cuneate; both surfaces glabrous; main nerves 16 to 18 pairs, spreading, bold and prominent on the lower; length 3·5 to 5 in., breadth 1·5 to 2·25 in.; petiole ·5 to ·75 in., transversely wrinkled when dry. *Flowers* unknown. *Ripe fruit* ovoid-rotund, apiculate, glabrous, ·5 in. long; the two outer sepals much enlarged, oblong-lanceolate, obtuse, slightly narrowed to the concave thickened smooth base, 10-nerved, 4 to 4·5 in. long, and ·6 to ·75 in. wide; the three inner sepals not quite so long as the fruit, broadly ovate, obtuse, thickened, smooth, closely embracing but not adherent to the fruit.

Perak: King's Collector, No. 3690.

This is a very distinct species, belonging to the group of *Hopea* with the nerves of the leaves bold. It is so distinct that, contrary to my general practice, I venture to name it without having seen the flower.

2. Hopea Curtisii, King, n. sp. A tree 50 to 60 feet high: young branches slender, dark-coloured, lenticellate, almost glabrous. *Leaves* coriaceous, broadly ovate to ovate-oblong, shortly acuminate or acute, the base slightly unequal-sided, rounded, rarely sub-cuneate; both surfaces glabrous, the upper slightly puberulous on the midrib near the base, the lower with several hairy glands at the base, the midrib sparsely and minutely stellate-puberulous; main nerves 10 to 13 pairs, curving, ascending, prominent beneath; length 3·5 to 4·5 in., breadth 1·75 to 2·5 in.; petiole ·4 in., puberulous when young. *Panicles* axillary and terminal, lax, few-flowered. *Flowers* about ·2 in. long, pedicelled. *Sepals* broadly ovate, blunt, concave, tomentose outside, glabrous inside; the inner two rather smaller and more glabrous than the others. *Petals* oblong, oblique, falcate, obtuse, partially tomentose outside, glabrous inside. *Stamens* 10, the filaments short, dilated; anthers ovate, short, the connective with an apical awn longer than the anther. *Ovary* broadly ovate, puberulous at the truncate apex, otherwise glabrous: style short. *Ripe fruit* ovoid, apiculate, pale striate, ·3 in. long; outer two sepals accrescent, narrowly-oblong, reticulate, membranous, obscurely 5-nerved, obtuse, slightly narrowed to the concave smooth base, 1·75 to 2·5 in. long and from ·35 to ·6 in. broad; the three inner non-accrescent sepals about as long as the fruit.

Penang: Curtis No. 1562. Perak: King's Collector, 8161.

3. Hopea micrantha, Hook. fil. in Trans. Linn. Soc., xxiii, 160. A tree 60 to 80 feet high: young branches slender with dark-coloured, lenticellate bark and minute brownish pubescence. *Leaves* coriaceous,

ovate-lanceolate or oblong-lanceolate, bluntly caudate-acuminate; the base slightly cuneate or sometimes broad, rounded and slightly unequal; both surfaces glabrous except the pubescent midrib: main nerves numerous, not much more prominent than the secondary, and both indistinct; length 2 to 4 in., breadth ·8 to 1·75 in.; petiole ·25 to ·4 in. minutely tomentose. *Panicles* axillary and terminal, numerous, short, spreading, 1 to 1·5 in. long, puberulous or glabrous. *Flowers* ·15 to ·25 in. long, shortly pedicellate. *Sepals* sub-equal, ovate-rotund, sub-acute or obtuse, puberulous and resinous outside, glabrous inside. *Petals* twice as long as the sepals, broadly oblong-obtuse, silky outside except on one side, glabrous inside. *Stamens* about 12, the filaments dilated in the lower half, longer than the ovate anthers; the connective produced into a single apical awn longer than the stamen. *Ovary* elongated, often constricted in the middle, glabrous; style very short, stigma minute. *Ripe fruit* ovoid, apiculate, ·3 in. long, striate, closely embraced by the 3 inner sepals which about equal it in length; the outer two sepals accrescent, oblanceolate, obtuse, tapering to the concave base, reticulate, 7-nerved, 1·75 to 2 in. long, and ·2 to ·25 in. broad. A. DC. Prod. XVI. 2, p. 634. Dyer in Hook. fil. Fl. Br. Ind. I, 310. Burck in Ann. Bot. Jard. Buitenzorg, VI, 238.

Malacca; Maingay (Kew Distrib.) No. 210. Penang: Curtis, Nos. 167, 266, 1397. Perak: King's Collector, Nos. 3525, 8170. Distrib. Borneo: Bangka, Sumatra.

Mr. Curtis notes on the Penang specimens of this, that the bark of the tree is smooth and of a grey colour, whereas the back of its close ally *H. intermedia* is fissured like that of *Shorea parviflora.* The species of *Hopea* with numerous indistinct nerves, (Sect. *Dryobalanoides*) are not easy to distinguish from each other in the Herbarium. *H. Mengarawan*, Miq., a species published two years earlier than this (*i. e.*, in 1860), comes very near this, and the two may possibly prove to be identical, in which case Miquel's name must be adopted. *Hopea cernua*, Teysm. and Binn. was described by its authors from a plant originally obtained from Sumatra, but cultivated in the Buitenzorg Garden. It differs from *H. Mengarawan* and from *H. micrantha* in having larger leaves with more prominent nerves. Its authors were doubtful as to its being really distinct from *H. Mengarawan*, and I think these doubts were well founded. Under the species named *H. Dryobalanoides* by Miquel (l. c) there are, Dr. Burck asserts, two plants. One of these collected at Soengie-pagoe in Sumatra, is, he says, simply *H. Mengarawan*, Miq., and it is the fruit of this which Miquel describes under his *H. Dryobalanoides.* The other specimen from Priaman in Sumatra is different, and it is to it that Dr. Burck (Ann. Bot. Jard. Buitenzorg VI., 241) desires to restrict the name *H. Dryobalanoides*, Miq. There is in the Calcutta Herbarium an authentic specimen of the very gathering of the Soengie-pagoe plant on which Miquel worked, and I should refer it to *H. micrantha* Hook. fil.

Petalandra micrantha, Harssk. has been reduced by the authors of the Genera Plantarum (Vol. I. p. 193) to *Hopea*. It is however a different plant from this, and belongs to Miquel's section *Eu-hopea*, which is characterised by the nerves being prominent. By Dr. Burck, *Petalandra* is reduced to *Doona*.

4. Hopea intermedia, King n. sp. A tree 60 to 80 feet high: young branches rather dark-coloured, minutely lenticellate, puberulous. *Leaves* coriaceous, ovate-lanceolate, caudate-acuminate, the base cuneate, both surfaces glabrous; main nerves numerous, faint; length 2·5 to 3 in., breadth 1 to 1·35 in.; petiole ·35 to ·6 in. slender, puberulous but finally glabrous. *Panicles* as in *H. Mengarawan*, the flowers pedicellate. *Sepals* sub-equal; the two outer ovate, acuminate; the three inner broader and more obtuse, all resinous outside, glabrous and smooth inside. *Petals* twice as long as the sepals, narrowly oblong, obtuse, falcate, densely sericeous externally, glabrous within. *Stamens* 12; the filaments dilated, shorter than the anthers; the anthers short, crowned by a straight awn from the connective longer than the stamen. *Ovary* hour-glass shaped; style short, stigma small. *Ripe fruit* ovoid, apiculate, ·2 in. long, pale, striate; the two outer sepals accrescent, narrowly oblong-obtuse, narrowed to the base, reticulate, obscurely 5- to 7-nerved, 1·25 to 1·5 in. long and ·25 in. broad; the inner three sepals not accrescent, not longer than the fruit, and closely embracing it.

Penang: Curtis, No. 425 and 1398. Perak: King's Collector, No. 3709.

This species is no doubt near to *H. micrantha*, Hook. fil., but, according to Mr. Curtis, it is distinguishable from that, while growing, by its bark, this tree having a fissured bark like that of *Shorea parvifolia*, Dyer, while the bark of *H. micrantha* is smooth and grey. The petals of this are also more sericeous than those of *H. micrantha*, the filaments are shorter than the anthers (not longer, as in *H. micrantha*), the leaves are more glabrous, the petioles longer and more slender and more glabrous, and the fruit and accrescent sepals are smaller than in *H. micrantha*. I have therefore ventured, after much hesitation, to name this as a species, and from its relationship to *H. micrantha* and *H. Mengarawun*, I have called it *H. intermedia*. Its vernacular name in Penang is *Jankang*. It has been suggested that this plant should be referred to *H. Dryobalanoides*, Miq.—a course which I would have adopted with great pleasure had it been clear what *H. Dryobalanoides* really is.

But, as I have stated in a note under *H. micrantha*, *H. Dryobalanoides* appears to be a composite species; moreover, its author nowhere describes its flowers. For these reasons I think it ought to be suppressed as a species.

7. RETINODENDRON, Korthals.

Resinous trees, with the leaves, inflorescence, and flowers of *Vatica*. *Ripe fruit* globular, crowned by the persistent style, 1-celled, 1-seeded, the pericarp coriaceous, indehiscent. *Calyx* of ripe fruit slightly accrescent, the pieces oblong, nearly equal, and quite free from, and usually shorter than, the fruit (longer in. *R. Kunstleri*). *Isauxis* (sub-genus of *Vateria*) W and A. DISTRIB. Malaya and British India. Species about 10.

Isauxis was established by Wight and Arnot as a sub-genus of *Vateria*, Linn. to receive the three species *Vateria lancexfolia*, Roxb., *V. Roxburghiana*, Wight and *V. Ceylonica*, Wight (*Stemoporus Wightii*, Thw.) and its characters were, "Segments of the calyx ovate, acute, enlarging in fruit; petals falcate and about three times the length of the calyx: *stamens* 15 with oblong anther cells; *style* short; *stigma* clavate, 3–6 toothed: *panicles* axillary, shorter than the leaves." The other section of *Vateria* suggested by Wight was *Eu-Vateria* (the *Vateria* of Linnæus and of which *V. indica*, L. is the type) and of this the characters are, "*Calyx-segments* obtuse, scarcely enlarging in fruit: *petals* oval, scarcely longer than the calyx: *stamens* 40 or 50 with linear anther-cells: *style* elongated: *stigma* acute; *panicle* large and terminal. Korthals, evidently overlooking Wight's Illustrations, published (Verh. Nat. Gesch. Ned. Ind. p. 56) his genus *Retinodendron* to cover one of the very plants (*viz.*, *Vateria lancexfolia*, Roxb.) for which Wight and Arnot founded the sub-genus *Isauxis*; and to this *Retinodendron* Korthals added his own Malayan species *R. Rassak* and *R. pauciflorum*. Although *Isauxis* may have the priority as a sub-genus (Wight's Illustrations were published in 1840, and Korthals' book, just quoted, bears the date 1839—1842), *Retinodendron* takes precedence as a *genus*. The flowers of *Retinodendron* are exactly those of all the species of *Vatica* (except the anomalous *V. scaphula*, Roxb.) inasmuch as the segments of the calyx are slightly imbricate when the bud is very young, becoming valvate as the bud advances in age; the petals are much longer than broad, their apices are not inflexed in æstivation, and they are not spreading when expanded. The fruit itself is also practically that of *Vatica*; but the fruiting-calyx is different, for its lobes are invariably free from the beginning, they are pretty nearly equal to each other, but (although slightly accrescent) they are in most cases *shorter* than the fruit. As regards its calyx, *Retinodendron* is closely allied to *Vateria*, but it differs from *Vateria* in its flowers; for in *Vateria* the stamens are numerous (40 to 50), the petals are scarcely longer than the segments of the calyx and are spreading; moreover the inflorescence is longer in *Vateria* than in *Retinodendron*, and it is terminal. In short, *Retinodendron* has the flowers of *Vatica* and the fruit of *Vateria*. Dr. Burck forms *Retinodendron* and *Isauxis* into sections of the genus *Vatica*, giving however characters to the section *Isauxis* which form no part of Wight's original characters of it as a sub-section of *Vateria*. In Dr. Burck's section *Isauxis*, "the calyx-lobes are all accrescent, sub-equal to the fruit, or much longer."

Fruiting-calyx shorter than the fruit.

Leaves 3·5 to 6 in. long: fruit ·4 in. in diam. 1. *R. pallidum.*

Leaves 7 to 10 in. long: fruit ·65 in. in diam. 2. *R. Scortechinii.*

Fruiting-calyx longer than the fruit ... 3. *R. Kunstleri.*

1. RETINODENDRON PALLIDIUM, King. A small tree (fide Dyer): young branches slender, deciduously puberulous, their bark pale. *Leaves* coriaceous, oblong-lanceolate to narrowly elliptic, acuminate; the edges entire, recurved when dry; the base acute: both surfaces glabrous, the upper shining; main nerves 9 to 10 pairs, curving, oblique; length 3·5 to 6 in., breadth 1·2 to 1·8 in., petiole ·4 to ·5 in. *Panicles* axillary, rarely extra-axillary, puberulous, 1 to 3 in. long. *Flowers* ·45 in. long; *Calyx-segments* ovate-lanceolate, scurfy-pubescent. *Petals* oblong, lanceolate, sub-acute, stellate-pubescent externally. *Anthers* broadly ovate, with a short blunt apiculus. *Ovary* puberulous; stigma capitate, lobed. *Fruit* globular, about ·4 in. in diam., glabrous, shining, very minutely and sparsely lepidote, partially covered in the lower half by the slightly unequal, spreading or sub-reflexed, narrowly-oblong, membranous, 3-nerved, reticulate calyx-lobes. *Vatica pallida*, Dyer in Hook. fil. Fl. Br. Ind. I, 302.

Penang: Maingay, on Government Hill, at an elevation of about 800 feet; Curtis, No. 117; King, Kunstler.

This is known only from Penang. It is evidently a rare tree. Its fruit somewhat resembles (except in size) that of *V. lanceæfolia*, Blume.

2. RETINODENDRON SCORTECHINII, King, n. sp. A tall tree: young branches rather stout, densely furfuraceous-pubescent. *Leaves* coriaceous, oblong, tapering to the sub-acute apex; the base slightly narrowed, rounded: both surfaces glabrous: main nerves 14 to 18 pairs, spreading, curving, prominent on the lower, depressed on the upper, surface when dry, the transverse venation bold: length 7 to 10 in., breadth 2·6 to 3·2 in, petiole ·6 to ·75 in. *Panicles* crowded towards the apices of the branches, mostly axillary, 2 to 2·5 in. long, the rachises brownish flocculent stellate-tomentose, as is the calyx externally. *Flowers* ·6 in. long. *Calyx-lobes* ovate. *Petals* thick, oblong, blunt, puberulous externally, glabrous within. *Stamens* elliptic, apiculate. *Ovary* minutely tomentose; stigma clavate. *Ripe fruit* sub-globular, sub-rugose, vertically grooved, minutely rufous-scurfy, about ·65 in. in diam., laxly embraced in the lower half by the broadly ovate, membranous, many-nerved, reticulate, sub-equal calyx-lobes.

Perak: Scortechini, Nos. 1940 and 1942.

The calyx-lobes are nearly equal in size, quite free from the fruit, much shorter, and they embrace only its lower half. This species is allied to *Retinodendron Rassak*, Korth. (Nat. Gesch. Ned. Ind. 56, t. 8,) but has broader leaves and much more condensed panicles than that species.

3. Retinodendron Kunstleri, King n. sp. A tree, 20 to 50 feet high, sometimes a shrub: young branches slender, deciduously stellate-puberulous. *Leaves* thinly coriaceous, elliptic-oblong to oblong-lanceolate, sometimes slightly obovate, sub-acute or shortly and bluntly acuminate; the base cuneate, rarely rounded: upper surface glabrous, the midrib and nerves pubescent; the lower quite glabrous; main nerves 7 to 9 pairs, ascending, slightly prominent beneath: length 2·25 to 4·5 in., breadth 1·25 to 1·75 in., petiole ·25 to ·4 in. *Racemes* axillary, 1 to 1·5 in. long, sparsely scaly. *Flowers* ·4 in. long. *Calyx-lobes* ovate-lanceolate, puberulous. *Petals* oblong-elliptic, oblique, obtuse, puberulous outside. *Anthers* slightly and sharply apiculate. *Ovary* puberulous, stigma capitate. *Ripe fruit* globular, with a long curved apical beak, glabrous, about ·25 in. in diam. *Calyx-lobes* all accrescent, sub-equal, oblong, tapering slightly to the sub-obtuse apex, the base slightly auricled, thickly membranous, glabrous, 3-nerved, the longest about 1·3 in. long, and ·35 in. broad, loosely surrounding, and longer than, the fruit.

Perak; Scortechini, Wray, King's Collector; very common at low elevations.

In this species all the five calyx-lobes are accrescent and of nearly equal size. They are quite free from the ripe fruit, round which they form a loose semi-inflated investiture. Its nearest ally is *Vatica bancana*, Scheffer, (*Retinodendron bancanum*).

8. Isoptera, Scheffer.

A tall resinous tree. *Leaves* coriaceous, entire, feather-veined. *Flowers* in axillary or terminal panicles. *Calyx-tube* very short, the segments ovate-rotund, imbricate. *Stamens* 30 to 35, the anthers ovate, the cells divergent at the base, acute, the valves equal, the connective produced into an apical bristle-like appendage. *Ovary* 3-celled, the loculi bi-ovulate; the style short, terete, 3-angled at the apex. *Fruit* indehiscent, 1-seeded, the pericarp coriaceous. *Fruiting-calyx* an open cup not embracing the fruit; its lobes all slightly enlarged, spreading (not winged); the outer 3 rotund, broader than the 2 narrower inner lobes.

One species—Malayan.

1. Isoptera Borneensis, Scheff. MSS. ex Burck in Ann. Bot. Jard. Buitenzorg VI, 222. A large tree: young branches slender, dark-coloured, sparsely lenticellate, glabrescent. *Leaves* coriaceous, oblong, sub-acute, slightly narrowed to the rounded base: upper surface glabrous except the puberulous midrib; the lower pale, glabrous; main

nerves 8 or 9 pairs, oblique, slightly curving, prominent beneath; length 4 to 5 in., breadth 1·75 to 2 in., petiole ·5 in. *Panicles* 4 to 6 in. long, stellate-pubescent; bracteoles caducous. *Flowers* shortly stalked. *Calyx-segments* minutely tomentose. *Petals* ·5 in. long, pale tomentose. *Stamens* 30 to 36, in 3 series, the filaments dilated at the base: anthers with equal valves. *Ovary* sericeous, style glabrous. *Ripe fruit* sub-globose, acuminate, pale tomentose, about ·25 in. in diam.; fruiting-calyx forming a cup with a concave short tube embracing the fruit, the segments spreading, re-curved, the 3 outer ·65 in. in length and breadth, the 2 inner smaller. Heim, "Recherches sur les Dipterocarpacées," p. 51.

Pahang: Ridley, No. 2626. DISTRIB. Bangka, Borneo.

Leaf-specimens of what appear to be this tree were collected by Mr. Wray (Herb. No. 3426) in Upper Perak.

9. BALANOCARPUS, Beddome.

Glabrous or puberulous, rarely scabrid, resinous trees, with inconspicuous fugaceous stipules. *Leaves* entire, coriaceous or membranous, penni-nerved. *Flowers* secund, sessile or shortly pedicelled. *Sepals* distinct or united at the base, imbricated, two quite external to the others; in fruit sub-equal, only slightly enlarged, woody, thickened, and forming a 5-lobed cup round the base of (but rarely enveloping) the fruit, not adnate to it and never expanding into wings. *Petals* elliptic, obliquely acuminate, the apices slightly inflexed in bud or not inflexed at all. *Stamens* 15, attached to the bases of the petals, in 3 rows; or 10 in 2 rows, sub-equal, the filaments much dilated at the base, the connective prolonged into a straight apical awn longer than the ovate anther. *Torus* flat. *Ovary* 3-celled, cells 2-ovuled, ovules collateral. *Style* short. *Stigma* minute, entire. *Fruit* oblong or sub-globose, apiculate; the pericarp ligneous or sub-ligneous. *Seed* solitary, erect; cotyledons fleshy, plano-concave, the larger 2- or 3-lobed, or entire; the radicle prominent. Southern Peninsular India, Malaya. Probably 12 species.

Leaves glabrous, smooth.
  Leaves ovate-lanceolate or ovate, caudate-acuminate.
    Stamens 15
      Fruit entirely enveloped in the slightly enlarged calyx ... ... 1. *B. Curtisii.*
      Only the lower part of the fruit enveloped by the calyx ... ... 2. *B. penangianus.*
    Stamens 10 ... ... 3. *B. anomalus.*

Leaves narrowly oblong, gradually narrowed to the acute apex.
Fruit 1·75 to 2·25 in. long: stamens 10 ... 4. *B. maximus.*
Fruit 1·5 in. long; leaves 4 to 6 in. long, with 9 or 10 pairs of bold parallel nerves ... ... 5. *B. Heimii.*
Fruit ·6 in. long: leaves 2·25 to 2·75 in. long, with 7 or 8 pairs of slightly prominent nerves ... ... 6. *B. Wrayi.*
Leaves stellate-pubescent, scabrid ... ... 7. *B. Hemsleyanus.*

1. Balanocarpus Curtisii, King. A tree 20 to 30 feet high: young branches slender, the bark dark-coloured, puberulous. *Leaves* membranous, ovate-lanceolate, bluntly caudate-acuminate, the base slightly cuneate: both surfaces glabrous, dull; main nerves 8 to 10 pairs, spreading, faint and scarcely more prominent than the secondary nerves; length 2 to 2·5 in., breadth ·75 to 1 in., petiole ·1 to ·15 in. *Panicles* axillary and terminal, shorter than the leaves, glabrescent, lax, each with a few 3- to 5-flowered spreading branches. *Flowers* secund, shortly pedicelled, ·15 in. long. *Sepals* distinct, sub-equal, thick, rotund-ovate, very obtuse, puberulous outside, glabrous inside, the edges slightly ciliate. *Petals* elliptic, obliquely shortly and bluntly acuminate, glabrescent inside, partly puberulous and partly glabrous outside. *Stamens* 15, in 3 rows, sub-equal; the filaments shorter than the anthers, dilated: anthers broadly elliptic, truncate, the connective produced into an apical awn longer than the stamen. *Ovary* cylindric, truncate, glabrous, the style short and stigma minute. *Fruit* smooth, globular, apiculate, crowned by the sub-sessile discoid stigma, enveloped by, but not adherent to, the slightly thickened sepals, ·25 to ·3 in. in diam. (calyx included).

Penang: Curtis, No. 1406. Perak: King's Collector, Nos. 3171, 3294, 6543; Wray, No. 2860.

2. Balanocarpus penangianus, King, n. sp. A tree 40 to 50 feet high: young branches slender, dark-coloured, lenticellate, slightly puberulous at the very tips. *Leaves* coriaceous, ovate-lanceolate or ovate-acuminate, often caudate-acuminate, the base slightly cuneate or almost rounded, the edges slightly undulate, both surfaces glabrous: main nerves 7 to 8 pairs, spreading and curving upwards, not prominent on either surface; length 1·75 to 4 in., breadth ·8 to 1·6 in., petiole ·25 to ·4 in. *Panicles* axillary and terminal, hoary-pubescent, many-flowered; the flowers secund, 7 to 9 on each lateral branchlet, pedicelled, ·15 to ·2 in. long. *Sepals* sub-equal, broadly ovate, sub-acute, yellowish-pulverulent, tomentose externally, glabrous internally. *Petals* oblong, obtuse, twisted and with the apices reflexed in æstivation, spreading

when expanded, minutely yellowish-pulverulent, tomentose outside, glabrous inside. *Stamens* 15, sub-equal: apical awn curved, longer than the anther. *Ovary* ovoid, narrowing upwards into the style; stigma minute. *Fruit* ovoid, very slightly apiculate, striate, pale pubescent, about ·6 in. long and ·3 in. in diam., the persistent calyx covering the lower third of the fruit, sub-glabrous, thickened and concave at the base; the teeth deltoid, spreading. *Richetia penangiana*, Heim in Bull. Soc. Linn. Paris, 1891, p. 980.

Penang: on Government Hill, at an elevation of about 1,000 feet, Curtis, Nos. 1429 and 1393; Hullett, No. 188; King's Collector, No. 1534. Perak: King's Collector, Nos. 3333, 3707.

The leaves of this species, although larger, resemble those of *B. Curtisii*: but the fruits of the two are quite different. One of Mr. Curtis' specimens, No. 429 (communicated from Kew), forms the type of a new genus called *Richetia*, which M. Heim has founded (l. c. p., 975, also in his "Recherches sur les Dipterocarpacées" p. 50), without having seen its flowers. I have retained for this M. Heim's specific name, while referring it to Beddome's older genus. The vernacular name of the species is *Dammar Etam.*

3. Balanocarpus anomalus, King. A tree: young branches slender, dark-coloured, minutely lenticellate, the tips puberulous. *Leaves* coriaceous, ovate, acuminate; the base broad, sub-cuneate; both surfaces glabrous; main nerves 6 or 7 pairs, ascending, curving, not prominent: length 2·25 to 2·5 in., breadth 1 to 1·3 in., petiole ·6 to ·7 in. *Panicles* numerous, axillary and terminal, longer than the leaves, pubescent, their lateral branchlets bearing 6 to 8 sub-secund flowers. *Flowers* shortly pedicelled, ·15 in. long. *Sepals* broadly ovate, connate at the base, obtuse, minutely tomentose outside, glabrous inside. *Petals* elliptic, blunt, yellowish adpressed-sericeous outside, glabrous inside, only about twice as long as the sepals, spreading and reflexed so as to expose the stamens and pistil. *Stamens* 10, in two rows; the filaments longer than the anthers, dilated; anther short, ovate, its connective produced into an apical awn as long as itself. *Ovary* ovoid, striate, pubescent, style short and thick, stigma small.

Kedah: Curtis, No. 1654.

Mr. Curtis is as yet the only collector of this, and his specimens have no fruit. I refer it to this genus, although its flowers differ from those of the other species known to me, in having petals only about twice as long as the sepals, spreading and reflexed so that the androgynœcium is quite exposed; and in having only 10 stamens In other respects the specimens agree with *Balanocarpus.* Its vernacular name in Kedah is *Malaut.*

4. Balanocarpus maximus, King, n. sp. A tree 60 to 80 feet high: all parts except the inflorescence glabrous: young branches rather stout; the bark, loose, papery, lenticellate, pale. *Leaves* thinly coriaceous, oblong to elliptic-oblong, sub-acute, slightly narrowed to the rounded base; main nerves 7 to 9 pairs, slightly prominent beneath, the transverse veins slightly prominent when dry: length 5 to 7 in., breadth 2 to 2·5 in., petiole ·5 to ·6 in. *Panicles* axillary or terminal, about half as long as the leaves, few-flowered, minutely tomentose. *Flowers* sub-sessile, ·6 or ·7 in. long. *Sepals* broadly ovate, the outer two tomentose, the inner three more or less glabrous externally, all glabrous internally, the inner two with ciliate margins. *Petals* much longer than the sepals, narrowly oblong, the apex erose, expanded and concave at the base, ad-pressed-pubescent outside and towards the apex inside, otherwise glabrous. *Stamens* 10, in two rows; anthers with a deflexed terminal appendage from the connective. *Ovary* elongate, narrowly conical, sericeous. *Style* rather short, glabrous; stigma small. *Ripe fruit* cylindrical, tapering to each end but most to the apiculate apex; pericarp woody, striate, sub-glabrous, pale-brown when dry: 1·75 to 2·25 in. long, and ·6 or ·7 in. in diam. *Persistent sepals* fibrous, forming a toothed cup about ·5 in. deep, embracing the base of the fruit.

Perak: King's Collector, Nos. 7987 and 8006.

The flowers of this fine species do not exactly answer to Beddome's diagnosis of the genus *Balanocarpus*, inasmuch as they have 10 instead of 15 stamens, and neither of the cotyledons is lobed. In other respects the flowers and fruit agree perfectly.

5. Balanocarpus Heimii, King n. sp. A tree 50 to 60 feet high: young branches rather slender, the bark dark-coloured, puberulous or glabrescent. *Leaves* coriaceous, narrowly oblong, tapering to the acuminate apex, and slightly narrowed to the rounded base; upper surface glabrous, shining, the midrib minutely pubescent: lower surface glabrescent except the pubescent midrib and 9 or 10 pairs of ascending, bold, slightly-curving nerves: length 4 to 6 in., breadth 1 to 1·75 in.; petiole ·3 or ·4 in., with minute black tomentum. *Flowers* unknown. *Ripe carpels* cylindric, tapering to the apex, slightly narrowed to the base, 1·5 in. long and ·5 in. in diam.; the pericarp woody, sub-glabrous, sub-striate, dark-coloured when dry. *Persistent sepals* sub-equal, puberulous, thickened, forming a 5-lobed cup ·6 in. deep which embraces the base of the fruit. *Pierrea Penangiana*, Heim, MSS.

Penang: Curtis No. 273 (leaves only). Perak: King's Collector, No. 3718.

This tree, of which as yet only fruiting specimens have been found, so closely resembles the other Malayan species of *Balanocarpus* described here, that I refer it without any hesitation to this genus. M. Curtis' leaf specimens of this have, I understand, received from M. Heim the MSS. name, *Pierrea penangiana*. The genus *Pierrea* has been founded by M. Heim (Bull. Soc. Linn. Paris, 1891, p. 958, and "Recherches sur les Dipterocarpacées", p. 78) on specimens of which the author has not (as he admits) had the advantage of seeing the flowers. The vernacular name of this tree in Penang is *Chengah*, and its timber is, according to Mr. Curtis, very valuable. In the State of Perak, on the mainland almost opposite Penang, another species (*B. Wrayi*) receives a similar vernacular name.

6. BALANOCARPUS WRAYI, King n. sp. A tree: young branches slender, dark-coloured, glabrous. *Leaves* coriaceous, narrowly oblong, gradually tapering from the middle to the acute apex; the base sub-cuneate or rounded, slightly unequal-sided: both surfaces glabrous; main nerves 7 or 8 pairs, curved, oblique, slightly prominent beneath: length 2·25 to 2·75 in., breadth ·75 in.; petiole ·25 in., transversely wrinkled. *Panicles* axillary and terminal, nearly as long as the leaves. *Flowers* unknown. *Fruit* ovoid, much apiculate, glabrous, ·6 in. long, covered in its lower two-thirds by the persistent sub-accrescent glabrous calyx; outer two sepals smaller than the others, elliptic, obtuse, the inner three rotund, all thickened and concave.

Perak: Wray, No. 813.

Collected only once and without flowers. According to Mr. Wray the timber of this tree is valuable, and its vernacular name is *Chingi*, or *Chingal*. I refer this (in spite of the absence of flowers) to *Balanocarpus*, the other species of which it so closely resembles.

7. BALANOCARPUS HEMSLEYANUS, King, n. sp. A tree 50 to 100 feet high: young branches rather stout, rough, minutely lenticellate, puberulous. *Leaves* coriaceous, elliptic-oblong, sometimes slightly obovate, shortly and abruptly acuminate, slightly narrowed to the rounded or sub-emarginate base: upper surface glabrous except the minutely tomentose midrib; the lower scabrid from minute rigid stellately hairy tubercles which are most abundant on the stout midrib and nerves: main nerves 18 to 20 pairs, oblique, parallel, very prominent on the lower, obsolete on the upper, surface; length 7 to 12 in., breadth 3·25 to 5 in.; petiole ·6 to ·9 in. scabrid, pubescent. *Panicles* axillary or terminal, 3 to 7 in. long, scurfy stellate-pubescent; flowers rather crowded on the lateral branchlets, ·5 in. long, *Sepals* sub-equal, broadly ovate, acute, yellowish-tomentose externally, glabrous internally. *Petals* twice as long as the sepals, or longer, elliptic, oblique, obtuse, glabrous except a broad adpressed-sericeous band externally. *Stamens* 15, in three rows: the filaments dilated, unequal, longer than

the shortly ovate anthers; apical connectival appendage deflexed, curved, longer than the anther. *Ovary* elongated-conic, tomentose, tapering into the sparsely puberulous style; stigma small. *Ripe fruit* narrowly ovoid, apiculate, pale brownish-tomentose, 1·25 to 1·5 in. long. and ·75 to 1 in. in diam. *Persistent sepals* nearly equal, their bases thickened, woody, pubescent, and concave, forming an irregularly 5-toothed cup which embraces the lower half of the fruit. *Shorea Hemsleyana*, King MSS. in Herb. Calc.

Penang: Curtis No. 2512. Perak: King's Collector, Nos. 5431, 6670, and 7562. Scortechini No. 1653.

This is an altogether anomalous species. It has leaves like several of the scabrid species of *Shorea*, such as *S. eximia* and *S. leprosula*. Its flowers are also more like those of *Shorea* than *Balanocarpus;* but its fruit is essentially that of the latter genus, in which, not without hesitation, I include it.

10. PACHYNOCARPUS, Hook. fil.

Resinous trees with the leaves and flowers of *Vatica*, but with sometimes only ten stamens. *Fruit* ovoid-globose, umbonate at the apex, 1-celled, 1-seeded, the pericarp densely coriaceous, splitting vertically. *Calyx* with five equal segments, at first almost free from the fruit, but the tube gradually accrescent, much thickened and adnate to the fruit, and finally embracing the whole of it except the apex. *Seed* pendulous, testa thin and adherent to the endocarp, cotyledons very thick and fleshy.

Leaves elliptic to oblong-elliptic, sub-acute or shortly and obtusely acuminate... ... 1. *P. Wallichii.*

Leaves broadly-elliptic or obovate-elliptic, the apex very blunt ... ... 2. *P. Stapfianus.*

Dr. Burck (in Ann. Jard. Bot. Buitenzorg) expands the definition of the genus *Vatica* so as to include not only the closely allied *Synaptea*, but also the genera *Isauxis* W. A, *Retinodendron*, Korth., and *Pachynocarpus* Hook fil. To the union of *Synaptea* with *Vatica* I see no objection; for the whole difference between the two (as I have stated in a note under *Vatica*) consists in perfect freedom of the fruit in *Vatica* from the enlarged calyx, whereas in *Synaptea* there is a slight adhesion to the calyx at the very base. But for the inclusion of *Pachynocarpus*, I see no sufficient justification; for in this genus the calyx does not expand into membranous wings, but forms a dense fibro-cartilaginous cover for the fruit, which it tightly embraces, and to which it is quite adnate. As regards *Isauxis* and *Retinodendron*, they appear to me to be undistinguishable from each other by any but trivial marks, but they differ sufficiently in calyx from *Vatica* to be treated as a genus under the older name *Retinodendron*.

1. PACHYNOCARPUS WALLICHII, King. A tree 40 to 70 feet high: young branches deciduously scurfy-puberulous, their bark pale-brown, sparsely lenticellate. *Leaves* coriaceous, elliptic to oblong-elliptic,

sub-acute, or shortly and obtusely acuminate, the base cuneate; both surfaces glabrous, the lower pale and prominently reticulate when dry: main nerves 6 to 9 pairs, slightly prominent beneath, ascending; length 4·5 to 8 in., breadth 1·5 to 3 in., petiole; ·4 to ·6 in. *Panicles* crowded near the apices of the branches, many-flowered, 2 to 4 in. long. *Calyx-lobes* deltoid, minutely velvety outside. *Petals* linear-oblong, obtuse, puberulous externally. *Stamens* broadly ovoid, minutely but obtusely apiculate. *Ovary* puberulous: stigma sub-capitate, lobed. *Ripe fruit* ovoid-globose, about ·75 in. in diam., closely embraced by the slightly shorter, much thickened, persistent, fibrous or woody, rugose, enlarged calyx-lobes. *V. Wallichii* Dyer in Journ. Bot. 1878 p. 154. *Vatica ruminata,* Burck in Ann. Jard. Bot Buitenzorg, VI, 227 t. 29, fig. 4.

Penang: Wallich, Cat. No. 9018; Curtis Nos. 1161, 1218, 1391. Malacca: Maingay No. 201. Trang, King's Collector. Johore, Hullett and King. Perak: common at low elevations, King's Collector, Scortechini. DISTRIB., Bangka.

In the young stages of the fruit of this species the calyx is quite small and embraces only the very base of it, much as in *Isauxis;* but as the fruit expands the calyx grows, so that when ripe the fruit is, with the exception of its apex, closely embraced by the much thickened, lignified, obscurely toothed calyx-tube. This offers, therefore, a transition between *Isauxis* and *Pachynocarpus.* And, indeed, it is to the former section that Dyer refers it (Journ. Bot., l. c.), and to which Burck refers his *D. ruminata*, a species which authentic specimens shew to be identical with this. Dr. Burck's species, *Vatica verrucosa* (Ann. Jard. Bot. Buitenzorg) appears also to come very near to this.

2. PACHYNOCARPUS STAPFIANUS, King, n. sp. A tree 80 to 100 feet high: young branches rather stout, scaly-pubescent at first, ultimately glabrous. *Leaves* coriaceous, broadly elliptic or obovate-elliptic, the apex broadly rounded, slightly narrowed to the rounded or sub-cuneate base: upper surface glabrous, shining, the lower paler, minutely and sparsely scurfy-puberulous on the midrib and nerves; main nerves 10 to 13 pairs, oblique, prominent on the lower, depressed on the upper, surface; length 5 to 8 in., breadth 2·75 to 4·5 in., petiole ·65 to 1 in. *Flowers* unknown. *Ripe fruit* almost solitary, 2·5 to 3 in. long, on a woody raceme, globular, slightly apiculate, 1·25 in diam., closely invested by the gamosepalous, 5-toothed, thickened, woody, rugose, glaberulous calyx.

Perak: King's Collector, Nos. 5932 and 6132,

This very distinct species was first recognised as a *Pachynocarpus* by Dr. O. Stapf, of the Kew Herbarium, after whom I have named it. Its flowers are as yet unknown; but it is readily identified by its leaves.

11. Ancistrocladus, Wall.

Smooth climbing shrubs with short supra-axillary, often arrested and circinately-hooked, branches. *Leaves* usually in terminal tufts, coriaceous, entire, reticulately feather-veined; exstipulate. *Flowers* usually small, very caducous, in terminal or lateral panicles. *Calyx-tube* at first short, adnate to the base of the ovary, its lobes imbricate, finally turbinate and adnate to the fruit, with the lobes unequally enlarged, spreading and membranous. *Stamens* 5 or 10, subperigynous. *Ovary* 1-celled, inferior; style sub-globose, persistent; *Stigmas* 3, erect, compressed, truncate, deciduous. Ovule solitary, erect or laterally affixed. *Seed* sub-globose, testa prolonged into the ruminations of the copious fleshy albumen; embryo short, straight; cotyledons short, divergent.—Distrib. Except *A. guineensis* in W. Tropical Africa, confined to Tropical Asia and the Indian Archipelago. Species about 10.

I follow the authors of the Genera Plantarum and the Flora of British India in including *Ancistrocladus* in *Dipterocarpeæ*. I venture, however, to think that it would be better to keep it as the type of a distinct Natural Order as MM. Planchon and De Candolle have done: for its characters do not fit well into the diagnosis of any other Order

1. Ancistrocladus extensus, Wall. Cat. 1052. *Leaves* obovate or obovate-oblong, blunt or sub-acute, much narrowed at the base; panicles dichotomous, about half as long as the leaves: fruit smooth or slightly 5-ridged; accrescent calyx-lobes oblanceolate, obtuse. Planch. in Ann. Sc. Nat. Ser. 3, XIII, 318. DC. Prodr. XVI, 2, 602; Dyer in Hook. fil. Fl. Br. Ind. I, 299. *Ancistrolobus* sp. Griff. Notul. IV, 568, t. 605. fig. 2.

Andaman Islands. Distrib. Burmah.

Var. *pinangianus;* leaves sometimes oblanceolate-oblong, acute or sub-acuminate: panicles slender, lax, about as long as the leaves. *Ancistrocladus pinangianus*, Wall. Cat. 1054. Planchon in Ann. Sc. Nat. Ser. 3. XIII, 318; A. DC. Prodr. XVI. 2, 603; Dyer in Hook. fil. Fl. Br. Ind. I, 300.

Penang: Porter. Malacca: Maingay. (Kew Distrib.) No. 200. Singapore and Perak: King's Collectors. Distrib. Bangka, Sumatra, Burmah.

On some Newly-recorded Corals from the Indian Seas, by A. Alcock, M.B., C.M.Z.S., *Officiating Superintendent of the Indian Museum.*

Plate V.

[Received May 22nd, Read June 7th].

As so little has been written about the coral fauna of the seas within the limits of the Indian peninsulas, the following account of the corals dredged in recent years by the "Investigator," and by the late Professor Wood-Mason, may be of interest.

No reference is made in this paper to the true reef-forming corals.

FAMILY TURBINOLIDÆ.

Flabellum, Lesson.

1. *Flabellum stokesi*, Edw. & Haime, Moseley.

Flabellum stokesi, *Flabellum oweni*, *Flabellum aculeatum*, *Flabellum spinosum*, all of Milne-Edwards and Haime, Hist. Nat. des Coralliaires, vol. ii. pp. 96, 87 and 88.

Flabellum variabile, Semper, Z. Wiss. Zool., vol. xxii, 1872, p. 245.

Flabellum stokesi, Moseley, Challenger Deep-sea Madreporaria, p. 172.

This species, not hitherto recorded in the Indian Fauna, is common from Ceylon, along the east coast of India, to the Andaman Islands, at depths of from 20 to 30 fathoms. The numerous specimens dredged by Professor Wood-Mason in the Andaman Sea, and by the "Investigator" elsewhere, fully bear out Professor Semper's views as to the identity of all the four species of MM. Milne-Edwards and Haime above-cited. Undoubtedly Professor Semper's name for the species is very appropriate; but, as Professor Moseley says, it is necessary to retain one of the original names, and he has selected the specific designation *stokesi* as being least likely to lead to error.

Acanthocyathus, Edw. & Haime.

2. *Acanthocyathus grayi*, Edw. & Haime.

Acanthocyathus grayi, Milne-Edwards and Haime, Hist. Nat. des Corall., vol. ii. p. 22.

This species was described by MM. Milne-Edwards and Haime as of "patrie inconnue:" I have little hesitation in identifying with it a single specimen dredged by Professor Wood-Mason in the Andaman Sea.

PARACYATHUS, Edw. & Haime.

3. *Paracyathus indicus*, Duncan, var. nov. *gracilis*. Vide Duncan, Journ. Linn. Soc., Zool., vol xxi. 1889, p. 3.

The type of this species, which was brought by Dr. Anderson from Mergui, is in the Indian Museum, and I have now to record a distinct variety from the Bombay coast. This variety is characterized by its greater delicacy, and by the form of the corallum, which is subturbinate with a long slender pedicle.

4. *Paracyathus cavatus*, n. sp. Pl. V figs. 1. 1a., very near *Paracyathus crassus*, Edw. & Haime.

Corallum with a broad encrusting base, gently expanding into a low, slightly curved, sub-circular calice.

Costæ distinct from the basal encrustment, finely and distantly granular, every alternate one conspicuously salient.

Calice sub-circular, open, deep: the marginal axes in the same plane.

The finely and distantly granular septa are in five incomplete crowded cycles, and do not project far into the calice; those of the first three cycles are exsert. Those of the incomplete fifth cycle are small, and unite with those of the fourth cycle just below the calicular margin, while those of the fourth cycle unite with those of the third deep down in the calyx. The pali are in the form of numerous strong salient and very regular denticulations of the septal margins,—excluding those of the last cycle: those of the primary septa are much the most distinct, not because they are larger but because they are isolated.

The columella is very small, deeply-seated and concave, consisting of numerous minute close-set papillæ.

The tips of the septa are coloured pale madder-brown.

Greatest height of corallum 9 mm., major diameter of calice 11 mm., minor diameter of calice 10 mm., diameter of basal constriction 7 mm.

From the Persian Gulf.

The species is characterized by the very distinct alternately-salient costæ, by the deep hollow calice into which the septa project but little, and by the isolation of the series of strong paliform teeth opposite the septa of the first cycle.

5. *Paracyathus fulvus*, n. sp. Plate V, figs. 2. 2a., near *Paracyathus crassus*, Edw. & H.

Corallum low, with an extensively encrusting base, and a short stout gently curved cylindrical peduncle which expands gradually into a circular slightly drooping calicle.

Costæ indistinct at the base but gradually becoming distinct near the margin of the calicle, where they are broad, finely granular and in all respects uniform.

The circular calice is open and moderately deep, with the marginal axes on the same plane.

The septa, which are in six systems, are exsert, with blunted slightly crenulated edges and distantly granular surfaces. Those of the first cycle are particularly distinct, being larger and stouter than those of any of the other cycles, projecting more into the calicle, and being more exsert beyond the margin. The quaternaries unite with the tertiaries near the columella. The pali have the form of stout granular pinnacles in three crowns, decreasing in size from without inwards, before all the septa but those of the last cycle.

The columella is small circular and slightly concave, and consists of numerous crowded granules.

In the type specimen the height of the corallum is 12·5 mm., the diameter of the calice 10·5 mm., and the diameter of the peduncle 7 mm.

The septa and pali are of a permanent tawny-brown colour.

The specimens in the Museum came from the telegraph cable in the Persian Gulf.

The distinctive characters of this species are the marked predominance of the primary septa, and the definition and regularity of the pali.

6. *Paracyathus porphyreus*, n. sp. Plate V, figs. 3. 3a, near *Paracyathus pulchellus*, Edw. & H.

Corallum with an encrusting base, above which it is suddenly constricted to again gradually expand into a slightly drooping, turbinate calice.

Costæ distinct from the base, equal, finely granular, depressed.

The calice is slightly elliptical, with marginal axes almost on the same plane: it is deep, but its cavity is about two-thirds filled by the septa.

The septa, which are crowded and exsert, are in four complete cycles in the young, with an incomplete fifth cycle in older examples: they have sharp and slightly crenulated edges and coarsely granular surfaces: those of the first two cycles are the most exsert: those of the fourth cycle unite with those of the third deep down in the calice behind the outer crown of pali.

The pali, which are in two crowns, are tall and large, those which stand opposite the tertiary septa being much the largest: the two crowns of pali, as seen from above, form a broad ring within the calice, very distinctly delimited both from the septa and from the columella.

The very deeply seated columella is large and concave, and consists of numerous close-set, blunt pinnacles.

In the type specimen the height of the corallum is 11·5 mm., the major diameter of the calice 10 mm. and the minor diameter 8 mm., and the diameter of the pedicle 5 mm.

The septa, pali and columella are of a dull purple-black colour.

Dredged off the Arrakan Coast by the "Investigator:".

The distinctive characters of this species are (1) the delicacy of the calice wall in comparison with the stoutness of the septa and pali, (2) the large size of the pali and the very distinct definition of the palar zone, and (3) the punched-out appearance of the deep-seated columella.

HETEROCYATHUS, Edw. & Haime.

7. *Heterocyathus æquicostatus*, Edw. & Haime.

Heterocyathus æquicostatus, Milne-Edwards and Haime, Hist. Nat. des Corall., vol. ii, p. 51.

Numerous specimens were dredged by Professor Wood-Mason in the Andaman Sea. Every specimen has the base perforated and tunnelled for the residence of a worm, which no doubt lives as a commensal with the coral zoophyte, as I shall be able to show in the parallel case of *Heteropsammia.*

8. *Heterocyathus philippensis*, Semper.

Heterocyathus philippensis, Semper, Zeitschr. Wiss. Zool., vol. xxii 1872, p. 254, taf. xx. figs. 12–14.

Two specimens were dredged by Professor Wood-Mason in the Andaman Sea.

9. *Heterocyathus wood-masoni*, n. sp. Plate V, figs. 4. 4a.

The corallum is either low and discoid, or if it is higher it is so faintly and truncately conical that the diameter of the base is not much greater than that of the shallow plane calice.

The costæ, which begin on the flat basal surface near its margin, are equal, regular and very finely granular, and are separated from one another by deep incisions.

The calice is circular and quite flat, except for a central umbilication which marks the columella.

The septa are in four cycles, of which those of the third cycle are by far the smallest, while the primary septa along with the nearest quaternary of the adjoining half-system on each side are the largest. The six large primary septa with their large quaternary on each side thus form a six-rayed star, each ray consisting of three equal segments—namely a primary septum with a quaternary on each side of it.

The septa are hardly exsert, and they resemble the costæ, with which they are continuous, in being finely and uniformly granular.

Pali, in the form of series of very small denticles, stand before the primary and secondary septa, and also before the united margins of the tertiaries and quaternaries of each half-system.

The columella is distinct and consists of contorted granules. Dredged by Professor Wood-Mason in the Andaman Sea. Every specimen, as in the case of *H. æquicostatus* and *H. philippensis*, is perforated and tunnelled in the base by a worm.

The distinctive characters of this species are (1) the circular calicle almost or quite equal to the base in diameter, and not separated from the base by any constriction whatever, (2) the equivalence in size of the primary septa with the quaternaries standing immediately on each side, and (3) the small size of the pali.

Discotrochus, Edw. & Haime.

10. *Discotrochus investigatoris*, n. sp. Plate V, figs. 5. 5a.

Corallum discoid, thick and coarse. The almost horizontal base culminates in a coarse scar from which very distinct coarsely granular costæ radiate, the costæ being equally distinct throughout their course and all of uniform size

The calice is very shallow.

The septa, which are in four cycles, are slightly exsert, with thick coarsely spinate or dentate edges: those of the first cycle are the most prominent, and those of the third cycle the least so, but the difference in size between any of the cycles is not very marked.

The columella consists of a few papillæ.

Diameter of disk 8 mm., greatest thickness 2 mm.

The single specimen was dredged by the 'Investigator' off the Arrakan Coast, and appears to be a denuded fossil.

Its possible fossil character is supported by the fact that, as Professor Wood-Mason informed me, fossil Crustacea were dredged either at or very near the same place during the same surveying season. The exact spot at which the coral was dredged was off the Islands of Rámree and Cheduba.

In relation to the possible fossil nature of this species I may refer to two papers in the *Records of the Geological Survey of India*, vol. ix. (" On the Mud Volcanoes of Rámri and Cheduba " by F. R. Mallet, F. G. S., p. 188, and " On the Mineral Resources of Rámri, Cheduba, and the adjacent Islands," by the same author, p. 207), to which my attention has been very kindly directed by Mr. T. H. Holland of the Geological Survey.

In these papers there is notice of historical evidence of the recent elevation of the land in this vicinity and along with it of much recent coral.

The rocks of this region appear from Mr. Mallet's observations to consist (1) of petroliferous shales and sandstones with nodules and strangulated beds of impure limestone and with shallow seams of lignite and coal, and (2) of minutely crystalline grey limestone,—all the strata being very irregular and being generally steeply inclined: as regards age the conclusion appears to be that they are Eocene Tertiary (Nummulitic) though the possibility is noted that some may be Cretaceous.

POLYCYATHUS, Duncan.

12. *Polycyathus andamanensis*, n. sp. Pl. V, figs. 6. 6a.

The colony is large enough to cover a *Conus* shell, 70 mm. in length, with a thin spongy crust. The corallites are small, very short, cylindrical, and are placed close together.

The costæ are distinct from the basal encrustment upwards, are alternately salient, and are usually covered with a white, vitreous epitheca.

The calices are open, shallow, and either circular or slightly elliptical. The septa, which are in four nearly complete cycles, are slightly and irregularly exsert: they are nearly equal in size and are coarsely granular.

The pali, which are in the form of strong denticulations, are distinct before all the septa.

The small deep-seated columella consists of a few small close papillæ.

The height of the corallites ranges from 2 to 3 mm., and the diameter of their calice from 3 to 7 mm.

The encrusting base and the epitheca are of a porcelain white, as are the tips of the septa; the calice wall, the septa, pali and columella being of a purple-black colour.

Dredged in the Andaman Sea by Professor Wood-Mason.

FAMILY OCULINIDÆ.

LOPHOHELIA, Edw. & Haime.

11. *Lophohelia*, sp.

Several dead branches of a species so eroded as not to be exactly determinable were dredged by the "Investigator" off the Konkan Coast in 446 fathoms.

I mention it as being the first observed occurrence of this family in Indian waters.

FAMILY EUPSAMMIDÆ.

Balanophyllia, Searles Wood, Duncan.

13. *Balanophyllia scabra*, n. sp. Pl. V, figs. 7. 7a.

Corallum simple, large, stoutly pedunculate, and gradually expanding, with a slight curve, into an elliptical calice.

The costæ, which are distinct from the base, are equal in size, uniform, and closely and conspicuously dentate.

The elliptical calice is deep.

The septa, which are crowded and very thin, are in five cycles, of which the last is not complete. Those of the first and second cycles are of equal predominant size and are slightly exsert. The quaternaries, especially those immediately adjoining the large septa of the first and second cycles, are larger than the ternaries, and unite with them not far from the columella. In those quarter-systems in which a fifth cycle of septa is developed these unite with the septa of the fourth cycle not far below the calicular margin, and the quinary nearest the large septa of the first and second cycles becomes the largest of the united triad. The edges of all the septa except those of the two first cycles are either ragged or cut into deep serrations, the teeth nearest the columella standing upwards like pali.

The columella is well-developed, spongy, and either plane or concave.

In the type specimen the greatest height of the corallum is 26 mm., the major diameter of the calicle 21 mm., and the minor diameter 15 mm.

Dredged by Professor Wood-Mason in the Andaman Sea.

Eupsammia, Edw. & Haime.

14. *Eupsammia regalis*, n. sp. Pl. V, figs. 8., 8a.

Corallum simple, free with traces of former adhesion, curved, cornute, compressed.

Costæ distinct in the upper two-thirds of the corallum, occasionally trifurcating, united at regular intervals across the deepish intercostal incisions by horizontal spicules.

Calice elliptical with the major marginal axis on a slightly lower plane than the minor, deep, open.

The septa are in five cycles, of which the last is not complete, and are exsert. Those of the first two cycles are of equally predominant size and stoutness, while those of the other cycles are smaller and diminish in size in order, except that in the quarter-systems in which a fifth cycle is developed the quinary septum immediately adjoining the primary is larger than its neighbour of the fourth cycle.

The quinaries unite with the quaternaries much nearer to the columella than to the calicular margin, and close to the columella the quaternaries unite with the tertiaries.

All the septa are thick, spongy and perforate at their exsert tips and near the wall of the calice, but they soon become thin and dense with surfaces so finely granular as to appear quite smooth to the naked eye.

The columella is broad, spongy, and strongly convex.

The colour of the corallum is white, of the soft parts bright scarlet.

The greatest height of the corallum is 27·5 mm., the major diameter of the calice 25 mm., and the minor diameter 17·5 mm.

Dredged by the "Investigator," off Ceylon, in 32 fathoms.

HETEROPSAMMIA, Edw. & Haime.

15. *Heteropsammia geminata*, Verrill.

Heteropsammia geminata, Verrill, American Journal of Science and Arts, second series, vol. xlix. 1870, p. 370. fig. 1.

About two hundred and fifty specimens were dredged by Professor Wood-Mason in the Andaman Sea. All have the base perforated and tunnelled.

16. *Heteropsammia rotundata*, Semper.

Heteropsammia rotundata, Semper, Zeitschr. Wiss. Zool., vol. xxii. 1870, p. 265, taf. xx, fig. 10.

I refer to this species several specimens from the Persian Gulf presented by Mr. W. T. Blandford, F.R.S.

17. *Heteropsammia aphrodes*, n. sp. Pl. V, figs. 9, 9a. Near *Heteropsammia ovalis*, Semper.

Corallum with a single calice, the wall formed of a fine lace-like reticulum (not spongy as in other species).

Calice oval and deep, its major diameter being not much less than that of the base—the basal "spur" excluded.

Septa in four beautifully regular and complete cycles. Those of the first two cycles are of equally predominant size, are exsert, and are very thick, inflated, spongy, and porose, even up to their edges. Those of the fourth cycle are rather larger than those of the third, and unite in front of them, with beautiful symmetry, near the columella.

The deeply seated columella is well developed, and is slightly concave.

The greatest height of an average corallum is 10 mm., with a calice having a major diameter of 10 mm., and a minor diameter of 8 mm.

Numerous living specimens were dredged by the "Investigator" off the Ganjam Coast, at a depth of 20–25 fathoms, and every one of them was provided with a commensal Sipunculoid worm.

With specimens kept alive for a short time on board it was observed that the worm was able to propel the coral in a rapid series of short jerky spiral movements.

The movements were performed with great ease, and there appears to be little doubt that we have here to do with a true case of commensalism, in which the worm serves the polyp as a locomotive agent, while the polyp affords particularly effectual protection—owing to its power of urtication—to the worm. As Professors Moseley and Semper observed in their species of *Heteropsammia*, the worm lives in a tunnel hollowed out of the coral-tissue, and no traces of any adventitious shell can be discovered forming a core.

In addition to the aperture for the exit of the worm, which is found in a special spur-like process of the base of the corallum, the side of the corallum about half way up is ringed with small punctures. Similar punctures are found in the coralla of other species of *Heteropsammia* and also *Heterocyathus*, and Professor Moseley regarded them as respiratory apertures for the use of the commensal worm.

DENDROPHYLLIA, Edw. & Haime.

18. *Dendrophyllia* sp.

From the Orissa Coast, at 10 fathoms, we have a bush-shaped colony of long slender cylindrical corallites resembling *Dendrophyllia gracilis*, Edw. & Haime, in all respects except in the form of the columella which is very strongly convex, in some cases almost styliform, instead of being plane.

CŒNOPSAMMIA, Edw. & Haime.

19. *Cœnopsammia* sp.

From the Arrakan, Orissa and Ganjam Coasts respectively, we have three species of *Cœnopsammia* of the type of *C. urvillii*, Edw. & Haime, the colonies being in massive tufts from which the units of the colony project little or not at all.

I consider it better not to name any of these species until we have more material for comparison.

RHODOPSAMMIA, Semper.

20. *Rhodopsammia carinata*, Semper.

Rhodopsammia carinata, Semper, Zeitschr. Wiss. Zool., vol. xxii. 1872, p. 257, taf. xix. fig. 6.

Numerous specimens were dredged by Professor Wood-Mason in the Andaman Sea, and by the "Investigator" off Ceylon in 32 fathoms. The gemmation from the calicular margin is well seen in both series of specimens.

21. *Rhodopsammia socialis*, Semper.

Rhodopsammia socialis, Semper, tom. cit., p. 260, taf. xx. fig. 1–14.

Several specimens were dredged along with *R. carinata*, both in the Andaman Sea and off Ceylon. Among them is a specimen showing budding to the third generation.

FAMILY FUNGIDÆ.

Cycloseris Edw. & Haime.

22. *Cycloseris mycoides*, n. sp. Pl. V, fig. 10.

Corallum almost circular, gently convex, with a flat or slightly concave base, from the centre of which close-set, equidistant, alternately, unequal costæ radiate—the larger ones being finely lamellar, while the alternate smaller ones are composed of a single series of fine granules.

The septa, which are in seven very regular and complete cycles, are close-set and convex, with very finely and evenly denticulate edges and very finely and striately granular surfaces. Those of the first two cycles are of equally predominant size and touch the columella, while those of the last two cycles do not reach half-way to the columella. Those of the fifth cycle unite together in each quarter-system in front of their quaternary, the united pairs then showing a tendency to further unite in each half-system in front of their tertiary.

The central fossa is long, narrow, and moderately deep, and lodges a narrow loosely reticulate columella.

The synapticulæ are numerous and coarse.

In an average specimen the major diameter of the corallum is 23·5 mm., and the minor diameter 23 mm.

Dredged by Professor Wood-Mason in the Andaman Sea.

This species differs from *Cycloseris cyclolites*, with which I have compared it, in the much greater delicacy regularity and symmetry of all its parts: it appears to be near *Cycloseris sinensis*, Edw. & H., and *Cycloseris discus*, Quelch.

Diaseris, Edw. & Haime.

23. *Diaseris distorta*, Edw. & Haime.

Diaseris distorta, Milne Edwards and Haime, Hist. Nat. des Corall., vol. iii. p. 55, pl. D. 12, fig. 4.

Several specimens were dredged by Professor Wood-Mason in the Andaman Sea.

24. *Diaseris freycineti*, Edw. & Haime.

Diaseris freycineti, Milne-Edwards and Haime, Hist. Nat. des Corall., vol. iii. p. 55; and Semper, Zeitschr. Wiss. Zool., vol. xxii., 1872, p. 269, taf. xxi. fig. 1.

Several specimens dredged by Professor Wood-Mason in the Andaman Sea. In all the specimens, except two very young ones, the corallum is tunnelled apparently by a worm, just as in *Heterocyathus* and *Heteropsammia*, except that the aperture for the exit of the worm instead of being on the base is at one side of the oral fossa.

Before going on to describe a new species of the genus *Diaseris*, I must here remark that our beautiful series of *Diaseris freycineti*, and of the species about to be described do not support Mr. Quelch's opinion that the species of *Diaseris* are merely the results of the fracture and repair of *Cycloseris*.

25. *Diaseris fragilis*, n. sp. Pl. V, fig. 11.

The corallum is flat and very thin. In its youngest stage the corallum is almost circular with a triangular lobe breaking through an arc of about 90° of its circumference and projecting to form a sector of a much larger circle.

This lobe appears with age to spread round the original disk until this in turn becomes a small lobe occupying not much more than 50° of the circumference of the grown coral.

The full-grown coral forms an irregular ellipse divided into four lobes in opposite pairs, one pair being large (each lobe with a margin equal to about 180° of the entire circumference), and the other pair being small (each lobe with a margin extending through about 55° of the entire circumference). The lobes are very distinctly delimited up to the very centre of the corallum, which has the appearance of being composed of four artificially cemented pieces.

The costæ are in the form of very close delicate granular striations, alternately unequal.

The septa, which appear to be in eight cycles in six irregular systems, are thin with very finely and evenly serrate edges and granular surfaces: they are usually low, but the primaries and secondaries are unequally elevated near the fossa.

The synapticulæ near the centre are coarse, close and equidistant, and form regularly concentric circles, as in *Bathyactis*, throughout the interseptal chambers: near the margin they are much more delicate, and are not equidistant.

The fossa is conspicuous and a columella is usually absent, although sometimes a few distant papillæ are visible.

The largest specimen measures 50 mm. in the major diameter and 41 mm. in the minor and is not more than 6·5 mm. in height to the tip of the highest septum.

Dredged in the Andaman Sea by Professor Wood-Mason.

BATHYACTIS, Moseley.

26. *Bathyactis stephanus*, n. sp. Pl. V, figs. 12, 12a.

Corallum very thin and fragile, circular, strongly convex, the base forming an inverted bowl. The costæ radiate from the centre and gradually become laminar or crested as they approach the margin: the primaries are the most distinct.

Septa in six regular systems and five complete cycles arranged exactly as in *Bathyactis symmetrica*. Those of the first three cycles are foliaceous, with crenulated surfaces and irregularly lobate edges.

Synapticulæ distinct in ten to twelve zones, which though fairly regularly concentric do not at once attract the eye by this character as they do in *Bathyactis symmetrica*. Columella distinct, umbilicated.

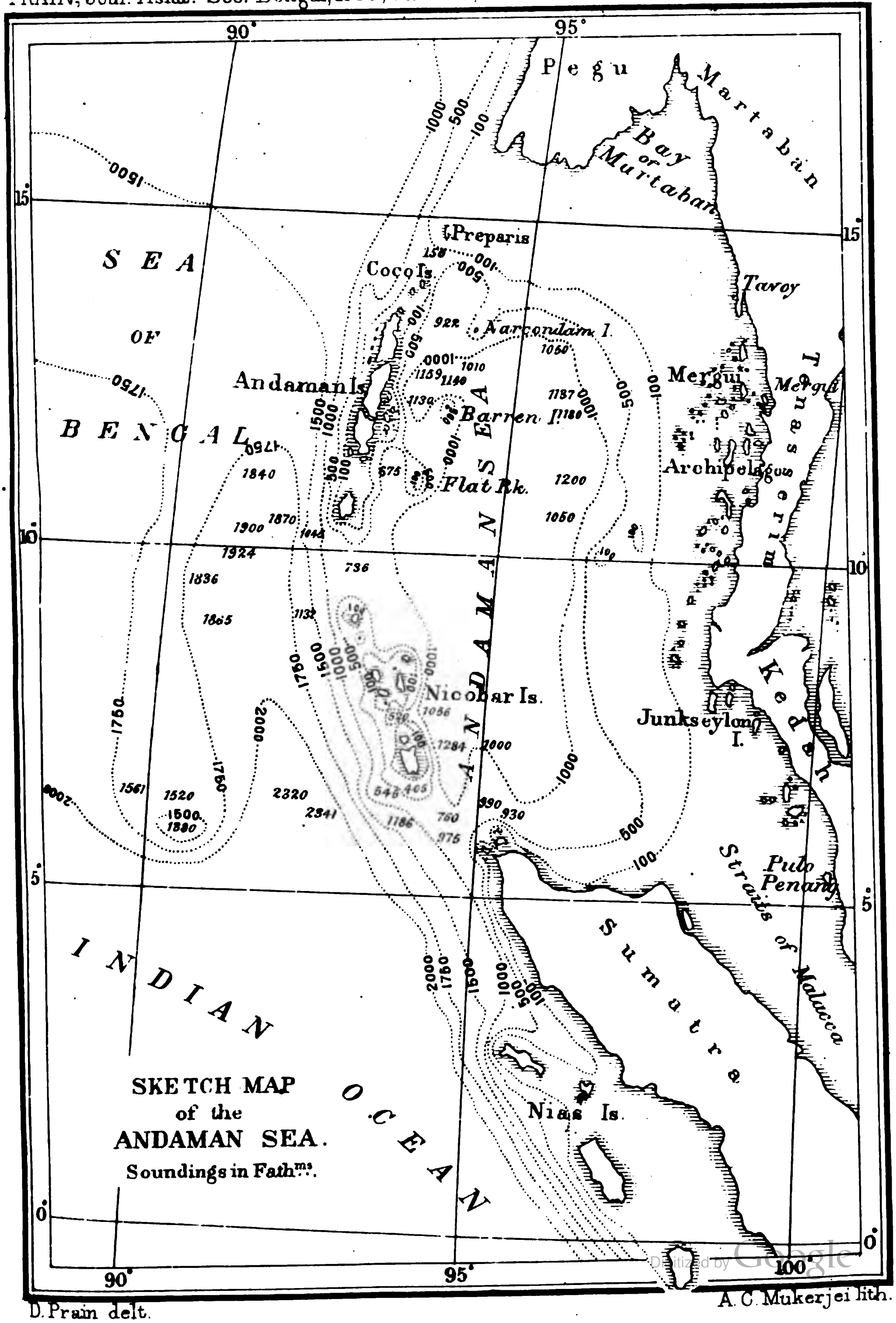
Diameter of corallum 34 mm., its greatest height from margin of base to the tips of the tallest foliaceous primary septa 17 mm.

The colour of the soft parts is a ruddy mauve.

Four specimens from the Bay of Bengal off the Kistna Delta in 678 fathoms.

EXPLANATION OF THE PLATE.

Figs. 1, 1a, *Paracyathus cavatus*, natural size;
Figs. 2, 2a, *Paracyathus fulvus*, natural size;
Figs. 3, 3a, *Paracyathus porphyreus*, natural size;
Figs. 4, 4a, *Heterocyathus wood-masoni*, natural size;
Figs. 5, 5a, *Discotrochus investigatoris*, enlarged five times;
Figs. 6, 6a, *Polycyathus andamanensis*, natural size;
Figs. 7, 7a, *Balanophyllia scabra*, natural size;
Figs. 8, 8a, *Eupsammia regalis*, natural size;
Fig. 9, *Heteropsammia aphrodes*, natural size; and 9a, viewed from above, enlarged twice;
Fig. 10, *Cycloseris mycoides*, natural size;
Fig. 11, *Diaseris fragilis*, natural size;
Figs. 12, 12a, *Bathyactis stephanus*, natural size.



D. Prain delt. A. C. Mukerjei lith.

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On some Actiniaria *from the Indian Seas. By* A. Alcock, M. B., C.M.Z.S., *Offg. Superintendent of the Indian Museum.*

[Read July 5th.]

In this short paper I propose to notice only the two aberrant Tribes, *Zoantheæ* and *Cerianthineæ.*

I. Zoantheæ.

The *Zoantheæ* are a tribe of sea-anemones distinguished, according to the limitations of R. Hertwig in his Report on the 'Challenger' *Actiniaria*, where full references are given, by the possession of septa of two kinds—larger septa (*macrosepta*) which alone bear mesenteric filaments and reproductive organs, and smaller septa (*microsepta*) which are sterile.

The *Zoantheæ* include two families—the *Zoanthidæ* which are peculiar among all sea-anemones in forming colonies of which the units are connected together by a canaliculated coenenchyma, and the *Sphenopidæ* which are solitary in the sense that the individuals are not morphologically connected, but appear to be gregarious in habit.

The majority of the *Zoantheæ* are characterized by the possession of a thick test very homogeneously compacted of small grains of sand.

The following genera and species occur in the Indian Seas, and are represented in the collection of the Indian Museum :—

FAMILY Zoanthidæ.

Zoanthus, Cuv.

1. *Zoanthus confertus*, Verrill.

This species was dredged by the "Investigator," the exact locality being uncertain, but probably off the Pegu coast.

2. *Zoanthus solanderi*, Lesueur.

This species occurs at Galle.

Epizoanthus, Verrill.

3. *Epizoanthus stellaris*, R. Hertwig.

Two species of *Epizoanthus* very commonly occur in the Andaman Sea, at depths of 200 to 500 fathoms, encrusting the anchor-ropes of the glass-rope sponges (*Hyalonema*): one of them appears to be identical with the above-named species from the Philippine Sea.

Family Sphenopidæ.

Sphenopus, Steenstrup.

4. *Sphenopus marsupialis*, (Gmelin).

This species is very common in shallow water all along the eastern coast of India, especially on the soft muddy bottom at the debouchement of the great rivers.

I can never recollect dredging it except in mass, and this seems to point to the conclusion that it is gregarious.

5. *Sphenopus arenaceus*, R. Hertwig.

We have six specimens from the Sandheads.

It is readily distinguished from *S. marsupialis* by the cylindrical body, by the thinner test, by the double row of tentacles, by the less powerful oral sphincter, and by the character of the œsophageal groove which although very distinct is not such a deep-cut channel as it is in *S. marsupialis*.

6. *Sphenopus arenaceus*, var. *barnettii*.

I propose to notice separately a variety in which there is a constant difference in external form, the oral end of the body being inflated, while the lower part forms a long vermiform peduncle. The external appearance, in short, approaches the figure of *Sphenopus pedunculatus*, Erdmann, R. Hertwig, in vol. XXVI of the 'Challenger' Reports Actiniaria, Suppl., Pl. I., fig 11.

The variety comes from the Sandheads, where it was dredged by Mr. Barnett.

II. Cerianthineæ.

The *Cerianthineæ* are distinguished from other sea-anemones (R. Hertwig, 'Challenger,' Reports, vol. vi, p. 123) in having the septa unpaired.

Cerianthus, Delle Chiaje.

7. *Cerianthus andamanensis*, n. sp.

The body is loosely encased, up to the outer tentacular crown, in a soft sheath of a dull cinnamon-brown colour, the oral disk between the two crowns of tentacles is of the same colour but lighter, and the tentacles with the central part of the oral disk are creamy white.

The tentacles of the outer crown are very thick-set, and number about 160; those of the inner crown are not nearly so thick-set, and number hardly half as many.

The septa and mesenteric filaments extend to the bottom of the gastral cavity.

The base is perforated centrally.

Three specimens from Port Blair. In the contracted state the shape of the body is beautifully caryophyllaceous, and the length of the largest specimen is a little short of four inches—(99 millim.) This species appears to be very close to *Cerianthus americanus*, Verrill, which it aproaches in size, judging from the magnitude of the spirit specimens.

Note on some methods of preparing botanical specimens, communicating Memoranda by Messrs. C. Maries, F.L.S., *and* R. Pantling.—*By* D. Prain, M.B.

[Read June 5th.]

Usually the preparation of botanical specimens is easy; some natural families, however, give a good deal of trouble. Those who have private herbaria are as interested to hear of improved methods of treating such families, as are those who look after public collections. The writer, therefore, would call general attention to modes of dealing with three troublesome families—*Magnoliaceæ*, *Coniferæ* and *Orchidaceæ*.

I. Magnoliaceæ. The *Champak* family is not troublesome to preserve as to the leaves, but the flowers are apt to go to pieces. If, however, pieces of blotting-paper are carefully insinuated between the petals before the specimen is laid in drying-paper, and if the specimen is then rapidly fire-dried, even adult flowers may be preserved entire. Nothing, however, prevents the shrinkage of the large leathery petals. In this order shrinkage is so excessive and so unequal, that in the case of herbarium specimens the estimation of the size of the flowers becomes to some extent guess-work.

Those who know Rangoon may recollect the practice of selling bottles of flowers on the stairs of the Shwe-Dagon Pagoda. Unless, however, their stay has been long enough, or their interest sufficiently great, to have led them to notice that the flowers in these bottles are not fresh but preserved, they may have supposed, as the writer did, that the medium in which the flowers are kept is water.

Everyone, however, has not been so void of curiosity. When Assistant Surgeon C. L. Bose,* was in Rangoon in 1885, he was struck by the length of time the flowers were kept, and brought some with him to Calcutta for examination. Dr. Warden, then chemical examiner, and Mr. Bose found on examining the fluid that it was a solution of Alum. The solution is of no special strength; the Burman, being a happy-go-lucky individual puts some Alum into the water along with the flowers and is not particular as to the amount.

Mr. Bose brought only *Champak* petals; some of these are in shape, size, colour and consistence much as they were when taken from the tree eight years ago. Here then we seem to have the means of overcoming the difficulty, hitherto insoluble, of preserving the natural size in specimens of *Magnoliaceous* flowers.

Though only *Champak* was brought by Mr. Bose, the writer recollects seeing *Plumieria* and *Nymphæa* flowers as well, and a bottle in which Dr. Warden placed some green leaves with a 1°/o Alum solution at the time he examined the Rangoon bottle has its contents very much as they were when he put them in. There is, therefore, no reason why the use of Alum solution should be confined to *Magnolia* flowers.

It should be understood that the use of Alum solution is only suggested as an auxiliary to the usual means of preserving specimens. Wet preparations are to be avoided; they are difficult to handle, difficult to keep, difficult to house, and still more difficult to carry about. But occasions arise when wet specimens are of the greatest moment as supplements to dried ones, and the Burmese preservative has the advantages over spirit of not discolouring the specimen or rendering it brittle. Most important of all, one can carry Alum about as a solid and make a solution when required.

If the bottles are not carefully sealed the specimens do not keep. The flowers immersed in the fluid do not suffer, but as the water evaporates the flowers at the top get exposed to the air, decay, and fall in a flocculent mass to the bottom. This flocculent matter keeps pushing up others to undergo the same decomposition. But from a well-stoppered bottle—

* Assistant to the Chemical Examiner to Government, Calcutta.

a glass stopper with wax is best—the fluid does not evaporate; the flowers, therefore, do not reach the air and seem to keep indefinitely.

II. Coniferæ. The *Pine*, *Fir* and *Spruce* family is usually very troublesome to preserve both in the field and afterwards in the Herbarium, from the readiness with which the cones fall to pieces and the leaves (needles) drop off. In the Calcutta Herbarium there are a number of beautiful specimens of Japanese *Conifers* presented by Mr. C. Maries, F. L. S.,* who collected them. The writer anxious to learn the secret of the success with which so troublesome a family had been treated asked Mr. Maries if he would kindly explain his method. Mr. Maries' reply, which he has courteously permitted the writer to communicate to the Society, is as follows :—

" *Conifer* specimens of the *Abies* or *Picea* section are generally rather " difficult to dry. When I was in the island of Yesso, in the North " Pacific, I was very much troubled with them. One night I arrived " very wet at my rooms and stacked my branches of *Abies*, with the " cones attached, round a big charcoal fire. I fell asleep and woke up " next morning to find my specimens dried beautifully. After this I " always dried them slowly over a charcoal fire, first wiring or wrapping " up the cones. All fir-cones, except Pine, or Spruce, or Cedar, should " be tied up either with cotton or wire immediately they are gathered. " The Spruce section is the most difficult to dry, even roasting is not " always a success."

Mr. Maries goes on to say :—" The way I dry ferns and leaves " of trees for fitting up my bird-cases " (in the Gwalior State Museum) " to preserve their natural shape, is to take some very *clean*, washed " sand, arrange the leaves in a *clean* box and fill in with hot sand, and " keep at a temperature of 100° to 120° Fh. or even more. They soon " dry (I imagine Spruce would dry like this if very hot) and flowers " dry beautifully in this way, some keeping their natural colours in a " most remarkable manner. When I was young and living in London, an " old gardener taught me this; he used it for ferns and roses for winter " decorations when fresh ferns and flowers were scarce. All the dried " flowers one sees in florists' shops in London are dried in hot sand. "—C. Maries."

III. Orchidaceæ. The *Orchid* family is perhaps the most troublesome of all natural families to represent in Herbaria. In all the epiphytic kinds the leaves and, in most of them, the flowers also are apt to drop off when the specimens are dried in the ordinary way, while even in ground Orchids the pressure that has to be applied during drying usually so distorts the flower that a true conception of the relative

* Superintendent of the State Gardens and State Museum at Gwalior.

position of its parts becomes impossible. This is very unfortunate, because there is no natural order where a proper understanding of the position of parts, particularly of the lip and the column, is so necessary. Spirit preparations are most unsatisfactory. If the spirit is sufficiently strong to preserve the flowers the parts become so brittle that when handled they go to pieces; if weak enough to prevent this hardening and consequent friability the spirit does not adequately preserve the specimens. The jars and bottles in which the specimens are placed, moreover, are very apt to get broken, and any one who has tried it will testify to the worry that is caused by the necessity of having to carry about a stock of alcohol. Dr. Schweinfurth when travelling in Africa, made use of a most excellent modification of the method of preservation in spirit. He laid his specimens between sheets of drying paper, laid these in tin-boxes and soldered them up after soaking the paper thoroughly with spirit. He was thus able greatly to reduce the initial stock of alcohol and was freed from the subsequent anxiety of possible breakages. But the objections to spirit as a preserving medium for flowers are not obviated by this mode of applying it, and it remains to be seen whether the Alum solution will answer as a subtitute if used in this way.

In the meantime Mr. R. Pantling,* who for many years has made a special study of Orchids, has perfected a method of drying them so far in advance of anything hitherto accomplished that it is highly desirable, that the details of his process should be made known. At the writer's request Mr. Pantling has supplied these details and like Mr. Maries, has courteously given him permission to communicate the account to the Society. This memorandum is given below; it will be noticed that it consists of a happy combination, suitably modified, of the ordinary method of fire-drying recommended for all ordinary plants with the hot-sand process mentioned by Mr. Maries as that practised by florists in Europe.

" *To dry Orchid Specimens.*—In order to preserve *Orchids* so that " the leaves and flowers remain intact and do not fall away in fragments " as invariably happens to epiphytal species when pressed in the ordi- " nary way between drying paper, the procedure to be adopted should " be as follows. Procure a light metal box—14 inches, by 12 inches, " by 6 inches deep is a convenient size—and place over the bottom half- " an-inch of sand. Arrange a specimen between two sheets of thin " paper inside the box and cover over with a layer of sand taking care, " as far as possible, that the interstices between leaves, etc., are filled " up. Repeat this until the box is full, then place it on a stove or above

* First Assistant, Department of Cinchona Cultivation in Bengal.

"a fire and dry with a brisk heat. No weights for pressing are neces-"sary. As a general rule, the sand at the commencement of drying "should not be allowed to attain a greater heat than can be borne by "the hand, and this should be lessened as drying proceeds or the flowers "may become scorched and rendered useless for purposes of dissection.

"Occasionally species (*Dendrobium Pierardi* Roxb., and *Phajus* "*alba* Lindl.) are met with whose perianths will adhere to the paper; "the removal of the perianth cannot then be effected without mutilation. "This may be obviated by using porous drying-paper or blotting-paper "instead of the thin kind recommended above.

"The advantages of drying in hot sand as compared with the "universally adopted method in paper are :—*First*, the rapidity in pre-"paring specimens; plants belonging to such genera as *Saccolabium*, "*Vanda*, *Cleisostoma*, etc., being ready within a week against a period of "three to four months by the old method. *Secondly*; when finished the "specimens will be found preserved in their entirety and will not fall "to pieces. The column and lip will be found to have suffered little, "as the pressure of the sand is not sufficient to cause any material dam-"age to these organs".—R. PANTLING.

The boxes that Mr. Pantling has found handiest for his purpose are old kerosine tins cut through lengthways; one is placed within the other to give more strength to the tin and a rivet or two hammered through the seams as the solder runs when the boxes are over the fire. The only thing to be guarded against in the process is the adhesion of the flowers of certain species to the paper, and Mr. Pantling shows how this is easily overcome.

The possibilities of this method either as recommended by Mr. Pantling or with slight modifications for the drying of succulent species generally, such as the *Cactus* family and fleshy members of the *Spurge* family, as well as for families like *Scitamineæ*—the ginger family—and for water plants, where the flowers are very delicate and therefore very difficult to dry seem considerable and the plan is well worth trying for them as well as for orchids.

Blind root-suckers of the Sunderbans.—*By* R. L. Heinig, *Deputy Conservator of Forests, Bengal, Communicated by the Natural History Secretary. Plate VI.*

[Read August 2nd.]

The name "Sunderbans" is applied to the tract of littoral forest and cultivation that occupies the southern portion of the Ganges Delta, extending from the Hooghly river to the Meghna in the districts of the 24-Parganas, Khulna, and Backergunge. This tract is, roughly, 5,000 square miles in area, and comprises a large number of low-lying swampy islands formed by the principal rivers and their connecting water-channels.

The State Forests occupy the portion that extends from the Hooghly river to the Baliswar, on the western border of Backergunge. They are divided, both geographically and as to their legal status, into two approximately equal and well-defined areas, namely, the *Protected* Forests, extending from the Hooghly river to the Raimangal, in the district of the 24-Parganas; and the *Reserved* Forests, extending from the Raimangal river to the Baliswar in the Khulna district.

The *Protected* Forests are traversed by rivers not directly connected with the Ganges, and resembling estuaries or long arms of the sea; these rivers are very saline and subject to tidal influences throughout.

The principal species of forest tree is *Gozán* (*Ceriops Candolleana*, Arn.), a tree that does not develop root-suckers, but has short buttresses. It reproduces itself abundantly, and the innumerable stems and tangled roots of this species and of others with which it is associated, *Gengwá*, (*Excæcaria agallocha*, Linn.); *Hantál*, (*Phœnix paludosa* Roxb., &c.), serve, in the absence of herbaceous undergrowth, to protect the surface soil from erosion during tidal inundations, and to induce the deposit of alluvial mud.

The *Reserved* Forests are traversed by rivers directly connected with the Ganges, that bring down vast bodies of fresh water, especially during the rains. The principal species of forest tree is *Sundri* (*Heritiera fomes*, Buch.). The accessory species are *Pussur* (*Carapa moluccensis*, Lam.), *Amúr* (*Amoora cucullata*, Roxb.), *Keora* (*Sonneratia apetala*, Lam.), *Ora* (*S. acida*, Linn. f.), and a few others. Each island is bordered by a zone of characteristic growth consisting of *Golpatta* (*Nipa fruticans*, Wurmb.), *Hantál*, species of the mangrove family, *Keora*, *Ora*, *Kúmia* (*Barringtonia racemosa*, Blume.), &c. Behind this zone of riparian growth occurs the *Sundri* forest, pure, or mixed with a few inferior species. Towards the sea coast, where the water of the rivers is markedly saline, especially during the dry months of the year, *Gorán* and *Gengwá* form the predominating species, and *Sundri* trees are comparatively few in number, and of inferior growth. The *Sundri*-producing tract resembles that on the west in the general absence of grass and other herbaceous vegetation, but differentiates from it entirely by the presence of innumerable blind root-suckers.

The magnificent rivers that traverse the Sunderbans, many of them of considerable breadth and depth, bring down, during the monsoon months, vast quantities of silt, some of which is deposited to form *churs* or sand-banks.

On the subsidence of the waters at the close of the rains those sand-banks, the surface of which is left exposed at low tide, are soon covered by a luxuriant growth of grass which effectually binds the soil, induces further accumulations of silt, and arrests floating seeds.

It is not surprising that under the forcing conditions of a rich soil, a moist warm climate, and abundance of light, seedlings on these new islands should make extremely rapid growth, forming in a few years an uninterrupted canopy, in the dense shade of which it is impossible for the grass to live.

When the grass has disappeared there is a continual danger of the island wasting away by erosion, the banks being liable to be undermined and swept away by the rivers, and the whole surface, inundated during high spring-floods, is subject to denudation under the considerable force (to be seen to be fully appreciated) with which the water pours away at every point of egress after the tide has turned.

The soil of the islands eventually consists of a thin top-layer of alluvial mud overlying a thick layer of moist, black soil in which the large quantities of wood *débris* that accumulate in these forests undergo slow decomposition with the generation of gases having the odour of sulphuretted and carburetted hydrogen. The top-layer of soil excludes atmospheric air, and imprisons the gases generated in the miasmic mud beneath. Occasionally the gases find vent along river banks at low tide, and during storms when the stems of the forest trees sway to and fro and cause the upper layers to be disturbed.

Each species of tree found growing in the swamp-forests of the Sunderbans has a root-system well adapted not only to anchor the tree firmly in the unstable medium below, but also to protect the mud from the effects of erosion. The roots do not penetrate the soil to a greater depth than 8 to 10 feet, but in this shallow layer they form a tangled and confused net-work in which the tap-root is not distinguishable. Some species produce adventitious roots, and others buttress freely, even at an early age; but perhaps the most curious adaptation of all, of means to ends, is to be found in the development of blind root-suckers.

The following species of forest trees in the Sunderbans produce blind root-suckers, namely, *Sundri*, *Pussur*, *Amúr*, *Keora*, *Ora*, and *Báen* (*Avicennia officinalis*, Linn.).

The root-suckers are woody processes, growing in an upward direction, and developed at irregular distances along the whole course of the roots of the above-mentioned species. They project from 1 to 3 feet above the surface of the ground, and apparently cease to make further growth upwards when the apex has reached the level of the highest spring-tides. They are called blind from the circumstance that they are destitute of buds, and incapable of producing buds under any conditions. The portion below ground is often furnished with rootlets, but the part above ground is invariably naked. The tender tops of the suckers are frequently gnawed by pig and deer, but this does not destroy their vitality, and only results in the formation of apical knobs and bifurcations.

The mechanical effect of the root-suckers of all the species that develop them (except *Báen*) is to enormously increase the holding power or grip of the roots on the soil, and thus to cause a far greater resistance to be offered to the uprooting of trees by storms, and generally to maintain the stems of the trees in an upright position; to prevent the erosion of the surface soil during high-tide inundations; to check the force of the egress of flood-water, and to induce deposits of alluvial mud; to detain seeds floated on to the islands at high tide, and thus aid in the natural reproduction of all species; to arrest fragments of fertilising wood *débris* that would, in the absence of the root-suckers, be swept into the rivers.

The accompanying plate illustrates the general form and relative length of the root-suckers of different species.

Sundri suckers are far more numerous than those of any other species, and their flattened shape renders them fit to fully exercise all the mechanical functions noted above. The suckers of *Pussur* and *Amúr* are met with in the low-lying localities affected by trees of these species; they are consequently, as a rule, much longer than those of *Sundri*. The suckers of *Keora* and *Ora*, species that are found only on river banks, are short on the high ground of the banks and long on the river-side. This accords with the general observation that the upward growth of a sucker continues until its apex has reached the level of high-water mark.

Keora sends out very long roots into the mud of river beds. These roots act as spurs deflecting the course of the current, causing accumulations of silt, and sometimes leading to the complete silting up of rivers. Innumerable suckers proceed from these roots up to distances of 150 feet and more from the parent tree, and aid in fixing whatever silt has accumulated, and inducing the deposit of more. These suckers are exposed at low tide, but are subjected to long-continued submergence daily until the bank has risen sufficiently to allow the tops to remain above the level of high tide.

Báen suckers are of exceptional interest. Their form and flexibility render them almost useless as agents for the prevention of erosion and the arrest of silt, seeds, and wood *débris;* and it is certain that they do not have the effect of enabling trees of this species to maintain a vertical position. *Báen* trees after attaining a girth of 2 to 3 feet, incline from the vertical. In the case of large trees, 15 feet in girth and more, the inclination from the vertical is often considerable; but the trees of this size have long since passed their maturity, and are merely light, hollow shells.

The most interesting fact regarding the root-suckers of this species is that they have been found, on examination of the internal structure, to contain vessels that are supposed to serve as passages for the conveyance of atmospheric air to the roots.

It has been remarked that the top-layer of alluvial mud, a very fine silt, excludes atmospheric air from the lower stratum of miasmic mud wherein the wood *débris* of the forests decomposes and large quantities of gas are generated. The fact has also been noted that the root-suckers continue to make upward growth until their tops are above high-water level. It is accordingly considered probable that the root-suckers of all the species that produce these curious processes not only discharge the mechanical functions already referred to, but are provided with a structure that enables them to supply atmospheric air to the roots.

The Petrology of Job Charnock's Tombstone,—*By* THOMAS H. HOLLAND, A.R.C.S., F.G.S., *Geological Survey of India.*

[Received August 29th, Read November 1st.]

At the suggestion of the Rev. H. B. Hyde, I recently examined the tombstone preserved in the 'Charnock Mausoleum,' St. John's Churchyard, to the memory of Job Charnock.* Apart from its historic interest, the rock itself, being of a type hitherto undescribed, is of sufficient scientific value to call for a description.

The abundance of blue quartz, the occasional crystals of garnet, the black, and sometimes bronzy-looking, pyroxene, and the cleavage faces of the felspars are characters which are at once striking features in the hand-specimen.

Under the microscope, the rock is seen to be granitic in structure; that is, it is perfectly crystalline throughout, with the crystals mutually interlocked, and the intergrowth so perfect that in places a beautiful micro-pegmatitic structure results. The following minerals can be identified (1), Quartz. (2), Orthoclase (Microcline). (3), Plagioclase. (4), Hypersthene. (5), Garnet, and (6), Magnetite.

(1.) The QUARTZ-CRYSTALS are crowded with minute acicular inclusions, the structure of which cannot be made out with the microscope; they are arranged without discoverable regularity: and are probably the cause of the blue colour seen in hand-specimens. Blue quartz-crystals have been noticed before in granites and granitites, as in that from Rumburg in Sweden.

(2). ORTHOCLASE and MICROCLINE. Most of the potash-felspars show the remarkable and unmistakable microcline structure. Occasionally also the orthoclase is seen presenting the "streifige" appearance due to regularly arranged intergrowths with a plagioclase, giving rise to the structure described by Becke as micro-perthitic. To prove the identity of this felspar I have isolated crystals having a specific gravity of 2·59, and examined them chemically by Szabo's method.

(3). PLAGIOCLASE occurs only in small quantities. The isolated crystals show the characteristic twinning, with extinction-angles approaching those of oligoclase.

(4). HYPERSTHENE occurs, not in large quantities, but presenting its characteristic pleochroism and straight extinction. The presence of this mineral is a feature of exceptional interest from the fact that, so far as I am aware, a hypersthene-granite has never before been record-

* Job Charnock died in 1693, and the tombstone was erected about two years later.

ed, although the mineral has been frequently found as a constituent of the intermediate, basic and ultra-basic holocrystalline rocks. The precise reasons why the micas, hornblendes, and, more rarely, augites should occur as the ferro-magnesian constituents of granites, and not hypersthene, have never been accurately settled. The discovery of hypersthene, therefore, in this capacity fills a very well-marked gap in the granitic series, and for the time we can do no more than record as precisely as possible its nature and mode of occurrence, with the hope that in future the facts may be of service in framing an hypothesis for explaining the fact that chemically similar magmas, under special conditions of temperature and pressure during the process of consolidation, give rise to different mineral species.

(5). GARNET of the almandine variety occurs very sparingly in the rock, and seldom shows anything approaching idiomorphic crystalline form.

(6). MAGNETITE in small grains is sparsely scattered amongst the other minerals.

The rock has a *specific gravity* of 2·646, agreeing thus with normal granites.

In microscopic and macroscopic characters this rock agrees with certain specimens which I have recently collected in the Madras Presidency. At different places in the south of India (Pallavaram in the Chingleput district, the Shevaroy and Nilgiri hills, in N.-W. Madura, and in Travancore) there occur exposures of igneous rock in which hypersthene is a constant constituent, and which at the same time exhibit every gradation in acidity, from hypersthene-granite, the most silicious (acid), to pyroxenite the most basic. These rocks, although their exposures are now separated by such distances from one another, I believe to have been derived from a common molten magma: they belong to one "petrographical province," and the differentiation of the originally homogeneous molten material into masses so widely distinct in chemical composition can be shown to be in agreement with well-established, though recent, physical principles.

The massive rocks of the Nilgiri Hills, and the Shevaroys, as well as the similar rocks found in the localities mentioned above, have been hitherto regarded as belonging to the great metamorphic series of the South. Observations made during recent visits to the Madras Presidency have, however, convinced me that this series, together with certain others not now under discussion, must be looked upon as intrusive igneous rocks of younger age than the normal gneiss.

The evidences for these conclusions I hope shortly to produce in detail. For the present, however, we are concerned in identifying

Job Charnock's tombstone with the pypersthene-granites of the Madras Presidency; and from its proximity to the cost and to Madras, it seems likely that Pallavaram would have been selected by the earlier agents of the East India Company as a source of this handsome rock. Nearly all the old tombstones collected together in St. John's Churchyard are of the same rock; for example that of Job Charnock's son-in-law, Jonathan White (1703), and Mrs. Jane Smart (1753).

Briefly, the points in which these rocks agree with those of Pallavaram, and upon which I base this identification, are these :—

(a). *Structure* :—

(1). Micro-perthitic structure.

(2). Granophyric (micro-pegmatitic) structure.

(b). *Composition* :—

(1). The presence of potash-felspar in the form of microcline.

(2). „ hypersthene.

(3). „ blue quartz.

(4). „ almandine garnet.

(c). *The combination* of these minerals with the above-named structures. In this association hypersthene is especially note-worthy for the reasons already stated.

As this is a new type of rock, and modifications of it occur by the introduction of accessory minerals, I would suggest for it the name *Charnockite*, in honour of the founder of Calcutta, who was the unconscious means of bringing, perhaps, the first specimen of this interesting rock to our capital.

On a slab of Chinese agglomerate lava bearing a Chinese inscription discovered in St. John's Churchyard, Calcutta. By T. H. Holland, A.R.C.S., F.G.S., *Geological Survey of India.*

[Received October 26th;—Read November 1st, 1893.]

(With Plate VII.)

Through the kindness of the Revd. H. B. Hyde, I have been enabled to examine the slab bearing a Chinese inscription and discovered by him in St. John's Churchyard.

The slab has been imperfectly polished on the face bearing the inscription, and at first sight presents the character of a common artificial concrete, for which I at first mistook it. But on removing a fragment from the back of the slab and examining it in the laboratory, I found it to be a siliceous lava, which, though of course formed by natural means is, indeed, comparable to a concrete in ways other than appearances. It is a rhyolitic lava of a kind occurring in different parts of China, which, previous to consolidation, has included fragments of other rocks and now presents the patchy appearances of the agglomerate lavas and pipernos described by Fritsch and Reiss as varieties of eutaxite.*

Thin slices examined under the microscope leave no doubt as to the nature of the rock :—Corroded quartz-crystals embedded in a cryptocrystalline and microlitic magma are scattered irregularly through the slide. Occasionlly these preserve in part their original bi-pyramidal outlines, but the magma has corroded the majority of the crystals into irregular shapes. A curious feature worthy of record is the way in which many of the quartz-crystals are traversed by a series of cracks without discoverable regularity. These cracks recall the tessellated appearance of the polysynthetic porphyritic crystals described by Gen. McMahon in the eurite of Tushám Hill, 85 miles north-west of the town of Delhi.† But as a rule, in the present instance, the small fragments, although separated from one another by a series of cracks, all have the same optical orientation, whilst in the Tushám specimens the grains are, according to Gen. McMahon, oriented in different directions. I have found, however, one case of a quartz-crystal in which, after the formation of the cracks, many of the fragments have been slightly displaced, so that whilst the position of extinction is the same for the individuals in some of the pairs, others show slight differences, and still others have been moved through several degrees. Gen. McMahon explained the structure of the quartz-crystals in the Tushám rock as the result of rapid cooling after eruption, and I think the present case, in which many of the crystals are simply cracked more often without displacement of the fragments, are certainly more easily explained in this manner than by the other suggestions which, in his paper, Gen. McMahon has considered and rejected. Relief of pressure would also contribute to the same effect. A similar structure can be produced in clear quartz-crystals by rapidly cooling them from a red heat, the crystals becoming white and losing their transparency from a similar cause.

Next to the quartz-crystals in abundance amongst the porphyritic constituents are the felspars, some of which are of a plagioclase variety, and all greatly kaolinized. Black and brown patches of ferruginous material occur as relics of the ferro-magnesian constituents of the original rock. Secondary minerals like chalcedony occur in small quantities infilling cavities.

* *Geologische Beschreibung der Insel Tenerife*, 1868, p. 420.

† *Min. Mag.*, Vol. VIII. (1888), p. 10.

Lumps of andesitic rocks are common as inclusions in the matrix, which in places shows damascened and eutaxitic structures.

The specific gravity of the rock is 2·35. Thin splinters fuse before the blowpipe to a white vesicular glass.

Comparison with Chinese rocks:—The peculiar structures presented by this rock are of especial interest from the way in which they can be parallelled amongst the Chinese eurites and rhyolites. The damascened structure and the included fragments of a similar andesitic rock I have previously described in the Korean acid lavas.*

Amongst the rocks which I have collected in China, there is a specimen of eurite from the Victoria Peak, Hong Kong, in which the porphyritic crystals of quartz are cracked in the same peculiar manner. The felspars, also, in this rock are in part plagioclastic, and irregular patches of small biotite bundles resemble in shape the ferruginous masses occurring in the slab. But although the Hong Kong rock shows a very distinct flow structure, the groundmass is composed wholly of microgranulitic material, and there is a notable absence of the andesitic foreign inclusions. Whilst, then, the porphyritic constituents of the slab agree with those of this rock, the groundmass shows that the conditions of consolidation were different; but although the circumstances of solidification were not the same there seems little doubt that the slab in St. John's Churchyard belongs to the same geological mass as the Hong Kong eurite, and both these are members of the acid series of igneous rocks—granites, granitites †, eurites and rhyolites—which can be traced from the Island of Hainan, north-east through Hong Kong to Foochow, and are repeated in a parallel band which reaches the sea-coast at Chusan, are repeated in the Korea, and possibly represented again by the central granitic axis of Kamtschatka. These rocks probably belong to one petrographical province and are the relics of a great chain of eruptions which took place in East Asia during middle carboniferous times. The granites and eurites are found intruding into the limestones which occur below the coal-bearing series; whilst fragments of these rocks are the principal constituents of the conglomerates which lie at the base of the coal-measures. The out-crop of these rocks is approximately parallel to the general strike of the stratified series, following the directions of the principal mountain ranges, which in East China Pumpelly has described

* *Quart. Journ. Geol. Soc.*, Vol. XLVII. (1891), pp. 176–178.

† The prevalence of granitite and the occurrence of its representatives amongst the hemicrystalline and felsitic rocks are striking features in these Chinese rocks, and I regard them as a later stage in the eruptions which first gave rise to diorites and andesites—rocks which I have frequently found associated with and included in the later acid eruptions of China.

as the Sinian system of elevation.* Elsewhere I may have occasion to refer to these features in greater detail: for the present I have referred to them for the purpose of showing that, whilst I think the slab found in St. John's Churchyard is undoubtedly of Chinese origin, it may have been brought from any of the localities in East China and Korea where these characteristic, acid, igneous rocks prevail. In what manner the slab was brought to India will doubtless appear from Mr. Hyde's researches.

EXPLANATION OF PLATE.

Figs. 1 & 2. From slab of Chinese agglomerate lava found in St. John's Churchyard.

Fig. 1. Bi-pyramidal crystal of quartz corroded by the magma.

Fig. 2. Crystal cracked and corroded.

Figs. 3 & 4. From eurite. Victoria Peak, Hong Kong.

Fig. 3. Bi-pyramidal crystal of quartz corroded by the magma.

Fig. 4. Crystal cracked and corroded.

* Geological Researches in China, Mongolia, and Japan, 1866, p. 67.

Fig: 1.

Fig: 2.

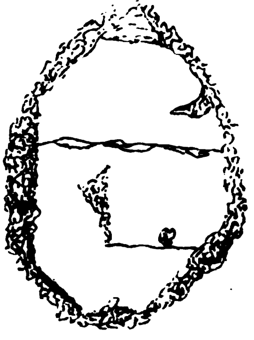

Fig: 3.

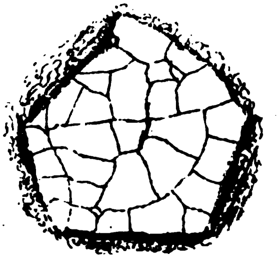

Fig: 4.

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JOURNAL

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No. IV.—1893.

Natural History Notes from H. M. Indian Marine Survey Steamer, 'Investigator,' Commander C. F. Oldham, R. N., Commanding. Series II., No. 9. *An Account of the Deep Sea Collection made during the Season of* 1892–93.—*By* A. Alcock, M.B., C.M.Z.S., *Superintendent of the Indian Museum.*

With plates VIII. and IX.

[Recd. Nov. 21. Read Decr. 6th.]

The collection here described is a very small one, but the few things obtained are interesting.

Among Coelenterata, *Cerianthus* and *Cyathohelia* do not appear to have been before recorded from the Bay of Bengal: among Echinoderma, *Astroschema* and *Echinolampas*—although the latter has been recorded as a Sind Tertiary fossil: and among fishes *Odontostomus*. All these occur in the present collection.

COELENTERATA.

NEMATOPHORA.

ANTHOZOA ACTINIOMORPHA.

ACTINIARIA.

Family **Cerianthineæ.**

Cerianthus, Delle Chiaje.

1. *Cerianthus tenebrarum*, n. sp.

Elegantly caryophyllaceous in shape.

The body wall is thick, and the characteristic investing sheath is loose. The oral sphincter is stout. The tentacles of the inner crown are short and number about fifty: those of the outer crown are very long with stout base and long wavy filamentous ending, and number about sixty. The septa with their mesenteric filaments are almost entirely confined to the upper third of the enteric cavity, leaving about the lower two-thirds as a perfectly smooth-walled chamber.

Colour dull madder, the tentacles being lighter and ruddier than the body.

Length, contracted in spirit, 50 mm.

With the exception of a species from the Andaman Reefs, described in J. A. S. B., Vol. LXII., Pt. II., 1893, p. 153, this seems to be the only *Cerianthus* hitherto recorded from India.

From the Bay of Bengal on a muddy bottom at 410 fathoms: bottom-temperature 45.5° Fahr.

MADREPORARIA APOROSA.

Family **Turbinolidæ.**

(1) *Flabellum laciniatum*, Phil., and (2) *Flabellum japonicum*, Moseley, appear to be quite common inhabitants of the muddy bottom of the Bay of Bengal at 400–700 fathoms. And among the corals obtained with them during the past year is a new species of *Rhizotrochus.*

Rhizotrochus, Edw. and Haime.

3. *Rhizotrochus crateriformis*, n. sp., Pl. VIII. figs. 1 and 2.

Corallum low, bowl-shaped, having a small central mamillary pedicular scar, a very thin fragile epithecate wall, and a regular, circular calicular orifice with the lip gently everted.

From the thecal wall, which is marked with close faint costal striæ and with close faint concentric lines of growth, the large cylindrical "rootlets" stand out at a wide angle.

The septa, which are in four complete cycles, with an incomplete fifth, are thin, and have their crests strongly emarginate, so that when the corallum is viewed from above they look something like large pali: their surface is marked with lines of distant, coarse granules, concentric with the curve of the crest. The septa of the first two cycles are approximately co-equal, and all unite at the very bottom of the calice by a few stout cylindrical trabeculæ which form a rudimentary columella: above this they do not encroach very greatly on the calicular space, but leave a clear wide central fossa. The septa of the third cycle are narrow laminæ, those of the fourth are still narrower, and those of the incomplete fifth are merely fine ridges in the upper part of the calicle.

Colour in spirit—both corallum and soft parts—quite white.

The tentacles, which appear to be about ninety in number, are disposed in three concentric series.

Greatest height 22 mm.: diameter of calicular orifice 32 mm.: depth of calicular fossa 16 mm.

From the Bay of Bengal on a muddy bottom at 573 fathoms: bottom-temperature 45·3° Fahr.

Family **Oculinidæ**.

CYATHOHELIA, Edw. and H.

4. *Cyathohelia axillaris* (Ell. and Sol.)

Madrepora axillaris, Ellis and Solander, Nat. Hist. of Zoophytes, p. 153, tab. 13, fig. 5.

Cyathohelia axillaris, Edw. and Haime, Coralliaires II. 110.

A branch of a colony answering to the figure in Ellis and Solander was dredged from a previously unknown coral bank in Lat. 14° 11′ 6″ N., Long. 80° 24′ E. [about 55 miles N. by E. of Madras) in 88 fathoms, bottom-temperature 65° Fahr.

MADREPORARIA POROSA.

Family **Eupsammidæ**.

DENDROPHYLLIA, Edw. and H.

5. *Dendrophyllia nigrescens*, Dana.

Dendrophyllia nigrescens, Dana, Zoophytes, p. 387, pl. 27 (30), fig. 1.

From the same coral bank, at the same depth, several branches of this species were dredged.

ANTHOZOA ALCYONIOMORPHA.

The coral bank in 88 fathoms, N. by E. of Madras, appears to be very rich in *Gorgonacea* and *Alcyonacea*. Unfortunately the dredgings were merely rough dried, without any treatment, so that they reached the Museum denuded and almost valueless. The following genera are recognized:—*Anthogorgia, Echinogorgia, Acis, Gorgonella, Juncella, Scirpearella; Spongodes.*

ECHINODERMA.

ASTEROIDEA.

Family **Archasteridæ**.

PSEUDARCHASTER, Sladen.

1. *Pseudarchaster mosaicus*, Alcock and Wood-Mason.

Pseudarchaster mosaicus, Alcock and Wood-Mason, Ann. and Mag. Nat. Hist., Dec. 1891, p. 432.

A specimen with a span of nearly 200 mm. from 599 fathoms off the Madras Coast.

Family **Astropectinidæ.**

Dipsacaster, gen. nov.

2. *Dipsacaster, pentagonalis*, n. sp.

Differs from *Dipsacaster sladeni* (Ann. Mag. Nat. Hist., February, 1893, p. 87, pl. V. figs 3 and 4) in the following particulars:—The disk is relatively larger, and the rays, which are bluntly rounded at the tip, are relatively shorter and broader—the whole form being thus more pentagonal; the relative length of the rays to the radius of the the disk is 2·5: 1; the paxillæ are larger; on the adambulacral plates the central spine of the paxilliform group is a large distinct spine and not a mere spinelet. Two specimens from the Andaman Sea, 112 fathoms.

Family **Pentagonasteridæ.**

Calliaster, Gray.

3. *Calliaster mamillifer*, n. sp., Pl. VIII. figs. 3 and 4.

Rays 5 R=2·5 to 3r.

Abactinal area covered with sunken circular plates, each bounded by a ring of discoid granules: the mid-radial plates of the disk bear each a great globular mammillated spinelet, as do also, but on a smaller scale, the dorso-central and basal inter-radial plates.

The supero-marginal plates, which are six in number, excluding the terminal, and come in partial contact across the distal third of the rays, have the form of great globules, each surmounted centrally with a nipple-like spinelet: those in the outer third of the ray sometimes bear also one or two granules.

The infero-marginal plates coincide not quite exactly with their fellows of the supero-marginal series: they are long, broad and tumid, and each bears near the suture line with that series, a row or a group of large coarse truncated spinelets.

The adambulacral plates have each a furrow series of four radiating spinelets, and actinally a single large coarse truncated spine and rarely a few granules also.

The actinal inter-radial areas are of some size, with large and slightly tumid plates, many of which have one, or very rarely two, large coarse spinelets.

All the marginal, adambulacral, and actinal plates have much the same fringe of discoid granules or squames as the abactinal plates, only it is not so regular.

Anus subcentral.

Madreporite small, circular, radially striated, situated about midway between the margin and the centre.

Colour in spirit, chalky yellow. This singularly beautiful species was dredged in the Andaman Sea, between 270 and 245 fathoms.

Family **Zoroasteridæ.**

ZOROASTER Wyville Thomson.

Fine specimens of (4.) *Zoroaster Alfredi* and (5.) *Zoroaster barathri* (Ann. Mag. Nat. Hist., Feb. 1893, pp. 102, 103), from the Bay of Bengal, 599 fathoms.

OPHIUROIDEA.

Family **Astrophytidæ.**

ASTROSCHEMA, Örst. and Ltk.

1. *Astroschema flosculus*, n. sp., Pl. VIII. fig. 5.

R = 11r – 16r.

The sides and abactinal surface of the disk and arms are covered with granules,—prominent granules and globules being scattered over a finely granular surface, and the actinal surface is covered with an uniform microscopic granulation.

Viewed from the aboral aspect the disk is rotate-corolla-shaped, being deeply depressed in the centre and consisting of five deep cut petaloid lobes, each composed of a pair of radial plates. There are no mouth papillæ or tooth papillæ, but there is a vertical row of five large hastate teeth on each mouth segment.

Rays long, tapering to a lash, simple, and perfectly square in section, the actinal angles of the square being occupied by the series of paired spine-like tentacle scales, and the abactinal angles by series of prominent clumps of globuar granules corresponding to the tentacle scales, this arrangement emphasing the arm joints and giving the arms a regularly beaded appearance.

Genital openings nearly vertical, and traversing nearly the whole depth of the disk.

Mouth tentacles large, the second pair of tentacles without any scale, the third pair with the pairs of scales small.

Colour, in alcohol, grey; in life, blood-red.

From the newly discovered coral bank north of Madras, in 88 fathoms.

ECHINOIDEA.

SPATANGOIDA.

Family **Cassidulidæ.**

ECHINOLAMPAS, Gray.

1. *Echinolampas castanea*, n. sp., Pl. VIII. fig. 6.

Test thick, high, bluntly conical towards the greatly excentric abruptly subacuminate apical system; sub-pentagonal in tumid ambital outline; densely felted with short capillary spines, which are larger and sparser on the actinal surface, and at the tumid inter-radial peristomial margins form fan-like tufts.

Ambulacra equal, narrow, petaloid abactinally, the poriferous areas of unequal length in the same petal, approaching as if to close, and then again diverging, the pairs of pores set very close together in grooves separated by moniliform ridges: beyond the petals the ambulacra increase considerably in width to the ambitus, whence they taper to the peristome, while the pores become single, distant, and invisible to the naked eye as far as the vicinity of the peristome, where they are again large and double, and are crowded together to form distinct phyllodes.

Inter-radia large, constricted very abruptly at the apical system and gradually at the peristome, being represented at the peristomial margin by a single tumid granular plate.

Both ambulacral and interradial plates closely covered with small scrobiculate tubercles of uniform size and disposition, except in the middle of the actinal surface, where they become a little larger and much more scattered: fine miliary granulation between the tubercles.

Apical system small, very excentric in front: a large central madreporite extending from the right anterior basal: four genital pores.

Peristome situated in the middle of a distinct hollow, excentric in front, transverse, pentagonal, with a distinct floscelle.

Periproct in posterior inter-radium, large, elliptical, transverse, immediately inframarginal, with a valvular operculum formed of three large tuberculated plates.

Colour, yellowish green.

Bay of Bengal, 11 fathoms.

At first sight this species has a strong resemblance to *Echinolampas spheroidalis*, d'Arch and Haime, from the Miocene of Sind and Kuchh; from which it is distinguished at once by the concavity of the actinal surface and by the tumid peristomial margin. The test is also higher in the present species.

Family **Spatangidæ.**

Brissopsis, Ag.

2. *Brissopsis Oldhami*, n. sp., Pl. VIII. figs. 7 and 8.

Test thin, inflated, ovoid, with a faint anterior groove and a strong posterior truncation; abactinally covered with recurved hair-like spines which are largest and densest within the peripetalous fasciole; actinally with similar large spines in the interradii, the ambulacra being almost naked.

All the ambulacra are abactinally petaloid and sunken: in the anterior petal, which is the longest and narrowest, the pores are small and extremely evenly and closely set, in the other petals the pores are large: beyond the petals the ambulacra are only slightly spiniferous at the ambitus, and are almost or quite naked actinally; and all have small and distant pores; but abactinally the plates of the postero-lateral ambulacra are spiniferous, and the pores of those that are enclosed in the sub-anal fasciole are exceptionally large. Abactinally, as actinally, the inter-radii are very large, with big broad plates that are finely and closely granular abactinally and much more coarsely and distantly granular actinally.

Peristome reniform: the orifice of the mouth is made valvular by the remarkable prolongation forwards of the labrum.

Apical system hardly excentric; the madreporite is large, passing backwards from the right anterior basal and separating the posterior basals and radials and several inter-radial plates; four large genital pores.

Periproct small, vertically pyriform, high up in the posterior truncation, with many plates, of which those at the circumference are the largest.

The peripetalous fasciole is very distinct, being broadest posteriorly. Sub-anal fasciole reniform, largely actinal in position, being far distant from the periproct. Two narrow and inconspicuous fasciolar bands extend up from the sub-anal fasciole, one on each side, to the level of the periproct and are then gradually lost.

The pedicels of the anterior petal are of conspicuous length.

Colour, dull olive-green; fascioles dull madder brown.

Bay of Bengal, 753 fathoms, bottom soft mud; bottom temperature 41·2° fahr.

Lovenia, Ag. and Desor.

3. *Lovenia gregalis*, n. sp., Pl. VIII. fig. 9.

Test thin, broad, flat, cordiform, grooved and deeply excised anteriorly, broadly truncate posteriorly, the ambital margin in front sharp, behind gently rounded. Spinature scanty.

Anterior ambulacrum in the groove, with pores small and inconspicuous except at the peristome, where they are larger: it is practically unmodified throughout its course, from apex to peristome. Lateral petaloid ambulacra with pores almost invisible to the naked eye within the internal fasciole: beyond the internal fasciole the antero-lateral petals are markedly divergent from, while the postero-lateral petals are convergent towards, the sagittal line: the slightly sunken pairs of pores are large and are separated from one another by faint ridges with minute distant granulation, the interporiferous space is broad and bears several series of granules. Beyond the petals the postero-lateral ambulacra increase greatly, while the antero-lateral decrease somewhat in width.

Inter-radii very large and broad abactinally where the antero-lateral bear each a small patch, and the postero-lateral each a much larger patch, of large deeply scrobiculate perforated tubercles, each surmounted by a long slender recurved recumbent hollow spine. Similar but smaller tubercles, with similar spines, cover the actinal surface rather more densely throughout almost the whole of the broad antero-lateral and postero-lateral inter-radii, and also occur in two small patches, involving both ambulacral and posterior inter-radial plates, in each wing of the sub-anal fasciole.

Peristome situated immediately behind the anterior cleft, semilunar in shape, and followed by a long narrow labrum.

Apical system hardly excentric; the madreporite in the posterior basal.

Periproct in the upper part of the posterior truncation, large, transversely oval, not sunken.

The internal fasciole is remarkable in not crossing the anterior ambulacrum; after skirting the groove in rather more than half of its extent, it gradually fades away on either side, sometimes bending slightly towards the groove, as if to cross, sometimes not. The subanal fasciole is large and dumb-bell shaped, and encloses three pairs of pores on either side.

Colours: brownish green, spines white.

Bay of Bengal, 475 fathoms, bottom brown ooze, bottom temperature 45·5° Fahr.

MOLLUSCA.

The Mollusca that we may now regard as characteristic of the hundred-fathom line in the Bay, were again met with in considerable numbers, namely, *Rostellaria delicatula*, Nevill, *Sigaretus* sp., *Tellina* sp., and *Nucula* sp. At about the same depth (128 fathoms) there were dredged *Phos* sp., *Pleurotoma* sp. prox. *atractoides*, Watson, and *Tellina* sp. prox. *Murrayi*, E. A. Smith, and on the coral bank, at 88 fathoms, *Murex palmarosæ*, Lmk.

ARTHROPODA.

CRUSTACEA.

DECAPODA.

At 128 fathoms the Penæid (1.) *Solenocera Hextii*, Wood-Mason, characteristic of that depth here, was dredged.

Of the other crustacea taken, three appear to be new to the Indian record. They are as follows:—

Family **Trapeziidæ.**

QUADRELLA, Dana.

2. *Quadrella coronata*, Dana.

Quadrella coronata, Dana, U. S. Expl. Exped., Crust, Pt. I. p. 266, Pl. XVI. figs. 5 a–d.

A single female.

From the Coral Bank north of Madras, 88 fathoms.

Family **Parthenopidæ.**

PARTHENOPE, Fabr.

3. *Parthenope spinosissima*, A. M.-Edw.

Parthenope spinosissima, A.M.-Edw., Notes sur L' Ile dé la Réunion Annexe F., p. 8, Pl. XVII;

A large ovigerous female and a small male.

Colour in life reported to be blood-red.

From the Coral Bank north of Madras, 88 fathoms.

Family **Raninidæ.**

RANINOIDES, Milne-Edwards.

4. *Raninoides personatus*, White MS., Henderson.

Raninoides personatus, Henderson, Challenger Anomura, p. 27, Pl. II. fig. 5.

Numerous specimens from the Bay of Bengal, 31 fathoms.

Family **Homolidæ.**

HYPSOPHRYS, Wood-Mason.

5. *Hypsophrys superciliosa*, Wood-Mason, Ann. Mag. Nat. Hist., March 1891, p 269.

Several beautiful specimens, both males and ovigerous females, from the Laccadive Sea, 865 fathoms, bottom *Globigerina* ooze, bottom temperature 40° Fahr.

VERTEBRATA.

PISCES.

ACANTHOPTERYGII.

Family, **Trachinidæ.**

Group Trachinina.

BATHYPERCIS, n. gen.

Head large, depressed; body cylindrical, elongate. Cleft of the mouth wide, oblique, with the lower jaw projecting; villiform teeth in jaws, vomer, and palatines. Eyes large, supero-lateral. Gill-cleft wide; seven branchiostegals; preoperculum armed; four gills; pseudobranchiæ large. Scales ctenoid; lateral line continuous from occiput to caudal fin, its anterior portion armed. Two separate dorsal fins, the first short, the second long, and equal opposite and similar to the anal. Ventrals jugular.

No air-bladder; no pyloric cæca.

1. *Bathypercis platyrhynchus*, n. sp., Pl. IX fig. 1.

General aspect Platycephaloid, with some superficial resemblances to *Callionymus*.

B. 7. D. 6/14. A. 16. C. 12, with numerous rudimentary rays at base. P. circ. 25. V. 1/5. L. lat., from origin on occiput, 50. L. tr., 11.

Head large, broad, depressed, its extreme length, measured from the tip of the projecting mandible to the apex of the prolonged opercular flap is not much less than half the total, caudal excluded. Body elongate, cylindrical, low, and tapering to the large caudal.

The snout is broad, much depressed, and spathulate, resembling the bill of *Bathypterois;* its extreme length is equal to the major diameter of the orbit, and rather over one-fourth the extreme length of the head. Mouth-cleft wide, slightly oblique, the maxilla reaching nearly to the vertical through the middle of the eye, and ending in a fleshy barbel. Teeth in villiform bands on the jaws, vomer, and palatines. Tongue large, spathulate.

The large eyes are placed close together on the summit of the head, separated from each other by a narrow groove; but the visual axis is lateral. The gill-cleft is very wide, the gill-membranes being free of the isthmus throughout: the preopercular angle is spinate, and the operculum, which is prolonged in membrane nearly to the level of the 4th dorsal spine, has two spines above and one below. Four gills with setiform gill-rakers and broad laminæ: pseudobranchiæ large.

The body, and the head and the snout above, are covered with rather large finely ctenoid scales. The lateral line, beginning on the occiput as a close-set row of re-curved spines, or strongly carinated scales, curves inwards towards the first dorsal fin and then downwards along the lower half of the tail, being salient but unarmed in this part of its course.

The first dorsal fin is short, and is separated from the second by four or five rows of scales: the second, which is much more elevated than the first, extends from the level of the vent to within an eye-length of the base of the caudal. The anal fin is similar to the second dorsal. The pectorals are large and long, reaching to the fourth anal ray. The ventrals are jugular, arising an eye-length in advance of the pectorals: their plane of origin is horizontal, and they reach considerably beyond the scaly bases of the pectorals.

Stomach siphonal with a large cæcal sack. No pyloric cæca. No air-bladder.

Colours in spirit, yellowish-brown, with thirteen incomplete and indefinite darker cross-bands on body and tail: a golden-green ocellus on crown of head and in the apex of each opercular flap: spinous dorsal white at base, black in the upper half; second dorsal with dusky bands: caudal and pectorals dusky: anal and ventrals hyaline. Length 4·3 inches.

Bay of Bengal, 128 fathoms.

Family, **Pediculati.**

Lophius, Art.

2. *Lophius mutilus*, n. sp.

This species is distinguished from all its fellows by the structure of the second part of the spinous dorsal fin, which is rudimentary.

B. 5. D. 3/ (2)/ 8. A. 5. C. 8. P. 15. V. 1/5.

Cephalic disk enormous, its width nearly equal to its length, which is not much less than half the total, including the caudal.

The head bones are marked by spinate crests, one small and bifid at the pre-orbital angle; one large and tridentate above each orbit; one at the upper limit of the clavicle, one large and trifid at the angle of the clavicle, and two on the preoperculum—besides numerous ridges ending in acute points.

The eyes are large, their major diameter being nearly one-fifth the length of the head.

The mouth-cleft involves the whole breadth of the cephalic disk. Small depressible fangs of unèqual size in three irregular series in the mandible, in two series at the pre-maxilliary symphysis, but in a single series along the greater extent of the pre-maxilla: a pair of rigid fangs on each side of the vomer: an uneven row of five or six rigid fangs along each palatine. Gill-cleft relatively wide: three gills.

Head and body covered with loose glandular skin, which forms a row of filaments along the edge of the cephalic disk and along the sides of the tail.

Dorsal spines in the form of plain setæ, the first two of which have the usual position close together on the snout, while the third, which is as long as the cephalic disk and nearly twice as long as the second, arises behind the orbit. The second portion of the spinous dorsal is represented by two distant rudimentary rays only visible by dissection. The soft dorsal, and all the other fins have the usual position.

Colours in spirit, mottled brown, tip of tongue dusky. Length 5·25 inches.

Bay of Bengal, 128 fathoms.

ANACANTHINI.

Family, **Gadidæ.**

Physiculus, Kaup.

3. *Physiculus argyropastus*, n. sp., Pl. IX. fig. 2.

B. 7. D. 8-9/55. A. 57. V. 6.

Head large, broad, depressed, its length a good deal more than one-fourth of the total, caudal included. Height of the compressed body from about half to eleven-nineteenths the length of the head. Snout broad, depressed, rounded, its length equal to the width of the interorbital space and just exceeding the major diameter of the eye. Mouth wide, oblique, with the upper jaw overhanging; the maxilla reaches behind the vertical through the middle of the orbit; broadish bands of villiform teeth in the jaws only. Barbel filiform and inconspicuous, its length not half that of the eye. Gill-openings extremely wide, free from the isthmus throughout: four gills. with about eleven spathulate gill-rakers. Pseudobranchiæ glandular. Body and head invested with small thin deciduous cycloid scales, of which there are six rows between the first dorsal fin and the lateral line.

The first dorsal, which is separated from the second only by a notch, begins in the vertical through the origin of the pectorals; its height is about equal to the length of its base, which is considerably less than one-third that of the head: the second dorsal extends to within an eye-length of the caudal, and its rays, posteriorly especially, are longer than those of the first. The anal begins almost in the vertical through the base of the pectoral, the vent being situated forwards in the vertical through the posterior edge of the operculum. The pectorals are long and pointed, the upper rays reaching to the twelfth or fourteenth anal ray, and being as long as the head behind the middle of the eye. The ventrals arise on narrow horizontal bases: the second ray is nearly as long as the head. There is a post-anal papilla, and a pre-anal pigmented pit, as in *Physiculus roseus.*

The margin of the large thick-walled air-bladdder is pectinately lobed somewhat as in Sciænoids. Colour in spirit, light pinkish brown, with a silvery sheen; belly, throat, and gill-membranes black.

Bay of Bengal, 128 fathoms.

The largest specimen, an adult female, is 9 inches long.

BREGMACEROS, Thompson.

4. *Bregmaceros MacClellandii*, Thomps.

A fine specimen from the Bay of Bengal in 128 fathoms.

The small and immature specimens dredged in previous years at and near this depth, probably belong to this species.

Family, **Ophidiidæ.**

NEOBYTHITES, Goode and Bean.

5. *Neobythites steatiticus*, n. sp., Pl. IX Fig 3.

B. 8. D. circ. 85. A circ. 65. C. 8. P. circ. 22. V. 2.

The large heavy head is in length about one-fourth of the total, caudal included, and is armed with a large opercular spine. The snout, which is bluntly pointed and overhangs the mouth, is in length equal to the diameter of the eye, or between a fifth and a sixth the length of the head. The eyes are large and prominent, without any orbital fold: they are a little over a diameter apart. The nostrils are large, the anterior being a small tube near the tip of the snout, the posterior being a large foramen at the angle of the eye.

The mouth is large, the maxillary extending far behind the posterior border of the orbit, and being nearly half of the head in length.

Teeth viliform, in narrow bands in the jaws, vomer, and palatines.

Gill-cleft very wide, the gill-membranes being separate throughout. Four gills, with broad laminæ and close-set gill-rakers, which are long in the middle of the first arch.

Each pseudobranch consists of two pinnules only. The head, body, and base of the dorsal and pectoral fins are covered with small, moderately adherent scales, of which there are about nine rows between the first dorsal ray and the lateral line, and about twenty-one rows between the lateral line and the vent. The vertical fins have long delicate rays, which are completely invested in loose skin: the dorsal begins well in advance of the base of the pectoral, and the anal on a level with the tip of the latter, both being confluent with the caudal at its base.

Pectorals with large fleshy scaly base: the ventrals arise on the pectoral symphysis, and consist of two long filaments fused together in their basal half.

Stomach siphonal; intestine much coiled; about eight or nine minute rudimentary pyloric cæca encircle the pylorus.

Colour in spirit, creamy yellow clouded and marbled with shades of light brown which forms four ill-defined cross-bands, all of them involving the dorsal fin: a large oval ocellus, formed of a black centre in a broad creamy white ring, on the dorsal fin between the 20th and 30th rays or a little beyond: anal jet black with a milk-white border.

Length of type 5·25 inches.

Bay of Bengal, 128 fathoms.

PHYSOSTOMI.

Family, **Scopelidæ.**

ODONTOSTOMUS, Cocco.

6. *Odontostomus atratus*, n. sp., Pl. IX Fig. 4.

The extreme length of the square, high, compressed head is a little more, and the greatest height of the compressed tapering body is a little less, than one-fourth of the total, caudal included.

The snout has the form of a pointed wart beyond which the upper jaw projects, the lower jaw again projecting beyond the upper.

The eyes, which are situated about a diameter apart, near the top of the head, have their major diameter obliquely vertical, and are capable of such strong rotation inwards as to bring the visual axis obliquely upwards, the orbit being walled in laterally by a stout but transparent fold of skin in its lower half.

The cleft of the mouth extends almost to the posterior edge of the operculum: the premaxillæ are armed with a series of close uniform serrations for the most part pointing forwards, the vomer bears on each side a sabre-shaped depressible fang nearly half as long as the head, the palatines have each an exactly similar fang succeeded by a row of close serrations, and the mandible has on each side a distant series of similar fangs of unequal size, the largest of them however being hardly half the length of those on the vomer and palatines.

Gill-cleft extremely wide and high: four gills with wide laminæ and gill-rakers inconspicuous or absent: pseudobranchiæ large.

Body covered with a glandular scaleless skin in which the lateral line appears in spirit as a white streak. Rows of white dots (luminous organs?) exist along the free border of the preoperculum and the inner border of the broad boat-shaped mandible.

The dorsal fin lies altogether within the anterior half of the body: the anal begins about half a head length behind the vertical through the last dorsal ray, and extends to the rudimentary basal rays of the forked caudal. The large pectorals arise close to the ventral profile, almost in the same plane with the ventrals, the bases of which they touch when laid back. The ventrals arise under the middle of the dorsal.

Colour in spirit, jet black.

Length 3·5 inches.

Bay of Bengal, 573 fathoms.

Family **Murænidæ.**

Congromuræna, Kaup.

7. *Congromuræna squaliceps*, n. sp., allied to *C. megastoma.* Gthr. and *C. longicauda*, Alcock.

Head about an eye-length longer than the trunk, which is not quite one-fourth the length of the tail. The snout, which projects far beyond the mouth, is a little more than one-fifth the head in length. The major diameter of the very elliptical eye is not quite two-thirds of the length of the snout. The anterior nostril is a short wide tube situated on the lip near the end of the snout, the posterior is a wide foramen situated in advance of and above the angle of the eye. The mouth-cleft is wide, extending almost to the vertical through the posterior border of the orbit, and the lips are greatly developed: the minute teeth are in bands in the jaws, and in a broad rasp-like patch outside the mouth in the premaxillary; there are a few teeth on the vomer quite anteriorly. Gill-openings comparatively wide, separate. No scales: lateral line with small pores. Pectorals narrow, half an eye-length longer than the snout. Vertical fins confluent, the dorsal beginning nearly an eye-length in advance of the gill-opening.

Colour in spirit, grey, the vertical fins in their after half to two-thirds with a black edge, which in the anal tends to involve the whole fin. A very large air-bladder extending half a head-length beyond the vent. Visceral peritoneum silvery. A sexually mature male 15 inches long from the Bay of Bengal, 128 fathoms.

8. *Congromuræna nasica*, n. sp. Allied to the preceding group.

Head depressed, an eye-length longer than the trunk, which is much more than a-fourth the length of the tail (1 : about 3·4).

The snout, which projects beyond the mouth, is a fourth the length of the head and nearly twice the major diameter of the eye. The nostrils are as in the preceding species.

The mouth cleft extends almost to the vertical through the posterior border of the orbit. The teeth are in two bands in each jaw, an inner band of minute teeth, and an outer broader band of larger teeth: the premaxillary teeth are in bands outside of the closed mouth, and the vomerine teeth are in a single row along the anterior fourth of the bone.

Gill-openings comparatively wide, separate. No scales: lateral line with minute pores. Pectorals narrow, equal to the snout in length. Vertical fins confluent, the dorsal beginning over the gill-opening.

Colour in spirit gray, the vertical fins in their after third to fourth with a much narrower black edge. Visceral peritoneum black.

Two nearly mature females 10 inches long, and two young from the Bay of Bengal, 128 fathoms. The differences between this species and the preceding are too numerous to support the opinion that they are only different sexes of the same species.

At the same station a specimen of (9.) *Dysomma bucephalus* was dredged.

On some Indian Species of Canarium.—By George King, M. B., LL. D., F.R.S., C.I.E. *Superintendent of the Royal Botanic Garden, Calcutta.*

With Plates X, XI, XII, and XIII.

[Read—December 6th]

In Sir Joseph Hooker's Flora of British India eighteen species of *Canarium* are described. Of these, twelve are Indo-Malayan, two have hitherto been collected only in the Andaman Islands, and two are confined to Ceylon. The remaining two, *viz.*, *C. strictum*, Roxb., and *C. bengalense*, Roxb. are natives of British India proper, and were both originally published by Roxburgh in his Flora Indica. *C. strictum* is a native of Southern India, and was originally described from specimens received by Roxburgh from the Forests of the Tinnivelli district in the extreme South of the Peninsula. It has since been collected in the Anamalli and Bababudin Hills, in the Concan, and in other parts of the Forests of the Western Ghats. *C. bengalense*, on the other hand, is known only from Sylhet and Assam. The distribution of the two species is therefore very different. All the species of *Canarium* known to me are large trees with tall clear stems, bearing branches, (and consequently flower and fruit), only at their apices. Botanical specimens are therefore not easily obtained, and the various species are poorly represented in most collections, and are therefore but imperfectly understood by Botanists. The species indigenous to British India proper do not in these respects form any exception; for, in spite of the existence for the last five and twenty years of a large and well-organised Forest Department, we do not appear to know more to-day about them than we did when Roxburgh originally described two of them eighty years ago. With the view of directing the attention of forest officers to their study, I venture to submit to the Society descriptions of the two already recognised Indian species, a description of what appears to me to be a new species from Sikkim, and some notes on specimens which appear to belong to two species hitherto unrecognised and undescribed.

CANARIUM, Linn.

Tall reziniferous trees. Leaves alternate, unequally pinnate, stipulate or exstipulate. *Flowers* bracteate, in panicles or racemes, dimorphous, those with fertile stamens and rudimentary ovaries being smaller but in larger inflorescences, those with fertile ovaries and rudimentary stamens being larger but in smaller inflorescences. *Calyx* campanulate, with 3 valvate lobes or teeth. *Petals* 3, imbricate, longer than the calyx. *Stamens* 6, the filaments united in their lower part to form a tube. *Ovary* 3-celled, ovules 2 in each cell. *Style* cylindric, or stigma subsessile and capitate. *Drupe* ellipsoid, more or less distinctly trigonous, with a 1–3-celled, 1–3-seeded, stone; cotyledons often partite.*

1. C. BENGALENSE, Roxb. Hort. Beng. 49: Fl. Ind. III., 136. Young branches glabrous. *Leaves* 1 to 2 feet long (in young trees considerably more); leaflets 11 to 21, oblong-lanceolate to ovate-oblong, entire, acute, or very shortly acuminate, the base rounded or slightly narrowed; both surfaces glabrous; the main nerves 10 to 20 pairs, sub-horizontal, curving at their tips, distinct on the lower surface when dry; length 3 to 7 in., breadth 1·25 to 2·5 in.; stipules subulate, pubescent, deciduous. *Inflorescence* glabrous as to the rachises, the pedicels of the flowers puberulous; the male flowers in racemose panicles, the lateral branches of which are pedunculate few-flowered rather lax cymules. *Calyx* about one-third of the length of the corolla, campanulate, its mouth with 3 shallow broad teeth. *Petals* coriaceous, oblong, concave, glabrous. *Staminal-tube* about the same length as the free part of the filaments and anthers; free part of filament slightly shorter than the narrowly ovate anthers. *Disc* none; rudimentary ovary depressed, deeply lobed, hispid at the apex. *Female flower* (fide Roxburgh) like the male; the ovary ovoid, tapering gradually into the style, the stigma 3-cleft. *Ripe drupe* oblong; the style sub-persistent, tapering to each end, smooth, 1·5 to 1·75 in. long and ·7 to ·8 in. in diam. Hook. fil. Fl. Br. Ind. I, 534; Engler in DC. Monog. Phan. IV, 118.

Assam and Sylhet; Griffith No. 1144. (Kew Distrib.), Simons, S. E. Peal, Mann.

A tall tree like *C. strictum* but, unlike that species, almost entirely glabrous, and having leaves with smaller and more numerous leaflets. According to Mr. S. E. Peal, who has resided and observed in Assam for five and twenty years, its vernacular name in the Sibsagar district of that province is *Neribi*. From wounds in the

* There is no true disc in any of the species here described. What some writers refer to as a disc is merely the tube formed by the union of the dilated lower part of the filaments.

bark a clear amber-like rezin exudes which is used for a variety of purposes, but chiefly to be burnt as incense.

Plate X, *C. bengalense*, Roxb.—1. Two leaflets. 2. inflorescence. 3. ripe fruit; *of natural size.* 4. calyx. 5, 6, 7. petals. 8. staminal column. 9. rudimentary ovary; *enlarged.* 10. two stamens; *much enlarged.*

2. C. STRICTUM, Roxb. Hort. Beng. 49: Fl. Ind. III, 138. Young branches rufous-tomentose. *Leaves* 1 to $1\frac{1}{2}$ feet long (in young trees up to even 4 feet); leaflets 7 to 9, ovate to elliptic, minutely serrate or crenulate when young, entire or sub-entire when adult, shortly acuminate, the base rounded or slightly cordate and sometimes sub-oblique; when young tomentose on both surfaces; when adult the upper surface glabrous and shining, the lower more or less tomentose with the 11 to 16 pairs of spreading rather straight main nerves bold and prominent and the intermediate nerves distinct and parallel; length 3 to 6 in., breadth 1·5 to 2·5 in., petiolule ·25 or ·3 in., that of the terminal leaflet two or three times as long. *Inflorescence* more or less deciduously rusty-tomentose, that of the staminiferous flowers a narrow racemose panicle 6 to 9 in. long, its lateral branches being shortly peduncled few-flowered cymes. *Male* flowers ·35 in. long. *Calyx* tubular, with 3 shallow, broad, sub-acute teeth. *Petals* coriaceous, oblong, concave and pubescent outside in the upper two-thirds, glabrous inside. *Staminal tube* equal in length to the free part of the filaments and the anthers; free part of the filaments dilated towards the base, half as long as the ovate apiculate anthers. *Disc* none. *Rudimentary ovary* short, depressed, lobed, hispid. *Female flowers* ·5 in. long, in few-flowered racemes 4 or 5 inches long. *Calyx* wider than in the male. *Staminal tube* also as in the male, but shorter and the anthers with little or no pollen. *Ovary* ovoid-cylindric, tapering into the short thick style; stigma conical. *Ripe drupe* ellipsoid, tapering more to the apex than to the base, slightly trigonous, glabrous, 1·5 in. long, and ·75 in diam. Wight and Arnot Prodrom., 175: Dalz. and Gibs. Fl. Bombay, 52: Beddome Fl. Sylvat. I, t. 128; Hooker Fl. Br. Ind. I, 534; Engler in DC. Monog. Phan. IV, 118. *Pimela stricta*, Blume Mus. Bot. Lugd. Bat. I, 226.

Peninsular India, in the moist Forests of the Western Ghats up to elevations of 4,000 to 4,500 feet.

A very tall tree, the young leaves of a beautiful red colour, those of young trees or of young shoots of old trees being much larger than the measurements given above. According to Col. Beddome, the flowers have occasionally 4 petals and 8 stamens. The tree is known to Europeans in Southern India (Beddome Fl. Sylv., 128) as "black dammar." Its Tamil name, says the same authority, is *Karapu Kungi-*

liam; but it is also known as *Googal* and *Dhup*, two words which in the Eastern Himalaya are conjoined as the name of the species which I below name *C. sikkimensis.* In S. Canara *C. strictum* is known as *Manda Dhup.* The rezin, which is obtained by the barbarous and destructive method of cutting gashes in the lower part of the stem and then setting it on fire, is an article of trade in Southern India. It is used in the manufacture of bottling-wax, varnishes, &c., and is known by a variety of names of which the commonest are *Dhup*, *Googal*, and *Black dammar.*

Plate XI, *Canarium strictum*, Roxb.—1 and 2. leaflets. 3. inflorescence of male flowers. 4. inflorescence of female flowers. 14. drupe; *of natural size.* 5. calyx of male flower. 6. the three petals of the same. 7. side view of a petal. 8. staminal tube laid open. 12 and 13, pistils; *enlarged,* 10 and 11. front and back view of stamens; *much enlarged.*

3. C. SIKKIMENSE, King, n. sp. Young branches very thick and (like the petioles, petiolules, and under surfaces of leaves) densely rusty-tomentose. *Leaves* 15 to 13 inches long; leaflets ovate or elliptic to oblong, minutely crenate-serrate, shortly acuminate, the base rounded or emarginate, slightly oblique; upper surface (when adult) glabrous, shining; the lower softly tomentose, the 13 to 20 pairs of spreading, rather straight main nerves bold and prominent; length 4 to 7·5 in., breadth 2 to 3·5 in., petiole ·1 to ·25 in. *Male inflorescence* a racemose panicle 9 to 15 in. long, the lateral branches being shortly-stalked few-flowered cymes. *Flowers* ·3 in. long. *Calyx* tomentose outside, glabrous inside, campanulate, cut for one-third of its length into 3 broad, obtuse teeth. *Petals* twice as long as the calyx, oblong, obovate, coriaceous, concave and pubescent externally in the upper two-thirds, glabrous within. *Staminal tube* about half as long as the free part of the filaments and anthers, puberulous inside; free part of the filament nearly as long as the linear-ovate anther. *Rudimentary ovary* depressed, hirsute, lobed. *Disc* none. *Female flowers* unknown. *Ripe drupe* narrowly cylindric, ellipsoid, slightly obovoid, glabrous, sub-trigonous, 1·75 in. long and ·7 in. in diam. *C. bengalense*, (not of Roxb.) Gamble List of Trees of Darjeeling District, 15.

Sikkim, in tropical valleys at elevations of from 1,000 to 3,000 feet.

This is named *Googal Dhup* by the Nepalese, and *Nar-ok-pa* by the Lepchas. It is a very tall tree, and was once very common on the lower hill-forests; but now, alas! it is rare. According to Mr. Gamble (l. c. 15) the wood is white, open-grained and soft, with large medullary rays, and has a low specific gravity. It yields a rezin which is burnt as incense by the Lepchas. This much resembles the Southern Indian *C.*

strictum, Roxb., but differs in having broader leaflets more tomentose beneath, a narrower drupe, and shorter branchlets.

Plate XII. *Canarium sikkimense*, King. 1. Leaflet. 2. inflorescence of male flowers. 3. ripe drupe; *of natural size.* 4. calyx. 5,6, & 7. petals, 8. staminal tube. 9. rudimentary ovary; *enlarged.* 10. stamens; *much enlarged.*

Besides the foregoing species, of which pretty full materials exist in the Calcutta Herbarium, there are imperfect materials of another species from Assam, *viz* :—

C. REZINIFERUM, Brace MSS. in Herb. Calc. A large tree 6 or 8 feet in girth, with leaflets resembling those of *C. sikkimense* in shape and size, but having their under surfaces covered with much less and much minuter tomentum, and with the rachises on which they are inserted almost glabrous. The *male inflorescence* is a panicle of cymes 12 to 16 in. long, the *female inflorescence* being racemose and only half as long, and both being rufous-puberulous. *Drupe* ovoid, 1·5 in. long, and nearly 1 in. in diam. when ripe, glabrous. Male and female flowers unknown. Assam and Khasia Hills, G. Mann.

This is the *Dhoona*, or *Dhua*, tree of Assam, and is a species apparently well enough known by its vernacular name and probably common in that province. It yields a rezin which is used to make torches. Fruiting specimens of it were collected by Mr. Gustav Mann at Nangpoo and at other places in the Khasia Hills. Male inflorescences with a few worm-eaten flowers accompany other specimens sent to the Calcutta herbarium by the same indefatigable collector. Leaf-specimens collected at Jota Bhor (near Jorhat) in the year 1845 by Mr. Masters, (a collector sent from the Garden,) also exist in the Calcutta Herbarium. But perfect specimens of flowers of both kinds are still wanting. Will no Forest officer now collect them ?

Plate XIII. *C. reziniferum*, Brace. 1. Leaflet. 2 inflorescence of male flowers. 3. ripe fruit; *of natural size.* 4. calyx. 5,6, & 7. petals. 8. staminal tube. 9. rudimentary ovary; *enlarged.* 10. two anthers; *much enlarged.*

There also exist in the Calcutta Herbarium specimens in fruit of a species from Arakan with glabrous oblong leaflets 6 or 7 inches long and about 3 inches broad, with minutely serrate edges, acuminate apices and broad emarginate bases, and drupes like those of *C. strictum*, Roxb. The nearest allies of this are apparently (1) *C. bengalense*, which has however smaller leaflets and much narrower drupes; and (2) *C. euphyllum*, Kurz, a species of which the drupe is as yet unknown.

Materials for a Flora of the Malayan Peninsula—*By* George King, M. B., LL. D., F.R.S., C.I.E., *Superintendent of the Royal Botanic Garden, Calcutta.*

No. 6.

Order XX. LINEÆ.

Herbs or shrubs. *Leaves* usually alternate, simple, entire, rarely crenate-serrate; stipules lateral or intrapetiolar or 0. *Inflorescence* various. *Flowers* regular, bisexual. *Sepals* 5, rarely 4, free or connate below, imbricate. *Petals* as many, hypogynous or slightly perigynous, usually fugacious, often contorted. *Stamens* 4–5, with as many interposed staminodes, or 8–10, (rarely more) filaments united at the base into a hypogynous or slightly perigynous ring, filiform; anthers versatile, 2-celled. *Glands* 5, entire or 2-lobed, usually adnate to the staminal ring, or obsolete. *Ovary* entire, 3–5 celled; styles 3–5, free or more or less connate, stigmas terminal; ovules 1 or 2, inserted in the inner angle of the cells, anatropous, pendulous. *Fruit* usually splitting into 3–5 cocci, rarely a drupe. *Seeds* 1–2 in each cell, testa sometimes winged, albumen fleshy or 0; embryo nearly as long as the seed, straight, rarely incurved, cotyledons broad, radicle superior.—Distrib. All regions; genera 14, species about 145.

Petals contorted, fugaceous; perfect stamens 2 or 3 times as many as the petals. Fruit drupaceous. Scandent herbs with hooked lateral branchlets ... ... 1 *Roucheria*.

Petals imbricate, with scales on their inner faces, ultimately deciduous; perfect stamens twice as many as the petals. Fruit drupaceous. Shrubs or trees ... ... 2 *Erythroxylon*.

Petals contorted, persistent; stamens 2 to 4 times as many as the petals. Fruit capsular, septicidal ... ... 3 *Ixonanthes*.

1. Roucheria, Planch.

Erect or climbing trees or shrubs with revolute woody tendrils. *Leaves* quite entire or glandular-serrate, coriaceous, penninerved; stipules minute, caducous. *Flowers* axillary, yellow, subsessile, or in excessively short fascicled spikes; pedicels bracteolate. *Sepals* 5. *Petals* 5, hypogynous, contorted, fugacious. *Stamens* 10, all fertile, filaments connate into a short tube below. *Glands* obsolete. *Ovary* 3–5-celled, styles 3–5, filiform, stigmas cuneate, 2-lobed; ovules 2, collateral. *Drupe* scarcely fleshy, subglobose; stone 3–6-angled, bony, cells 1-2-seeded. *Seeds* compressed, pendulous; albumen rather fleshy, embryo with foliaceous cotyledons and an elongate radicle.—DISTRIB. 3 or 4 species, one or more Malayan and 2 from Guiana.

1. ROUCHERIA GRIFFITHIANA, Planch. in Hook. Journ. Bot. VI, 143: VII, 527. A glabrous climbing shrub with hooked lateral branchlets. *Leaves* alternate, lanceolate, oblanceolate or elliptic-lanceolate, rather bluntly caudate-acuminate, obscurely crenate-serrate, the base cuneate; main nerves faint, 6 to 8 pairs, curving; length 3 to 5 in., breadth 1·2 to 1·6 in.; petiole ·35 to ·5 in., slender. *Flowers* ·35 in. in diam., in dense shortly-pedicelled clusters of 7 or 8. *Petals* narrowly oblong, obtuse, very fugaceous, thin. *Drupe* ovoid, ·25 in. long, the pulp thin. Hook. fil. Fl. Br. Ind. I, 414.

In all the provinces except the Andamans and Nicobars. DISTRIB. Sumatra, Borneo.

2. ERYTHROXYLON, Linn.

Shrubs or small trees, usually quite glabrous. *Leaves* alternate, entire, often subdistichous; stipules intrapetiolar, often imbricating on short arrested leafless branches. *Flowers* axillary, small, white or pink, solitary or fascicled, peduncles bracteolate. *Sepals* 5, rarely 6, free or connate. *Petals* 5, hypogynous, deciduous, with an erect double ligula on the inner face, imbricate. *Stamens* 10, rarely 12, filaments united into a glandular or eglandular tube. *Ovary* 3- rarely 4-celled; styles 3, rarely 4, free or connate, stigmas capitate; ovules, 1, rarely 2 in each cell. *Drupe* 1-celled, 1-seeded. *Seed* with a thin testa, albumen variable in quantity or 0; embryo straight, cotyledons plano-convex, radicle short.—DISTRIB. Species about 50, mostly American, and tropical.

1. ERYTHROXYLON BURMANICUM Griff. Notul. IV, 468: Ic. Pl. Asiat. t. 581, f. 3. A glabrous tree 20 to 30 feet high. *Leaves* elliptic or obovate-elliptic, obtuse or slightly emarginate, the base cuneate; upper surface shining, the lower glaucous, both with open reticulations; the main nerves about 8 pairs, not more prominent than the secondary; length 1·75 to 2·5 in., breadth ·75 to 1·25 in., petiole ·2 to ·3 in. *Flowers* in clusters of 2 to 4, their pedicels about ·25 in. long. *Fruit* cylindric-clavate, shining, ·5 in. long; the calyx and staminal tube sub-persistent. Hook. fil. Fl. Br. Ind. I, 415; Kurz For. Fl. Burma I, 171. *E. sumatranum*, Miq. Fl. Ind. Bat. Suppl. 572. *E. retusum*, Bauer ex Teysm. and Binn. in Tijdisch Nat. Ver. Ned. Ind. XXVIII, 71. *Ficus cuneata*, Wall. Cat. 4534.

In all the provinces. DISTRIB. Burma, Sumatra.

3. Ixonanthes, Jack.

Glabrous trees, often turning black in drying. *Leaves* alternate, entire or crenate-serrate, reticulate; stipules minute or 0. *Flowers* small, in axillary cymose dichotomous peduncled panicles. *Sepals* 5–6, shortly connate at the base. *Petals* 5–6, perigynous, contorted, persistent, hardened round the fruit. *Stamens* 10–20, inserted on the outside of a perigynous annular or cupular eglandular disk. *Ovary* free, 5-celled, cells perfectly or imperfectly 2-locellate; style simple, stigma capitate, lobed; ovules 10. *Capsule* coriaceous or woody, oblong or conic, more or less perfectly 10-celled, septicidal, carpels opening inward. *Seeds* winged or crowned with a mitriform aril, albumen fleshy; embryo lateral, cotyledons foliaceous, radicle superior.—Distrib. Species 3–4, chiefly Malayan.

Leaves oblong-oblanceolate to obovate-oblong, petals ·2 in. long. Capsules ·7 in. long, imperfectly 10-celled ... ... 1 *I. icosandra.*

Leaves elliptic to elliptic-rotund, not obovate; petals ·3 in. long. Capsules 1·35 to 1·75 in. long, almost completely 10-celled ... 2 *I. reticulata.*

1. Ixonanthes icosandra, Jack Mal. Miscel. II, No. 7 p. 53: Hook. Comp. Bot. Mag. I, 154. A tree 30 to 40 feet high. *Leaves* coriaceous, oblong-oblanceolate to obovate-oblong, the apex blunt or much rounded; the edges entire, obscurely serrate or crenate, the base cuneate: main nerves spreading, sub-horizontal, faint, about 10 to 12 pairs: length 2·5 to 5·5 in., breadth 1 to 2·5 in., petiole ·25 to ·5 in. *Cymes* on slender peduncles, many-flowered. *Flowers* ovoid, ·2 in. long, scarcely opening; petals broadly elliptic: stamens 12 (usually), the filaments, much longer than the petals. *Capsule* narrowly ovoid, ·7 to ·8 in. long, 5-valved, imperfectly 10-celled. *Seeds* 10, on elongated podosperms. Hook. fil. Fl. Br. Ind. I, 416; Miq. Fl. Ind. Bat. i., pt. 2, 494. *I. dodecandra*, Griff. Plant. Cantor 12. *I. cuneata*, Miq. Fl. Ind. Bat. Suppl. 484 and Hook. fil. Fl. Br. Ind. I, 416. *I. obovata* Hook. fil. Fl. Br. Ind. I, 417. *Gordonia? peduncularis*, Wall. Cat. 4409. *Hypericinea dentata*, Wall. Cat. 4832. *Pierotia lucida*, Blume Mus. Bot. i. 180. *Brewstera crenata*, Roem. Synops. i. 141. *Macharisia icosandra*, Planch. MSS. *Ixonanthes sp.* Griff. Notul. iv. 498; Ic. Pl. Asiat., t. 589, f. 2.

In all the provinces except the Nicobars and Andamans; very common.

This is rather a variable plant as to leaves, and to two of the forms specific names have been given. I cannot, however, discover any tangible differences in the flowers or fruit, so I have treated all the forms as belonging to Jack's *I. icosandra.* The fruit is only imperfectly 10-celled in this species, the vertical processes from the back walls of the cells of the capsule being incomplete. In the next species they are nearly quite complete, and its capsules are really 10-celled.

2. IXONANTHES RETICULATA, Jack in Mal. Miscel. II, No. 7, 51; Hook. Comp. Bot. Mag. I. 154. A small tree, occasionally only a shrub. *Leaves* coriaceous, not black when dry, elliptic, sometimes elliptic-rotund, the apex blunt, the base cuneate; main nerves 7 or 8 pairs, slightly prominent when dry, interarching ·25 in. from the edge; length 3·5 to 5 in., breadth 2 to 2·75 in., petiole ·6 to ·8 in. *Cymes* on stout peduncles, few-flowered. *Flowers* ovoid to ovoid-rotund, scarcely opening, ·3 in. long, petals broadly elliptic; stamens about 10, the filaments much longer than the petals. *Capsule* 1·35 to 1·75 in, long, 5-valved, 10-celled. Hook. fil. Fl. Br. Ind. I, 417; Griffith Plant. Cantor, 11. *Hypericinea macrocarpa*, Wall. Cat. 4833. *Gordonia decandra,* Roxb. Fl. Ind. ii., 573; Wall. Cat. 4408.

In all the provinces except the Nicobar and Andaman Islands. DISTRIB. Sumatra.

In this species the 5 cells of the fruit are converted into 10 by a dissepiment springing from the wall of each valve. I have never seen the seeds, all the capsules I have met with being empty.

ORDER XXI. MALPIGHIACEÆ.

Trees or shrubs, often climbing. *Leaves* (in the Indian genera) opposite, quite entire; stipules small or 0. *Inflorescence* axillary or terminal; pedicels articulate, usually 2-bracteolate. *Flowers* middling-sized or small, white or yellow, more rarely red, yellow, or blue, hermaphrodite, regular or irregular. *Calyx* usually 5-partite; segments imbricate or valvate, 1 or more (never all) furnished with a large gland, rarely eglandular (*Aspidopterys*). *Petals* 5, clawed or not, often fimbriate, imbricate. *Disc* obscure. *Stamens* 10, hypogynous or subperigynous, equal, or 1 or more much larger than the others, filaments free or connate below, anthers 2-lobed. *Ovary* 3-celled; styles 1–3, rarely 4, straight or circinate, stigmas capitate or punctiform or lateral; ovules solitary in each cell, micropyle superior, raphe ventral. *Fruit* (in all the Asiatic genera except *Brachylophon*) of one or more winged samaras. *Seed* exalbuminous; embryo straight or curved, radicle superior.—DISTRIB. An order, largely represented in America, but scantily in Asia; genera about 50, species about 620.

Styles 1 rarely 2; calyx glandular.
Fruit of 3, united, many-winged samaras ... 1. *Tristellateia.*
Fruit usually of a single 3-winged samara ... 2. *Hiptage.*

Styles 3 rarely 4; calyx eglandular.
Samaras with large membranous reticulate wings ... ... 3. *Aspidopterys.*
Fruit of 2 or 3 turgid almost wingless cocci 4. *Brachylophon.*

1. TRISTELLATEIA, Thouars.

Woody climbers. *Leaves* opposite or whorled; petiole 1–2-glandular at the apex; stipules minute. *Flowers* yellow, in terminal or lateral racemes. *Calyx* 5-partite, eglandular, or with minute glands. *Petals* 5, clawed. *Stamens* 10, all perfect; filaments rigid, truncate and articulate at the top, anthers acute. *Ovary* 3-lobed; styles 1–2, slender, one or more reduced to small papillæ. *Ripe carpels* 3, each with about 3 or more wings, the whole forming a stellate fruit. *Seed* obovoid, testa membranous; cotyledons fleshy, hooked.—DISTRIB. About 8 species, natives of tropical Africa, Asia, and Australasia.

1. TRISTELLATEIA AUSTRALASICA, A. Rich. Sert. Astrol. 38 t. 15. Glabrous; *leaves* elliptic, ovate, or oblong, acute, the base cuneate or rounded; main nerves 4 or 5 pairs, forming wide arches far from the margin, faint; length 1·75 to 3·5 in., breadth ·75 to 1·25 in., petiole ·25 to ·35 in., eglandular or with only one gland. *Racemes* 2 to 6 in. long, few-flowered, terminal. *Flowers* 1 in. in diam., their pedicels opposite, minutely 2-bracteolate towards the base. *Petals* ovate. *Fruit* ·5 in. in diam., its wing linear-oblong, coriacious, recurved or spreading. Hook. fil. Fl. Br. Ind. I, 418; Benth. Flor. Austral. I. 286. *Platynema laurifolium,* W. & A. in Edin. New Phil. Journ. 1833, 179; Prodr. 107.

Singapore; Wight, Kurz, Anderson. Pangkore, Scortechini. Pahang, Ridley. DISTRIB.—Malayan Archipelago, Australasia.

2. HIPTAGE, Gærtner.

Climbing or suberect shrubs. *Leaves* opposite, quite entire, coriaceous, eglandular, or with a row of remote intramarginal glands beneath; stipules 0. *Racemes* terminal or axillary, simple or compound; peduncles erect, bracteate, jointed to the 2-bracteolate pedicels. *Calyx* 5-partite; glands adnate to the pedicel, large. *Petals* 5, clawed, unequal, white, the odd one discoloured. *Stamens* 10, all fertile, declinate, one much larger than the others; filaments connate at the base. *Ovary* with 3 appendiculate lobes; styles 1 or 2 bearing stigmas, the others rudimentary, all circinate. *Fruit* winged. *Seed* sub-globose, the cotyledons unequal, thick. DISTRIB: four tropical Asiatic species.

Main nerves of leaves about 4 pairs, inflorescence tomentose or sericeous, flowers ·35 to ·5 in. in diam ... ... 1. *H. sericea.*

Main nerves of leaves 4 to 6 pairs, inflorescence adpressed-pubescent; flowers ·75 to 1 in., in diam. ... ... 2. *H. madablota.*

1. HIPTAGE SERICEA, Hook. fil. Fl. Br. Ind. I, 419. A woody climber, the branches and inflorescence more or less covered with soft brown, villous pubescence; lateral branchlets slender, short. *Leaves* elliptic-ovate or oblong, acuminate, glabrous; main nerves about 4 pairs, ascending; length 2 to 6 in., breadth ·9 to 3 in., petiole ·25 in. *Racemes* 2 to 3·5 in. long, axillary and terminal, sometimes much crowded, minutely tomentose or sericeous, many-flowered. *Flowers* ·35 to ·5 in. in diam., pedicels thickened at the apex, ·25 to ·5 in. long. *Petals* clawed, the odd one much lobed, all more or less villous especially externally; central wing of carpel oblanceolate obtuse, with a central ridge near its base, 1·5 to 2 in. long, the lateral much smaller. *H. parviflora*, Wight Cat. 358. *Clerodendron sericeum*, Wall. Cat. 1814.

Penang: Wallich, King's collector, No. 1454. Singapore, Ridley. Pahang, Ridley No 2386. Malacca, Griffith, Derry. Maingay, (Kew Distrib.) No. 272. Perak, King's collector No. 4097.—DISTRIB. Burmah. Gallatly, No. 890.

This is a very variable plant as to leaves, some of the forms having narrowly oblong, while others have broadly elliptic leaves; the nervation is, however, alike in all. As regards vestiture there is also variation, the inflorescence being in some villous, in others minutely tomentose or pubescent. This must come very near, if it be not actually identical with, *H. javanica*, Blume. The Burmese form of this species has not only narrowly oblong leaves, but racemes 6 inches long and more slender than in Malayan specimens. I propose to name it VAR. *longe-racemosa.*

2. HIPTAGE MADABLOTA, Gærtn. Fruct. II, 169, t. 116. A glabrous woody climber, the young parts and inflorescence hoary or adpressed-tomentose, the branches stout. *Leaves* coriaceous, ovate-lanceolate, oblong or ovate-oblong, acute or shortly acuminate, the base rounded or cuneate, both surfaces glabrous: main nerves 4 to 6 pairs, oblique, slightly prominent beneath; length 4·5 to 6 in., breadth 1·5 to 3 in., petiole ·25 to ·4 in. *Racemes* 1 to 6 in. long, axillary, sometimes leafy, adpressed-pubescent. *Flowers* ·75 to 1 in. in diam., fragrant. *Sepals* obtuse, less than half as long as the petals. *Petals* fimbriate, the odd one dashed with yellow. *Fruit* with three coriaceous spreading wings, the middle one oblanceolate, obtuse, 1 to 2 in. long, the 2 lateral linear and half as large. Hook. fil. Fl. Br. Ind. I, 418; Kurz For. Flora Burma I, 173; Miq. Fl. Ind. Bat. I, Pt. 2, 585; DC. Prod. I, 583; W. and A. Prod. 107; Wight Ill. t. 50. *Molina racemosa*, Lamk. Dict. IV. 227; Cav. Diss. IX. t. 263. *Gærtnera racemosa*, Roxb. Cor. Pl. I. t. 18; Fl. Ind. II, 368.

Banisteria bengalensis, Linn. *B. unicapsularis*, Lamk. *B. tetraptera*, Sonnerat Voy. II, t. 135. Rheede Hort. Malab. VI, t. 59.

In all the provinces. DISTRIB. British India, China, Malayan Archipelago.

3. ASPIDOPTERYS, A. Juss.

Shrubs, usually climbing. *Leaves* opposite, eglandular, quite entire; stipules 0. *Flowers* in simple or compound axillary and terminal panicles; peduncles bracteate, jointed at the top, pedicels often minutely 2-bracteolate. *Flowers* small, yellow or white. *Calyx* short, 5-partite, eglandular. *Petals* 5, not clawed, spreading or reflexed, quite entire. *Stamens* 10, all perfect, filaments connate or distinct at the base. *Ovary* 3-lobed, lobes flattened at the back, sides winged; styles 3, glabrous, stigmas capitate. *Fruit* of 1–3 samaras; nucleus sometimes crested or winged at the back, and surrounded with a broad oblong or orbicular wing. *Seeds* oblong, subterete; embryo, straight, cotyledons equal, radicle short.—DISTRIB. Species about 15; all tropical Asiatic.

Leaves ovate or obovate, more or less orbicular; panicles slender, lax, with short few-flowered lateral branches: samaras ovate, narrowed and retuse at the apex ... 1 *A. concava.*

Leaves ovate or elliptic, narrowed upwards, not orbicular; panicles spreading, the branches umbellate, many-flowered: samaras orbicular ... ... 2 *A. Helferiana.*

1. ASPIDOPTERYS CONCAVA, A. Juss. in Archiv. Mus. Hist. Nat. III, 509. A climber; young shoots rusty-puberulous, soon becoming glabrous. *Leaves* ovate-elliptic or elliptic, bluntly and shortly acuminate, the base rounded or very slightly narrowed: both surfaces glabrous, the lower minutely dotted when young; main nerves 4 to 6 pairs, curving, ascending; length 3 to 4·5 in., breadth 1·5 to 2·3 in., petiole ·5 to ·65 in. *Flowers* in spreading lateral umbellate panicles. *Samaras* orbicular, membranous, pale, reticulate, the veins radiating, the nucleus winged, about 1·25 in. in diam; their pedicels slender, minutely bracteolate, often 1·5 in. long. Hook. fil. Fl. Br. Ind. I, 420; Kurz For. Flora Burmah, I, 175. *Hiraea concava*, Wall. Pl. As. Rar. I, 13; Cat. 1061. *H. merguensis*, Wight. Ill. I, 139.

Penang; Curtis No. 138, 798. DISTRIB. Burmah.

2. ASPIDOPTERYS HELFERIANA, Kurz Journ. As. Soc. Bengal, Pt. 2, (1874), 137, 184; For. Flora Burma, I., 176. A climber, the young shoots tawny-pubescent. *Leaves* membranous, orbicular-ovate to orbicular-obovate, the apex shortly cuspidate, the base rounded or slightly

cordate, glabrous; main nerves 4 or 5 pairs, curved, ascending; length 3 to 5·5 in., breadth 2·5 to 5 in.; petiole ·5 to ·65 in., puberulous or glabrescent. *Panicles* axillary or terminal, slender, lax, rusty-puberulous when young, the lateral branches distant, few-flowered; ovary quite glabrous, lobes of disc scarcely rugose. *Samaras* ovoid, narrowed towards the retuse apex, membranous, pale brown, with many radiating nerves, reticulate, glabrous, 1 in. or more in length, nucleus with oblong wing. *Hiraea indica* (?) Wall. Cat 1057.

Andaman Islands. DISTRIB. Burmah.

The type of this species is one of the things included under Wall. Cat. 1057, with which the Andaman specimens in the Calcutta Herbarium agree very well. Kurz has however also referred to this species certain Burmese specimens, *viz.*, Falconer's No. 72 (from Upper Weingo Valley) and Helfer's No. 923, which, although agreeing with each other, hardly agree with the Wallichian No. 1057 from Neidann. By the way! this sheet from Neidann is not included in Wallich's lithographed and published list.

4. BRACHYLOPHON, Oliver.

Glabrous shrubs. *Leaves* opposite, entire. Inflorescence terminal, racemose or corymbose, bracteolate. *Flowers* yellow. *Calyx* 5-partite, eglandular. *Petals* 5, imbricate in bud. *Stamens* 10, all perfect, the alternate shorter; filaments longer than the anthers, flat, conjoined at the base into a short disc: anthers linear, basifixed, opening by 2 apical pores. *Ovary* deeply 3–4-lobed, 3–4-celled; *Styles* 3 or 4, elongate, slender, divergent: ovules solitary in each cell, pendulous, anatropous. *Fruit* usually 3-, sometimes only 2-lobed; separating when ripe into turgid cocci; each coccus keeled along the back, and at the apex produced into a very short wing. *Seed* unknown. DISTRIB. Three species; all Malayan.

Rachides of the racemes ·5 in. long or less, leaves coriaceous ... ... 1 *B. Hullettii.*
Rachides of the racemes 2 in. or more in length.
  Main nerves of leaves 7 to 8 pairs, oblique 2 *B. Curtisii.*
  Main nerves of leaves 13 to 15 pairs, sub-horizontal ... ... 3 *B. Scortechinii.*

1. BRACHYLOPHON HULLETTII, King. n. sp. *Leaves* coriaceous, shining, minutely reticulate, narrowly elliptic, shortly and abruptly acuminate or acute, the base cuneate: main nerves 10 to 12 pairs, rather prominent beneath, sub-horizontal, interarching far from the margin; length 4 to 7 in., breadth 1·8 to 2·5 in., petiole ·1 in. *Racemes* terminal, the

rachis less than ·5 in. long, 4-to 8-flowered; pedicels ·75 in. long, bracteolate at the base. *Sepals* ovate, blunt.

Malacca: on mount Ophir, Hullett.

An imperfectly known plant, easily distinguished from both the other species by its much shorter racemes and more coriaceous leaves.

2. Brachylophon Curtisii, Oliver in Hook. Ic. Plantar. t. 1566. A shrub 3 to 6 feet high. *Leaves* membranous, narrowly elliptic to ovate-rotund, acuminate, the base cuneate; upper surface glabrous, the lower scaberulous; main nerves 7 or 8 pairs, not much more prominent than the intermediate, oblique, interarching ·15 in. from the edge; length 3·5 to 7 in., breadth 2 to 2·25 in., petiole ·1 in. *Racemes* corymbose, 1 to 2 in. long. *Flowers* ·75 in. in diam.; pedicels slender, ·8 to 1·2 in. long, bracteolate at the base. *Petals* yellow, oblong, obtuse, entire, shortly clawed, ·5 in. long. *Ripe fruit* ·35 to ·5 in. long, ·25 in. broad.

Penang: Curtis No. 231.

3. Brachylophon Scortechinii, King, n. sp. A shrub 3 to 6 feet high. *Leaves* membranous, oblong-lanceolate to oblong-elliptic, sometimes oblong-oblanceolate, tapering from the middle to each end, both surfaces glabrous: main nerves 13 to 15 pairs, rather faint, sub-horizontal, interarching ·15 to ·2 in. from the edge: length 5 to 11 in., breadth 2 to 4 in., petiole ·15 in. *Racemes* corymbose, terminal and axillary, 2 to 3 in. long, many-flowered, the rachis tuberculate. *Flowers* about ·6 in. in diam.; pedicels slender, ·65 to 1 in. long, bracteolate at the base. *Calyx-teeth* oblong, obtuse, puberulous, the edges ciliolate. *Petals* ovate, obtuse, entire, glabrous, ·5 in. long. *Filaments* flattened, unequal but all much longer than the petals. *Ovary* 3- to 4-lobed, or 3- to 4-celled: styles 3 or 4, as long as the filaments, spreading, cylindric. *Fruit* unknown. *Ryssopteris elliptica*, Scortechini MSS.

Perak: Scortechini, Wray, King's collector.

I have not seen fruit of this. In its flowers it closely resembles *B. Curtisii*, Oliver, but its leaves are larger, more membranous, and have more numerous nerves than those of *B. Curtisii*.

Order XXII. GERANIACEÆ.

Herbs, undershrubs, or rarely trees; glabrous or more usually pubescent and glandular. *Leaves* opposite or alternate, usually 2-stipulate. *Peduncles* usually solitary and axillary, 1- or more flowered. *Flowers* umbelled, cymose or racemose, usually showy, hermaphrodite, regular or irregular. *Sepals* 5, rarely 4 or 2, free or united to the middle, imbricate or rarely valvate, the posticous sometimes spurred. *Petals* as many as the sepals or fewer by suppression, or 0, hypogynous or subperigynous, variously imbricated, rarely contorted. *Torus* scarcely expanded into a disc, with 5 glands alternating with the petals, or without glands, raised in the centre into a beak, rarely flat. *Stamens* as many as, or double, or treble the sepals, or fewer by suppression; filaments filiform or dilated, or connate into a ring; anthers 2-celled; cells parallel, opening lengthwise. *Ovary* 3–5-lobed, 3–5-celled, rarely 2-lobed, of 3–5-carpels, united with the axis as far as the insertion of the ovules, sometimes lengthened into a beak-bearing style or styles, which are free or more or less united; stigmas capitate, linear or ligulate; ovules 1 or 2 or rarely more, horizontal or pendulous or ascending. *Fruit* capsular, 3-5-lobed, lobes 1-seeded, often separating from the axis, septicidal or loculicidal, rarely berried. *Seeds* pendulous or horizontal, albumen 0, or scanty or fleshy; embryo straight or curved; cotyledons flat, convex or variously folded, foliaceous or thick or fleshy; radicle either short and near the hilum, or longer and inflected, or incumbent on the cotyledons.—DISTRIB. Genera 20, with about 800 species, chiefly inhabiting temperate climates.

OXALIDEÆ.—Leaves compound, flowers regular.
Herbaceous.
Leaves 3-foliolate ... ... 1. *Oxalis.*
Leaves pinnate ... ... 2. *Biophytum.*
Woody.
Shrubs or trees, not scandent, fruit probably indehiscent ... ... 3. *Connaropsis.*
Scandent shrubs, fruit certainly dehiscent 4. *Dapania.*
BALSAMINEÆ.—Leaves simple, flowers irregular.
Lateral petals connate in pairs, fruit capsular. 5. *Impatiens.*
Lateral petals free: fruit drupaceous ... 6. *Hydrocera.*

1. OXALIS, Linn.

Acid herbs, rarely shrubby. *Leaves* radical or alternate, stipulate or ex-stipulate, compound, usually 3-foliolate. *Flowers* on axillary, 1- or more flowered peduncles, regular. *Sepals* 5, imbricate. *Petals* 5, hypogynous, contorted. *Glands* of the disc 0. *Stamens* 10, free or united at the base, all anther-bearing. *Ovary* 5-lobed, 5-celled; styles 5, distinct; stigma terminal, captitate, 2-fid or laciniate: ovules 1 or more in each cell. *Capsule* with loculicidal dehiscence, valves persistent to the axis. *Seeds* with an outer fleshy coat which bursts elastically, testa crustaceous, albumen fleshy, embryo straight.—DISTRIB. Species about 200, chiefly tropical and temperate S. American and S. African.

1. OXALIS CORNICULATA Linn. DC. Prod. I, 692. A diffuse, creeping, adpressed-pubescent herb with long-petioled 3-foliolate, stipulate

leaves; the leaflets obcordate, the stipules adnate to the petiole. *Flowers* sub-umbellate on 2- to many-fid, setaceously bracteolate peduncles. *Sepals* obtuse. *Petals* obcordate, yellow. *Fruiting pedicels* often depressed. *Capsules* sub-cylindric, tomentose, many-seeded. *Seeds* transversely striate. Hook. fil. Fl. Br. Ind. I, 436; Miq. Fl. Ind. Bat. I, pt. 2. p. 135; Boiss. Fl. Orient. i., 866; Wall. Cat. 4347; Roxb. Fl. Ind. ii. 457; W. & A. Prodr. 142. *O. repens*, Thunb; Wight Ic. t. 18; Blume Bijdr. 243. *O. pusilla*, Salisb.; Roxb. l.c.

Perak: by the sides of damp foot-paths near the bases of the hills. Penang: on Government Hill, Curtis.

2. BIOPHYTUM, De Cand.

Annual, rarely perennial herbs, with simple or branched stems. *Leaves* abruptly pinnate, fascicled or almost whorled at the top of the stem; leaflets opposite, oblique; petiole swollen at the base. *Peduncles* terminal, pedicels umbelled. *Flowers* small, yellow, or white. *Sepals* 5, lanceolate, acuminate. *Petals* 5. *Stamens* 10; filaments free, 5 outer smaller. *Styles* 5, stigmas notched at the apex or 2-fid. *Capsule* ovoid or oblong, or subglobose, splitting loculicidally sometimes to the base into 5 spreading valves. *Seeds* as in *Oxalis.*—DISTRIB. Tropical Asia, Africa, and America. Species about 20.

Leaflets 8 to 20 pairs, equal-sided, glabrous, their bases truncate, slightly oblique: flower-pedicels usually shorter than the sepals, petals yellow ... ... 1. *B. sensitivum.*

Leaflets 18 to 25 pairs, unequal-sided, sparsely hispid on upper surface, their bases obliquely truncate; flower-pedicels longer than the sepals, petals white... ... ... 2. *B. adiantoides.*

1. BIOPHYTUM SENSITIVUM, DC. Prod. I, 690. Stem 4 to 10 in. long, hispidulous, erect or decumbent, bearing at its apex 8 to 20 pinnate leaves 1·5 to 5 in. long; leaflets 6 to 15 pairs, the lower pairs oblong, the upper pair obovate-oblong, the apices of all obtuse, sometimes mucronate, the bases truncate, subequal, glabrous, ·25 to ·5 in. long. *Peduncles* variable in length, sometimes nearly as long as the leaves, puberulous, each bearing at its apex a bracteolate umbel of 10 or 12 flowers; bracteoles setaceous, as long as the flower pedicels, pedicels pubescent, as long as the sepals. *Petals* yellow. Hook. fil. Fl. Br. Ind. I, 436; Roxb. Fl. Ind. II, 457; W. and A. Prod. 162; Bot. Reg. XXXI, t. 68; Wall. Cat. 4343 C. E.

Malacca: Griffith. Penang, on the coast, Curtis; and probably in the other provinces.

2. BIOPHYTUM ADIANTOIDES, Wight ex Hook. fil. Fl. Br. Ind. I, 437. Stem from 6 to 12 in. high, erect or decumbent, pubescent, bearing at its apex 10 or 12 pinnate leaves 4 to 7 in. long; leaflets 18 to 25 pairs, oblong, obtuse, unequal-sided, the apex mucronate, the base obliquely truncate, sometimes auriculed at the upper margin, sparsely strigose on the upper surface. *Peduncles* more than half as long as the leaves, pubescent, each bearing at its apex a densely bracteolate umbel of 6 to 12 flowers; bracteoles short, setaceous: flower-pedicels slender, puberulous, longer than the sepals. *Petals* white, the claws yellow.

Perak: on the banks of the Kamha river, King's collector, No. 931; on the Plus river, Wray No. 3363. Goping, Scortechini, No. 1999. DISTRIB. Burmah.

3. CONNAROPSIS, Planch.

Trees or shrubs. *Leaves* pinnately 1–3-foliolate; leaflets coriaceous, quite entire, strongly nerved, triple-nerved at the base, margined. *Flowers* minute, regular, in terminal and axillary panicled cymes. *Sepals* 5, imbricate, connate at the base. *Petals* 5, imbricate. *Glands* 0. *Stamens* 10, filaments united at the base, the alternate shorter. *Ovary* 5-angled, 5-celled; styles 5, subulate, more or less united below, stigmas apiculate; ovules 2 in each cell. *Fruit* fleshy, 5-lobed or 5-angled with succulent epicarp and fibrous endocarp, 1- or 2-celled and 1- or 2-seeded by abortion, indehiscent. DISTRIB. Five species, all Malayan.

Leaves 3-foliolate ... ... 1. *C. Griffithii.*
Leaves 1-foliolate.
Leaves 2 to 3·5 in. long ... ... 2. *C. monophylla.*
Do. 6 to 12 in. long ... ... 3. *C. macrophylla.*

1. CONNAROPSIS GRIFFITHII, Planch. in Hook. fil. Fl. Br. Ind. 440. A small tree; young shoots glabrescent, dark-coloured when dry. *Leaves* pinnately trifoliolate, coriaceous, glabrous; leaflets elliptic-lanceolate, acuminate, the base cuneate; main nerves 4 pairs, ascending: length 2 to 3·5 in., breadth ·5 to 1 in., petiolule ·15 in. *Panicles* terminal, minutely ferruginous-tomentose, 1·5 to 2 in. long. *Fruit* unknown.

Malacca: Griffith, No. 1667. Maingay (Kew Distrib.), No. 274.

2. CONNAROPSIS MONOPHYLLA, Planch. Hook. fil. Fl. Br. Ind. I., 440. A shrub or small tree; young shoots minutely ferruginous-pubescent. *Leaves* 1-foliolate, coriaceous, glabrous, ovate, acuminate, the base rounded or sub-cuneate: main nerves about 6 pairs, faint; length 2 to 3·5 in., breadth ·8 to 1·5 in.; petiole ·6 to ·8 in., thickened and pointed towards the apex. *Panicles* terminal or lateral, 2 to 4 in. long, ferruginous-tomentose; the branches erect and spike-like; flowers

crowded. *Fruit* ovoid, glabrous, obtusely 5-angled and furrowed, ·3 in. long.; endocarp fibrous, sarcocarp fleshy.

Malacca; Griffith No. 947; Maingay (Kew Distrib.) as 273. Perak, Scortechini, King's collector, Wray.

3. CONNAROPSIS MACROPHYLLA, King n. sp. A shrub or small tree: young branches glabrescent or glabrous. *Leaves* 1-foliolate, coriaceous, glabrous, oblong, acute or shortly acuminate, scarcely narrowed to the rounded sub-truncate or sub-emarginate base; main nerves 8 or 9 pairs, spreading, the reticulations distinct beneath: length 6 to 12 in., breadth 2·35 to 3·65 in.; petiole ·5 in., jointed above the middle. *Flowers* in two or three terminal or lateral spikes which are sometimes united to form a kind of panicle. *Spikes* glabrescent, 2 or 3 in. long. *Flowers* crowded. *Fruit* ovoid, apiculate, glabrous, about ·3 in. long.

Perak: King's collector, Nos. 433, 3124; Ridley No. 3087. Province Wellesley; Curtis No. 474.

4. DAPANIA, Korthals.

Woody climbers. *Leaves* alternate, simple, coriaceous, entire, the petiole jointed about the middle. *Flowers* small, regular, sometimes unisexual, in slender spike-like racemes which are solitary, or in fascicles, axillary or from tubercles on the stem. *Sepals* 5, connate at the base, imbricate. *Petals* 5, hypogynous, imbricate, longer than the sepals. *Stamens* 10, the alternate 5 shorter, all united at the base into a shallow tube. *Ovary* deeply 5-lobed, 5-celled, each cell usually with 1 (sometimes with 2) pendulous ovule from an axile placenta. *Fruit* clavate, the calyx persistent but not enlarged, deeply 5-lobed, the epicarp slightly fleshy, the endocarp fibrous, 5-celled, 5-seeded, dehiscing loculicidally so as to form a five-rayed fibrous star with a seed attached to the central ridge (placenta) of each segment. DISTRIB. About 4 species; all Malayan.

1. DAPANIA SCANDENS, Stapf in Hook. Ic. Pl., t. 1997. A glabrous climber 50 to 100 feet long. *Leaves* ovate-elliptic, acuminate, the base rounded; main nerves 4 or 5 pairs, ascending, faint, length 3 to 5 in., breadth 1·25 to 2 in.; petiole ·25 to ·35 in., jointed about the middle. *Racemes* slender, puberulous, about 1·5 to 2·5 in. long. *Flowers* some hermaphrodite and some with stamens only, ·1 to ·15 in. long, each with a minute ovate bracteole at the base of its short pedicel. *Calyx-lobes* obtuse, ciliolate. *Petals* oblong, ob-lanceolate, twice as long as the calyx. *Fruit* 3 in. long, dehiscing into a flat star-shaped mass 4 in. in diam. *Connaropsis dioica*, Scortechini MSS. in Herb. Calcutta.

Perak: Curtis. Scortechini, Wray, King's collector.

By far the majority of the flowers have stamens only, the pistils being either quite rudimentary or absent: these male flowers are about half as long again as the hermaphrodites. The genus *Dapania* was founded by Korthals to receive the Sumatran plant which that author called *D. racemosa.* Of this, there is an authentic specimen in the Calcutta Herbarium; but unfortunately it has neither flowers nor fruit. Amongst Forbes' plants collected in Sumatra, No. 1217 agrees so perfectly with Korthal's *D. racemosa* in foliage, as to leave no doubt that it belongs to the same species; and on Forbes' specimens there are ripe fruits. These ripe fruits, as well as its leaves, show *D. racemosa* to be quite distinct from *D. scandens,* Stapf, the leaves being thinner in texture, and the fruits longer than those of *D. scandens.* The seeds of Forbes' specimens do not, however, show the curious aril (laciniate and almost 2-lipped) which Korthals describes: and, as the seeds of *D. scandens* show no trace of an aril, I agree with Dr. Stapf that Korthals probably described the existence of an aril as the result of some confusion. The majority of the ovaries dissected by me have only a single ovule: in one or two cases, however, a second (as figured by Dr. Stapf) has been found. In no case, however, have I found two seeds in a loculus of the fruit. There is no doubt that, as Dr. Stapf points out, the genus *Connaropsis* comes very near *Dapania*; and it may become desirable, as both genera became better known, to reduce *Connaropsis* (which dates only from 1862) to *Dapania* which was published in 1854. In the meantime the fruit of *Connaropsis* is not properly known, and there is no evidence that it is dehiscent. The fruit of *C. monophylla* is very like that of *Dapania scandens,* but no specimens that I have seen show any sign of dehiscence; while that of *C. macrophylla* is but little angled externally and the appearance of all the specimens I have seen is suggestive of indehiscence. Moreover, all the species of *Dapania* appear to be scandent; while all those of *Connaropsis* are shrubby or arboreous. Concerning the structure of the seeds I can say nothing, not having met with good seeds of either. The two genera remain at present separated chiefly by these two points of difference, *viz.,* dehiscence of the fruit and habit. Whether others may be found remains to be seen when better materials shall be obtained.

Beccari's specimen (P. S. 900) appears to belong to a species slightly different from either *D. scandens* or *D. racemosa.* And, as I understand from Dr. Stapf, the same Collector's No. 2951, from Borneo (which I have not myself examined), belongs to still another species.

5. Impatiens, Linn.

Herbs, rarely shrubby at the base. *Leaves* opposite or alternate, in some whorled, in others all radical, simple, exstipulate, or with stipular glands at the base of the petiole. *Flowers* in scapes, or in axillary or terminal 1–2 or many-flowered peduncles, irregular, resupinate. *Sepals* 3, rarely 5, imbricate; 2 anterior when present minute; 2 lateral small, flat, usually green; posterior (anterior in flower) large, petaloid, produced into a hollow spur or sac. *Petals* 3 (or 5); anterior (outer in bud) large; lateral 2-lobed (or 2 connate). *Stamens* 5, filaments short, broad; anthers cohering. *Disc* 0. *Ovary* oblong, 5-celled; stigma sessile, 5-toothed; ovules many, 1-seriate in each cell. *Capsule* loculicidal; valves 5, elastically springing away from a placentiferous axis. *Seeds* smooth or tubercled, glabrous or hairy, albumen 0; embryo straight.—DISTRIB. Mountainous parts of Trop. Asia and Africa, rare in Temp. Europe, N. America, N. Asia, and S. Africa; species about 200.

Flowers yellow: stem fleshy, several feet high and more than a foot in diam. at the base ... 1. *I. mirabilis.*

Flowers lilac, purple or white: stems herbaceous, slender.

Leaves linear-lanceolate, the upper whorled, the lower in pairs, opposite... 2. *I. Griffithii.*

Leaves linear-oblong to obovate or rotund, all opposite ... ... 3. *I. chinensis.*

1. IMPATIENS MIRABILIS, Hook. fil. in Curtis's Bot. Mag., t. 7195. Stem fleshy, cylindric, 3 to 5 feet high and 18 to 20 in. in diam. at the base, branched above. *Leaves* thinly fleshy, crowded at the ends of the branches, much narrowed to the base, obovate to ovate, crenate, with a thick fleshy midrib and 13 or 14 pairs of faint pinnate nerves, both surfaces glabrescent: length 5 to 7 in., breadth 3·5 to 4·5 in., petiole 1 to 1·5 in. *Racemes* axillary, as long as, or longer than the leaves, slender, and few-flowered. *Flowers* yellow, 1·75 in. long, sepals 3; the lateral elliptic-oblong, acute; the posterior widely hemispheric with a short incurved spur; anterior petal rotund, transversely oblong, the lateral petals united into a single 3-lobed piece.

Langkani: Curtis No. 1678.

The above description of this very remarkable species is chiefly copied from Sir Joseph Hooker.

2. IMPATIENS GRIFFITHII, Hook. fil. and Thoms. in Journ. Linn. Soc. IV, 120: Fl. Br. Ind. I, 445. Herbaceous; stem a foot or more in height, erect, terete, sparsely puberulous. *Leaves* linear-lanceolate, much narrowed towards the base, those in the lower part of the stem in pairs, opposite and petiolate; those in the upper part narrower, in whorls of three and sessile; all remotely serrate-toothed, 1·5 to 4 in. long; the texture rather thick, the lower surface pale and glabrous, the upper sparsely hairy. *Pedicels* solitary, rarely paired, slender,

1 in. or more in length. *Flowers* 1 in. in diam., flattish, rose-lilac. *Sepals* ovate-oblong, acuminate: standard broadly obcordate with a filiform spur behind, the wings broadly bi-lobed. *Capsule* elliptic, turgid in the middle.

Malacca: on Mount Ophir, Gerai, &c.; Griffith, Maingay.

3. IMPATIENS CHINENSIS, Linn. Herbaceous: stem 4 to 18 in. long, suberect, decumbent and rooting at the base, angled. *Leaves* subsessile, varying from linear-oblong to obovate or almost rotund, acute or obtuse, sharply serrate, always opposite, the base acute or rounded, often auricled; texture rather thick, glaucous beneath, glabrous or sparsely hairy, ·5 to 4 in. long: stipules setaceous, glandular, recurved. *Flowers* ·5 to 1 in. in diam., flattish, purple, or white. *Pedicels* solitary or fascicled, sometimes longer than the leaves. *Sepals* linear: standard orbicular, the wings semi-obovate, entire, auricled at the base; spur slender, long, incurved. *Capsule* ·5 to ·75 in. long, elliptic, turgid in the middle.

Malacca; Griffith. DISTRIB. China, British India.

6. HYDROCERA, Blume.

A glabrous erect marsh herb. *Leaves* narrow, alternate. *Flowers* in short axillary 1–2-flowered peduncles, irregular. *Sepals* 5, coloured, imbricate; 2 outer lateral, flat; posticous one produced into a short hollow spur. *Petals* 5, the anticous outer, very large, concave. *Disc-glands* 0. *Stamens* 5; filaments short, flat; anthers slightly cohering around the pistil. *Ovary* 5-celled; stigmas 5, sessile; ovules 2–3 in each cell. *Drupe* baccate, endocarp bony, truncate, 5-celled, cells 1-seeded. *Seeds* curved, corrugated, albumen 0; cotyledons plano-convex, thickish, radicle short, superior.—DISTRIB. One tropical Asiatic species.

1. HYDROCERA TRIFLORA, W. & A. Prod. I, 140. Annual; the stem often floating, fistular, often flexuose and rooting at the nodes; branches erect, 1 to 2 feet long, 5-angled. *Leaves* linear-lanceolate, serrate, attenuated into a petiole at the base, stipulate, glands two. *Flowers* 1 in. in diam., red white and yellow. *Drupe* globose, ·75 in. in diam., smooth, red, when dry 5-angled and truncate. Hook. fil. Fl. Br. Ind. I, 483; Miq. Fl. Ind. Bat. I, Pt. 2, 132; H. f. & T. in Journ. Linn. Soc. iv. 156. *H. angustifolia*, Blume Bijd. 241. *Impatiens triflora*, Linn. DC. Prodr. i. 687; Wall. Cat. 4756. *I. ? natans*, Willd.; DC. Prodr. i. 687; Roxb. Fl. Ind. i, 652; Wall. Cat. 4755. *Tytonia natans*, G. Don, Gen. Syst. i. 749. *Balsamina angustifolia*, Burm. Thes. Zeyl. t. 16 fig. 2 (*inaccurate*).

In all the Provinces except the Andaman and Nicobar Islands. DISTRIB. Malayan Archipelago, British India, Ceylon.

Order XXIII. RUTACEÆ.

Trees or shrubs, rarely herbs, abounding in pellucid glands filled with essential oil. *Leaves* opposite or alternate, simple or compound, exstipulate. *Flowers* in axillary or terminal cymes or panicles, never spiked, usually bisexual and regular in the Indian species. *Calyx* of 4–5 small lobes or sepals. *Petals* 4-5, hypogynous (in the Indian genera), valvate or imbricate. *Stamens* 4–5 or 8 or 10, rarely more (*Citrus*, *Ægle*); filaments usually free, hypogynous; anthers 2-celled, opening inwards. *Disc* within the stamens, crenate or lobed, sometimes large or long. *Ovary* of 4–5 free or connate carpels; styles as many, free or variously united; stigmas terminal, entire or lobed; ovules usually 2 in each cell. *Fruit* a capsule, berry or drupe, or 1–4 capsular cocci. *Seeds* usually solitary in the cells, testa various, albumen fleshy or 0: embryo straight or curved, radicle superior.—Distrib. Tropical and extratropical. Genera 83, and about 70 species.

Ripe fruit separating into dehiscent cocci or follicles.
  Flowers generally unisexual; disc free or absent; ovaries partially united; styles basilar or ventral, free at the base; cells 2-ovuled.
    Leaves opposite.
      Stamens 4 or 5 ... ... 1. *Evodia.*
      Stamens 8, four perfect opposite the sepals, alternating with four imperfect opposite the petals... 2. *Tetractomia.*
      Stamens 8, all perfect ... 3. *Melicope.*
    Leaves alternate, stamens 3 to 5 ... 4. *Zanthoxylum.*
Ripe fruit indehiscent.
  Flowers polygamous: petals 4, stamens 8; disc free: ovaries and styles 4, united, the cells 2-ovuled; fruit syncarpous, 4-celled, indehiscent, seed albuminous; leaves 1-foliolate ... ... 5. *Acronychia.*
  Flowers hermaphrodite, petals and stamens free or connate, ovaries and styles completely united, cells 1-to many-ovuled: fruit a berry, sometimes with but little pulp, seed exalbuminous
    Unarmed.
      Style short, persistent; leaves 1 to 5-foliolate ... ... 6. *Glycosmis.*

Style deciduous, leaves pinnate.
Cotyledons leafy, crumpled; petals valvate; filaments linear-subulate, not dilated at the base ... ... 7. *Micromelum.*
Cotyledons fleshy, plano-convex, petals imbricate.
Filaments not dilated at the base... ... 8. *Murraya,*
Filaments dilated at the base ... ... 9. *Clausena.*

Armed; leaves 3-to 8-foliolate.
Calyx 3-lobed, petals 3, stamens 6 10. *Triphasia.*
Calyx cup-shaped, entire or obscurely lobed: petals 4, stamens 8 to 10 ... ... 11. *Luvunga.*

Armed or unarmed; leaves 1-foliolate.
Anthers linear-oblong, disc cylindric forming a gynophore ... 12. *Paramignya.*
Anthers ovate-oblong, sometimes cordate, the filaments free or conjoined into a tube; disc cupular ... ... 13. *Atalantia.*

1. Evodia, Forst.

Trees or shrubs, unarmed. *Leaves* opposite, simple or 1–3-foliolate or imparipinnate, quite entire. *Flowers* small, in panicled axillary cymes, unisexual. *Sepals* 4–5, imbricate. *Petals* 4–5, sessile, valvate or slightly imbricate. *Stamens* 4–5, inserted at the base of the disc, filaments subulate, anthers oblong. *Ovary* deeply 4-lobed, 4-celled; style basilar, stigma 4-lobed, ovules 2 in each cell, collateral or superposed. *Fruit* of 2 to 4 coriaceous 1 to 2-seeded cocci; endocarp horny, elastic. *Seeds* oblong or globular, testa bony or crustaceous, shining; hilum linear, albumen fleshy; embryo straight, cotyledons ovate.—Distrib. About 25 species, natives of tropical Asia, the Pacific, the E. African Islands, and Australia.

Leaves 3-foliolate.
Leaflets usually more or less obovate: cymes broad pyramidal or corymbose, much branched.
Lower surface of leaflets pubescent... 1. *E. latifolia.*

Lower surface of leaves glabrous.

Apices of leaflets acuminate or apiculate, main nerves rather faint, sub-horizontal or slightly ascending; cymes pyramidal... 2. *E. Roxburghiana.*

Apices of leaflets shortly and abruptly acuminate, main nerves rather faint, sub-horizontal or ascending, cymes corymbose ... ... 3. *E. glabra.*

Apices of leaflets obtuse, nerves very prominent beneath, cymes corymbose ... ... 4. *E. robusta.*

Leaflets oblong or elliptic-oblong, not at all obovate, tapering little to the ends: ripe cocci ·4 in. long ... ... 5. *E. macrocarpa.*

Leaflets oblong-elliptic, tapering to each end: cymes few-branched, very tomentose: flowers in globular masses ... 6. *E. pilulifera.*

Leaflets oval to elliptic, obtuse or sub-acute, very coriaceous, the edges revolute when dry: cymes small, flowers ·25 in. long ... ... 7. *E. pachyphylla.*

Leaves 1-foliolate ... ... 8. *E. pedunculosa.*

1. Evodia latifolia, DC. Prod. I., 724. A tree 15 to 20 feet high: young branches stout, obscurely 4-angled, flattened at the nodes, rusty or tawny-puberulous. *Leaves* 3-foliolate, membranous, the petiole 4 to 6 in. long, usually angled, puberulous; leaflets obovate-elliptic to elliptic, acute or shortly acuminate, the base cuneate; main nerves 13 to 18 pairs, spreading, curving, prominent beneath; upper surface glabrescent or glabrous except the tomentose midrib and nerves, the lower softly pubescent, sometimes becoming glabrescent when old; length 5 to 9 in., breadth 2·5 to 4·5 in. (the middle one usually the largest); petiole ·2 to ·4 in. *Cymes* axillary, broad, with opposite spreading rusty-tomentose branches on stoutish puberulous peduncles 1 to 2 in. long. *Flowers* less than ·1 in. long, densely crowded; sepals sub-acute, pubescent outside; petals glabrous except a few hairs on the back outside; ovary villous. *Cocci* 2 or 3 from each flower, broadly ovate, blunt, sub-glabrous, 1–2-seeded: seed black. Hook. fil. Fl. Br. Ind. I., 489; Miq. Fl. Ind. Bat. i. pt. 2, 672; Ann. Mus. Lugd. Bat. iii, 244. *Zanthoxylum Rumphianum*, Cham. in Linnæa v. 58.

In all the provinces, except the Andamans and Nicobars: Distrib. Malayan Archipelago.

In its flowers and fruit this closely resembles *E. Roxburghiana*, Benth., but the leaves are different.

2. EVODIA ROXBURGHIANA, Benth. Flora of Hong-Kong, 59. A small tree; branches glabrous, opposite. *Leaves* glabrous, 3-foliolate, the petiole 2 to 5 in. long, terete; leaflets thinly coriaceous, shortly petiolulate, obovate, oblanceolate or oblong, the apex rounded acuminate or apiculate: main nerves 12 to 18 pairs, horizontal or slightly ascending, not prominent; length 2·5 to 6 in., breadth 1·25 to 3·25 in., the middle leaflet the largest; petiolule ·15 to ·25 in. *Cymes* pedunculate, spreading; the branches opposite, minutely bracteolate at the base: peduncles 2 to 3 in. long: cymes about 2·5 to 3 in. in diam. *Flowers* densely crowded, whitish, ·1 to ·15 in. long; the anthers exserted, shortly pedicelled, sepals very obtuse, ovary pubescent. *Cocci* about 2 from each flower, ovoid, pointed, 1-to 2-seeded, ·2 to ·3 in. long. *Seeds* black, shining. Hook. fil. Fl. Br. Ind. I, 487; Kurz Fl. Burm. I, 180. *E. triphylla*, Bedd. Flor. Sylvat; Anal. Gen. xli. t. vi. f. 2. *E. Marambong*, Miquel Ann. Mus. Bot. iii. 244. *Fagara triphylla*, Roxb. Fl. Ind. i. 416 (? of Linn.). *F. Lunur-ankenda*, Gærtn. Carp. i., 334, t. 68. f. 9. *Xanthoxylon triphyllum*, Wight Ic. t. 204; Ill. i. 169; Grah. Cat. Bomb. Pl. 36; Dalz. & Gibs. Bomb. Flor. 45. *X. Roxburghianum*, Cham. in Linnæa v. 58. *X. zeylanicum*, DC. Prodr. i., 728. *X. nilagiricum*, Miquel Herb. Hohenack.

In all the Provinces: common. DISTRIB. Malayan Archipelago, British India.

A widely distributed species very common in most parts of the Malayan Peninsula, and varying a good deal in the size of the leaves and in the degree of density of the cymes. In some cases the latter are lax and open, but in the majority they are condensed. There is some doubt as to what name this plant should bear. Sir Joseph Hooker (F. B. I. l. c.) has written an excellent note on its synonymy which should be consulted. The species, except in the matter of size, differs very little from *E. triphylla*. DC.

3. EVODIA GLABRA, Blume Bijdr. 245. A tree 40 to 70 feet high: young branches stout, compressed at the nodes, glabrous. *Leaves* 3-foliolate; the petioles 2 to 4 in. long, glabrous, terete, grooved in front towards the apex: leaflets more or less coriaceous, shortly petiolulate, obovate or obovate-elliptic, shortly and abruptly acuminate, rarely obtuse, always tapering much to the base, upper surface shining, the lower glabrous or puberulous: main nerves 10 to 15 pairs, oblique or sub-horizontal, prominent on the lower surface and often depressed on the upper when dry; length 4 to 10 in., breadth 2·25 to 5 in., petiolule ·2 to ·4 in., the middle leaflet the largest and with the longest petiolule.

Cymes pedunculate, corymbose, the main branches ascending, the secondary spreading, all opposite, minutely bracteolate at the base, puberulous or almost glabrous; peduncles stout, compressed, glabrescent, 1·5 to 4 in. long. *Flowers* ·1 in. long (excluding the exserted stamens) densely crowded, many of them practically unisexual, the ovary being abortive. *Sepals* sub-orbicular, obtuse, puberulous. *Petals* glabrous. *Stamens* exserted. *Ovary* depressed, glabrous, or hairy at the base of the styles. *Cocci* 2 or 3 to each flower, ·2 in. long, rugulose and glandular externally, broadly ovate, obtuse. *Seeds* black. Miq. Fl. Ind. Bat. I, Pt. 2, 672; Ann. Mus. Lugd. Bat. III, 243; Hook. fil. Fl. Br. Ind. I, 489.

Perak: very common. Penang, Curtis, No. 2485. Andaman Islands, King's collectors. Nicobars, Kurz.

This is best distinguished from *E. Roxburghiana* and *E. latifolia* by its more coriaceous leaves with stronger nerves, and by its more corymbose cymes. The flowers, however, are very little different in all three, and it seems doubtful whether it would not be better to treat all as forms of a single widely distributed and variable species.

4. Evodia robusta, Hook fil. Fl. Br. Ind. I., 488. A small tree; young branches as thick as a swan's quill, compressed, hoary. *Leaves* 3-foliolate, the petiole 4 in. long, terete, as thick as a crowquill: leaflets coriaceous, elliptic, the terminal sub-obovate, obtuse or obtusely acuminate, the midrib and arching nerves very strong, glabrous except the puberulous midrib beneath, the upper surface shining; length 6 to 8 in. *Cymes* broad, (5 in. in diam.), brachiate, their branches very robust. *Flowers* and fruit as in *E. Roxburghiana.*

Penang; Phillips. Singapore; Maingay (Kew Distrib.) No. 278.

This species must come very near *E. glabra*, Bl. It also greatly resembles the Sumatran *E. euneuron*, Miq. (Fl. Ind. Bat. Suppl. 532).

5. Evodia macrocarpa, King, n. sp. A tree 20 to 40 feet high: young branches rather stout, cinereous-puberulous, compressed. *Leaves* 3-foliolate, the petiole 3 to 4 in. long, glabrous: leaflets coriaceous, oblong, or elliptic-oblong, acute, narrowed to the slightly unequal-sided base; both surfaces glabrous, the upper shining, the lower dull and paler when dry; main nerves 14 to 18 pairs, almost horizontal, faint; length 6 to 12 in., breadth 2 to 3 in., petiole ·1 to ·2 in.; the middle leaflet the largest. *Cymes* axillary, pyramidal, shortly pedunculate, olivaceous-tomentose; the branches opposite, spreading, bracteolate at the base; peduncles ·5 to 1·5 in. long, puberulous. *Flowers* ·1 in. long, densely crowded, many of them with perfect stamens but an abortive ovary; sepals triangular, acute, pubescent; petals puberulous. *Stamens* exserted. *Ovary* villous. *Cocci* 3 or 4 to each flower, compressed, obovate, blunt, ·4 in. long, dark-coloured and

puberulous externally, lined inside with dense white hairs: seeds 2, black, shining.

Perak: Wray, No. 2648 and 3266; King's collector, No. 7489.

A very distinct species, recognisable at once by its long and comparatively large leaflets, small cymes, and large cocci.

6. EVODIA PILULIFERA, King n. sp. A shrub 10 to 15 feet high: young branches rather slender, flattened at the nodes, minutely tawny-tomentose, the bark pale. *Leaves* 3-foliolate, the petiole 3 to 4·25 in. long, terete, grooved in front, deciduously tawny-tomentose; leaflets thinly coriaceous, petiolulate, oblong-elliptic, tapering to each end, the apex shortly acuminate, the base very narrow; both surfaces glabrous, the lower paler when dry: main nerves 9 or 10 pairs, oblique, interarching boldly well within the edge, prominent on the lower, depressed on the upper surface when dry; length 3·5 to 8 in,; breadth 1·25 to 2·75 in.; petiolule ·15 to ·4 in., the middle leaflet rather larger than the lateral. *Cymes* everywhere tawny-tomentose, axillary, on long peduncles; the branches few, opposite, each bearing towards the apex a few dense sub-globose masses of flowers. *Flowers* less than ·1 in. long. *Sepals* ovate, acute, densely tawny-tomentose. *Petals* glabrous. *Ovary* villous. *Cocci* slightly compressed, ovoid, blunt, minutely tawny-tomentose outside, the interior glabrous, ·2 in. long. *Seed* solitary, shining.

Perak: Scortechini, No. 360; Wray, No. 2995; King's collector, No. 6275.

This species is readily distinguished by its minutely tomentose few-branched cymes, each bearing a few densely crowded heads of small flowers.

7. EVODIA PACHYPHYLLA, King n. sp. A small tree 10 to 15 feet high; young branches flattened at the nodes, minutely rufous-tomentose, as are the petiole, under surfaces of the midribs and peduncles of the cymes. *Leaves* 3-foliolate, the petiole 2·5 to 3 in. long: leaflets very coriaceous, oval to elliptic, obtuse or sub-acute, the base slightly cuneate, the edges revolute when dry; upper surface glabrous, shining, the lower pale, glaucous; main nerves 8 to 12 pairs, sub-horizontal, curving slightly, interarching within the edge, slightly prominent on the lower surface when dry, the midrib very bold; length 2·25 to 3·75 in., breadth 1·2 to 2·25 in., petiolule ·35 to ·5 in. *Cymes* axillary, pedunculate, the branches few, short, close together; peduncles 1 to 1·5 in. long. *Flowers* ·25 in. long, in dense sub-globular masses. *Sepals* broadly ovate, acute, olivaceous-tomentose externally, glabrous internally. *Petals* erect, ovate-lanceolate, pubescent on both surfaces, the edges glabrous. *Stamens* not exserted. *Ovary* glabrous. *Cocci* 2 or 3 from each flower, sub-compressed, ovate, blunt, pale and puberulous externally, glabrous within. *Seed* solitary, black, shining.

A very distinct species, at once distinguishable by its small coriaceous leaflets and large flowers and fruits.

8. Evodia pedunculosa, Hook. fil. Fl. Br. Ind. I, 489. A small tree? young branches cylindric, smooth. *Leaves* 1-foliolate; petiole rather stout, half-cylindric, ·5 to 1 in. long. *Leaflets* coriaceous, obovate, abruptly narrowed at the obtuse apex, the base cuneate: both surfaces glabrous, minutely reticulate, main nerves numerous, slender, spreading, length 4 to 5 in. *Cymes* pedunculate, pubescent, branching near the apex into small trichotomous pubescent cymules; peduncles 1 to 4 in. long. *Flowers* (buds only seen) ·1 in. long, shortly pedicelled. *Sepals* rounded. *Petals* broadly ovate, acute, glabrous. *Ovary* 4-cleft, immersed in the disc.

Singapore; Lobb.

Known only from Lobb's solitary and imperfect specimen.

2. Tetractomia, Hook. f.

Trees or shrubs. *Leaves* opposite, petioled, 1-foliolate, coriaceous, quite entire, punctate. *Flowers* small, in axillary branched cymes. *Calyx* small, 4-partite. *Petals* 4, triangular-ovate, acute, persistent, valvate. *Disc* broad, glandular, flattish or pulvinate, obtusely 4-angled. *Stamens* 4 or 8, (4 perfect alternate with the petals, 4 smaller with imperfect anthers opposite the petals and partially adnate to them at the base); filaments subulate, flattened at the base; anthers 2-lobed, dorsifixed. *Ovary* immersed in the centre of the disc, 4-celled, with 4 free projecting lobes; styles 4, free at the base, connate above; stigma capitate, obscurely 4-lobed; ovules 2, collateral in each cell. *Fruit* of 4 coriaceous, laterally compressed, oblong, 2-seeded cocci, splitting ventrally, the horny endocarp partially separating. *Seeds* inserted towards the base of the carpels.—Distrib. Three species, natives of the Malayan Peninsula and Borneo.

Leaves elliptic-obovate, 6 to 9 in. long; flowers ·25 in. long: ripe cocci ·5 in. long ... 1 *T. majus.*

Leaves usually cuneate-obovate, rarely elliptic-obovate, 2·5 to 5 in. long; flowers 1·3 in. long; ripe cocci ·25 in. long ... ... 2 *T. Roxburghii.*

1. Tetractomia majus, Hook. fil. Fl. Br. Ind. I. 491. A tree: young branches stout; their bark brown, rough. *Leaves* very coriaceous, obovate, elliptic, obtuse, narrowed to the base; both surfaces glabrous, very pale when dry: main nerves 12 to 16 pairs, rather straight, oblique, interarching far from the margin, slightly prominent or both surfaces when dry; length 6 to 9 in., breadth 3 to 4 in., petiole 2 to 2 25 in., stout, terete, slightly swollen at base and apex.

Cymes glabrous or glabrescent, 4 to 6 in. in diam., the branches opposite; bracts minute, persistent. *Flowers* ·25 in. in diam., glabrous. *Stamens* 4, perfect; the *filaments* longer than the petals and style, the 4 staminodes minute. *Ripe cocci* about ·5 in. long, keeled. *Seeds* oblong, the nucleus basal, much smaller than the oblong wing. *Tetramerista paniculata*, Kurz in Journ. Bot for 1875, p. 333.

Malacca; Maingay (Kew Distrib.) No. 290.

A rare plant known only by Maingay's scanty specimens.

2. Tetractomia Roxburghii, Hook. fil. Fl. Br. Ind. I., 491. A tree 30 to 80 feet high; young branches rather stout, glabrous, their bark pale, rough. *Leaves* coriaceous, cuneate-obovate, sometimes obovate-elliptic, the apex always broad and rounded, and very shortly and bluntly apiculate, much narrowed to the petiole; both surfaces glabrous, rather pale when dry, the upper glabrous, the lower glabrescent with numerous and rather large black dots: main nerves 7 to 9 pairs, oblique, straight, not prominent: length 2·5 to 5, rarely 6 in., breadth 1·5 to 2·5, rarely 3 in.; petiole ·5 to 1 in., rarely 1·25 in. *Cymes* glabrous in the lower, pubescent in the upper part, 3 or 4 in. in diam., pedunculate; bracts minute, persistent. *Flowers* ·13 in. in diam., puberulous. *Stamens* 8, the alternate row imperfect, minute and attached to the petals. *Ripe cocci* 1 to 3 from a flower, about ·25 in. long. *Seeds* oblong, nucleus rather shorter than the wing, Hook. fil. Icones Plantar. 1512. *Melicope tetrandra*, Roxb. Fl. Ind. II. 257.

Penang, Singapore, Perak.

A much more common plant than the last, with smaller flowers and fruit, and with leaves not only smaller but much more obovate.

3. Melicope, Forst.

Shrubs. *Leaves* opposite (in the Indian species), 1–3-foliolate, pellucid-punctate. *Flowers* small, in axillary cymes or panicles. *Calyx* 4-lobed or 4-partite. *Petals* 4, sessile, spreading, valvate or imbricate. *Disc* large, entire or 8-lobed, or obsolete. *Stamens* 8, inserted at the base of the disk, those opposite the petals shorter, filaments subulate or flattened; anthers oblong or cordate. *Ovary* 4-celled, deeply 4-lobed; style basilar, or styles 4, subterminal, more or less combined; stigma capitate, 4-lobed; ovules 2 in each, all collateral or superposed. *Fruit* of 4 free spreading coriaceous cocci, dehiscing on the inner face; endocarp more or less separating from pericarp. *Seeds* oblong, testa black, shining; embryo with large oblong cotyledons and short radicle. Distrib. chiefly Polynesian: species about 15.

1. Melicope Helferi, Hook. fil. Fl. Br. Ind. I, 492. A glabrous

dioeceous shrub: young branches rather stout, striate, sub-quadrangular. *Leaves* 1-foliolate: leaflet coriaceous, obovate-elliptic, very obtuse, narrowed to the base: main nerves about 9 pairs, spreading, inconspicuous; length 4·5 to 6 in., breadth 2 to 3 in.; petiole ·75 to 1 in. *Panicles* not much longer than the petioles, few-branched, cymose. *Flowers* ·2 in. in diam. *Calyx-lobes* acute. *Petals* longer than the calyx, lanceolate, acute, puberulous outside, ridged along the midrib on the inner surface inside. Kurz For. Flora Burmah, I, 182.

Andaman Islands; Helfer (Kew. Distrib.) No. 1192.

4. Zanthoxylum, Linn.

Shrubs or trees, often armed with stout prickles. *Leaves* alternate, 3-foliolate or unequally pinnate; leaflets opposite or alternate, entire or crenate, often oblique, punctate. *Flowers* small, in axillary or terminal, peduncled, broad or narrow cymes, white, pink, or greenish, often unisexual. *Calyx* 3–8-fid, rarely 0. *Petals* 3–5, rarely 0, imbricate or induplicate-valvate. *Disc* small or obscure. *Stamens* 3–5, hypogynous or reduced to scales in the ♀. *Ovary* rudimentary in the ♂, in the ♀ of 1–5 oblique, 1-celled carpels; styles sublateral, free or connate above, stigma capitate; ovules 2 in each cell, usually collateral. *Fruit* of 1–5, globose, coriaceous or fleshy, 1-seeded cocci, dehiscing ventrally; endocarp horny, separating or not. *Seed* oblong and compressed, or globose, often hanging out of the carpel, hilum broad, testa bony or crustaceous, blue or black, shining, albumen fleshy; embryo axile, straight or curved; cotyledons flat, radicle very short.—Distrib. About 80 species, all either tropical or subtropical.

Unarmed or very slightly armed: leaves 3-foliolate; cymes axillary and terminal; fruit ·3 in. in diam. ... ... 1. *Z. ovalifolium.*

Armed; leaves pinnate, leaflets 4 to 9 pairs; cymes terminal; fruit ·12 in. in diam. ... 2. *Z. myriacanthum.*

1. Zanthoxylum ovalifolium, Wight Ill. I, 169. A shrub or tree: young branches at first puberulous but speedily glabrous, lenticellate, unarmed, or with a few short straight prickles. *Leaves* 3-foliolate: petiole 1·25 to 2·5 in., not armed; leaflets sub-coriaceous, elliptic-oblong, slightly obovate, the apex with an abrupt short obtuse point, the edges crenulate, the base narrowed; both surfaces shining: main nerves 10 to 14 pairs, sub-horizontal, not much more prominent than the intermediate nerves; length 2 to 5 in., breadth 1·2 to 2·5 in.; petiole ·2 to ·4 in., sometimes almost absent; the middle leaflet larger than the two lateral. *Cymes* slender, paniculate, pedunculate, axillary and terminal, shorter than the leaves, with few alternate branches,

puberulous when young, speedily glabrous. *Flowers* 4-to 5-merous, ·12 to ·2 in. in diam., pedicellate. *Petals* valvate. *Fruit* solitary, sub-globular, ·3 in. in diam., pitted, glabrous. *Seed* sub-globose. Hook. fil. Fl. Br. Ind. I, 492. *Z. undulatum*, Wall. Cat, 1208. *Z. lucidum*, Wall. Cat. 1212. *Toddalia mitis*, Miq. MSS. *Limonia leptostachya*, Jack MSS. Wall. Cat. (without name) 7472 and 7469.

Singapore: Wallich. Andaman Islands, King's collectors. Distrib.: British India, Sumatra.

2. Zanthoxylum myriacanthum, Wall. Cat. 1214. A glabrous tree 40 feet high, all parts except the petioles armed with short straight prickles. *Leaves* 1 to 1·5 feet long; leaflets 4 to 9 pairs, coriaceous, oblong-lanceolate, acuminate, entire or very obscurely and minutely crenate; main nerves about 8 pairs, spreading, not prominent even when dry; length 3 to 4 in., breadth 1·25 to 1·5 in., petiolule ·1 to ·2 in. *Cymes* terminal, pedunculate, spreading, 6 to 8 in. in diam.; peduncle armed, 5 or 6 in. long; branches long, sub-opposite or alternate. *Flowers* ·2 in. in diam., sub-sessile, 5-merous. *Calyx* with a few small bracts at the base. *Ovaries* 3. *Ripe fruit* compressed, ·12 in. in diam., apiculate. *Seed* compressed. Hook. fil. Fl Br. Ind. I, 496. *Z. longifolium*, Wall. Cat. 7115.

Penang: Porter, Curtis No. 1076. Malacca; Maingay (Kew Distrib.) No. 279.

There are in Scortechini's Herbarium some scraps of a *Zanthoxylum* which appears to be *Z. glandulosum*, Teysm. and Binn.; but without better specimens I hesitate to include that species here.

5. Acronychia, Forst.

Trees, with opposite or alternate, 1-rarely 3-foliolate leaves; leaflets entire. *Flowers* polygamous, small or moderately sized, yellow, in pedunculate, terminal, or axillary corymbs. *Petals* 4, valvate, spreading, revolute. *Stamens* 8, inserted under a thick, 8-angled, tomentose disc; filaments subulate, the alternate longer. *Ovary* inserted in the hollowed apex of the disc, tomentose, 4-celled. *Style* terminal; stigma 4-grooved; ovules 2 in each cell, superposed. *Fruit* a 4-celled drupe, or 4-valved loculicidal capsule. *Seeds* with black testa and copious albumen; embryo straight; cotyledons flat, oblong. Distrib. About 15 species: all tropical Asiatic or Australasian.

Flowers ·35 to ·75 in. in diam., linear in bud,
filaments villous, inflorescence cymose ... 1. *A. laurifolia*.
Flowers ·15 in. in diam., globular in bud,
filaments glabrous, inflorescence racemose ... 2. *A. Porteri*.

1. Acronychia laurifolia, Blume Bijdr. 245. A small tree or

shrub; young branches puberulous, speedily becoming glabrous. *Leaves* sub-opposite, 1-foliolate; leaflet thinly coriaceous, oblong, elliptic or sub-obovate, obtusely acuminate or obtuse, the base much narrowed; both surfaces glabrous, shining, reticulate: main nerves little more prominent than the secondary, 14 to 18 pairs, forming a double series of loops within the edge; length 2 to 6 in., breadth 1·1 to 2·4 in., petiole ·5 to ·75 in. *Cymes* axillary, slender, long-peduncled, corymbose, the branches opposite, bracts and bracteoles minute. *Flowers* linear in bud, when open ·35 to ·75 in. in diam., pale yellow. *Sepals* small, semi-orbicular, short. *Petals* linear-oblong, obtuse, widening at the base, revolute, more or less villous on the inner surface. *Filaments* villous below. *Ovary* villous, style short, stigma capitate. *Drupe* sub-globular to ovoid, with an angular apiculus, sometimes narrowed at the base and occasionally lobed, 4-angled when dry, from ·25 to ·4 in. long, 3- or 4-celled. Hook. fil. Fl. Br. Ind. I, 498; Miq. Fl. Ind. Bat. I, pt. 2, 668; Kurz For. Flora Burmah, I, 184. *A pedunculata*, Miq. Fl. Ind. Bat. Suppl. 532: Ann. Mus. Lugd. Bat. III, 245; Thwaites Enum. Pl. Ceyl. 409. *Cyminosma pedunculata* DC. Prod. I., 722: Thwaites Enum. Pl. Ceyl. 69: Wall. Cat. 1205. W. & A. Prod. 147; Wight Ill. I, 165, t. 65; Dalz. & Gibs. Fl. Bombay, Suppl. 17. *C. Ankenda*, Gærtn. Fruct. I, 280, t. 58. *Clausena simplicifolia*, Dalz. in Kew Journ. Bot. III, 180. *Jambolifera pedunculata*, Vahl Symb. III, 52, fig. 61. *Gela lanceolata*, Lour. Fl. Coch. I, 232. *Selas lanceolatum*, Spreng. Syst. II, 216. *Ximenia? lanceolata*, DC. Prod. I, 533. Wall Cat. *indeterm.* 9028.

In the Andaman and Nicobar Islands. DISTRIB. British India and Ceylon, Malayan Archipelago, Cochin China.

A widely distributed and variable species, of which Sir Joseph Hooker (Fl. Br. Ind. I, 498) recognises six varieties. Of these, however, only two occur in the Malayan Peninsula, the only very well marked form being (6) with flowers 1 in. in diam. and subglobose, fruit nearly 7 in. in diam.; and (5) with small fruit lobed at the apex.

2. ACRONYCHIA PORTERI, Hook. fil. Fl. Br. Ind. I, 498. A tree 15 to 30 (or even 50) feet high: young branches glabrous, pale. *Leaves* opposite or alternate, 1-foliolate; leaflet coriaceous, oblong, slightly obovate, usually acute or shortly acuminate, sometimes obtuse, the base much narrowed: both surfaces glabrous dull and opaque: main nerves 8 to 10 pairs, straight, oblique, slightly prominent beneath when dry; length 3 to 8 in., breadth 1·25 to 3 in., petiole ·5 to ·75 in. *Racemes* often several from one axil, sometimes as long as, but usually shorter than the leaves, slender, puberulous towards the apex, minutely bracteolate. *Flowers* ·15 in. in diam., much shorter than their pedicels, in pairs or sub-verticellate, globose in bud. *Sepals* triangular, acute.

Petals broadly ovate-oblong, pubescent inside. *Filaments* glabrous. *Ovary* glabrescent. *Style* very short; stigma large, ob-pyramidal, 4-lobed. *Drupe* ovoid, tapering to each end, 4-angled when dry, minutely pitted, 4-celled, but often only 2-seeded, ·5 in. long and ·3 in. diam. when dry.

Penang: Porter, Maingay (Kew Distrib.) No. 280, Curtis. Malacca: Griffith. Perak: Scortechini, King's collector.

6. Glycosmis, Correa.

Unarmed shrubs or trees. *Leaves* 1-foliolate or imparipinnate; leaflets alternate. *Flowers* small, in axillary, rarely terminal panicles. *Calyx* 4–5-partite, segments broad, imbricate. *Petals* 4–5, imbricate. *Stamens* 8–10, free, inserted round a disc; filaments subulate, dilated below; anthers small, with often a dorsal or apical gland. *Ovary* 2–5-celled; style very short, persistent, stigma simple, ovules solitary and pendulous in each cell. *Berry* small, dry or fleshy, 1–3-seeded. *Seeds* oblong, testa membranous; cotyledons equal, radicle very short.—Distrib.—Species 5, Asiatic and Australian.

Ovary glabrous: fruit globular ... ... 1. *G. pentaphylla.*
Ovary hairy: fruit oblong, narrowed at the base ... ... 2. *G. sapindoides.*
Ovary rusty-pilose ... ... 3. *G. puberula.*

1. Glycosmis pentaphylla, Corr. in Ann. Mus. VI, 384. A glabrous shrub or small tree. *Leaves* 3- to 5-foliolate, or 1-foliolate, leaflets sub-coriaceous, varying from elliptic-lanceolate, lanceolate, oblong, or obovate, or linear-lanceolate to oblong or even obovate; the apex acute, acuminate or obtuse; the edges entire or crenulate; the base narrowed; both surfaces shining; main nerves 4 to 9 pairs, oblique, curving, rather prominent beneath, and depressed above when dry; length 1·5 to 15 in., breadth ·5 to 6 in., petiolule ·1 to ·5 in. *Panicles* cymose, puberulous to glabrous, varying much in size, usually axillary, but often terminal. *Flowers* small. *Ovary* glabrous, 5-celled, rarely 3- to 4-celled: style short, stout. *Berry* globose, white or bluish white, from the size of a pea to that of a cherry. Hook. fil. Fl. Br. Ind. I, 499; Kurz For. Burmah, I, 186: Miq. Fl. Ind. Bat. I, pt. 2, 522: DC. Prodr. i. 538; W. & A. Prodr. 93; Oliv. in Journ. Linn. Soc. v., Suppl. ii. 37; Wall. Cat. 6374; Thwaites Enum. 45 and 406; Dalz. & Gibs. Bomb. Fl. 29; Bedd. in Trans. Linn. Soc. xxv. 211; Flor. Sylv. Anal. Gen. xliii. t. 6, f. 6. *G. chylocarpa*, W. & A. Prodr. 93. *G. arborea*, DC. l. c.; Wall. Cat. 6373; Thwaites Enum. 45. *G. Retzii*, Roem. Synops. fasc. i. 41. *Sclerostylis pentaphylla*, Bl. Bijdr. 135. *Limonia pentaphylla*, Retz Obs. v. 24; Roxb. Cor. Pl. t. 84; Flor. Ind. ii. 381. *L. arborea*, Roxb. Cor.

Pl. t. 85; Fl. Ind. l.c.; Bot. Mag. t. 2074. *Myxospermum chylocarpum*, Roem. Synops. fasc. i. 40.

In all the Provinces: common. Distrib.—Malayan Archipelago, British India, Philippine Islands, Australia.

A very variable and most perplexing species, the Protæan forms of which were first reduced to order by Professor D. Oliver (Journ. Linn. Soc. V, Suppl. II. p. 36). Of the forms recognised by Dr. Oliver only some are found in the Malayan Peninsula and Andaman Islands. Sir Joseph Hooker (in Fl. Br. Ind.) follows Professor Oliver for the most part; and from that book I copy the following account of the varieties. The Calcutta Herbarium is overloaded with specimens of this plant, many of which it is difficult to fit in under any of Professor Oliver's varieties; and for one of these I have ventured to suggest the varietal name *macrorachis*.

Var. 1: Leaves usually 3-, rarely 1- or 5-foliolate; leaflets 4–9 in., lanceolate or oblong, or obovate-lanceolate, quite entire or obscurely crenulate; panicles towards the tips of the branches usually elongate, many-flowered; ovary usually covered with mamillary glands, 5-celled, connate with the disc at the base.—The commonest form in the Malay Peninsula.—Distrib.; British India.

Var. 2: Leaves usually 3–5-foliolate (except sub-var. 1); leaflets elliptic or elliptic-lanceolate; panicles small, few or many-flowered, flowers smaller; ovary 4–5-celled, scarcely mamillate, constricted at the base and thus free from the disc.—*G. triphylla*, Wight in Hook. Bot. Misc. iii. 298, Suppl. t. 39; Ic. t. 167; W. & A. Prodr. 93. *G. nitida*, W. & A. Prodr. l. c.—The commonest form in the Andaman Islands. Distrib.—Western Peninsula, Ceylon, Tenasserim.

Sub-var. 1. *longifolia*: leaves usually 1-foliolate, leaflets 3–10 in., oblong or obovate-lanceolate, often acuminate or even caudate; panicles short, 1–2 in., or if terminal 3–4 in.—Malacca, Assam, the Khasia Mts., Rangoon.

Sub-var. 2. *macrophylla*: Leaves 3–5-foliolate, with the leaflets $3\frac{1}{2}$–6 in., or 1-foliolate with the leaflets 8 to 12 in. long, by 2·5 to 6 in. broad. *G. macrophylla*, Lindl. in Wall. Cat. 6377, Miq. Fl. Ind. Bat. I, pt. 2 p. 522. *Chionotria rigida*, Jack in Mal. Misc. ex. Hook. Comp. Bot. Mag. I, 155. *Ch. monogyna*, Walp. Rep. I, 382. *Sclerostylis macrophylla*, Bl. Bijdr. 135. Penang. Distrib.—Assam. Tavoy.

Sub-var 3. *macrorachis*, King, leaflets 1-foliolate, oblong-lanceolate, acuminate, 9 to 15 in. long and 3·5 to 5 in. broad: cymes small, pedicellate, arranged on a raceme 4 to 9 in. long. Penang: Curtis No. 89.

2. Glycosmis sapindoides, Lindl. in Wall. Cat. 6376. A shrub. *Leaves* 5-to 7-foliolate; leaflets sub-coriaceous, oblong or lanceolate,

acuminate or sub-acuminate, both surfaces glabrous; main nerves 7 to 9 pairs, oblique, faint: length 3 to 8 in., breadth 1 to 3 in., petiole about ·2 in. *Panicles* cymose, sub-pyramidal, axillary and terminal. *Flowers* shortly pedicelled. *Ovary* 2- to 3-celled, hairy, about as long as the thick style. *Berry* oblong, narrowed to the base, usually 1-seeded. Hook. fil. Fl. Br. Ind. I, 501. *G. cyanocarpa*, Spreng. VAR *sapindoides*, Kurz in Journ. Bot. for 1876, p. 34.

Penang: Wallich, Maingay, Curtis. DISTRIB.—Sumatra, Java, Sikkim.

I doubt very much indeed whether this would not be better treated as a variety of *G. pentaphylla*, than as a species. Except the hairiness and the smaller number of cells usually found in its ovary, and its oblong fruit, I see nothing to distinguish it.

3. GLYCOMIS PUBERULA, Lindl. in Wall. Cat 6375. A shrub: *leaves* usually 3-foliolate; leaflets sub-coriaceous, ovate to oblong-lanceolate, more or less bluntly acuminate; the base rounded or cuneate, lower surface pale when dry; main nerves about 8 pairs, spreading; length 2·5 to 4·5 in., breadth ·75 to 1·5 in. *Panicles* short, axillary; flowers in short pedicels; disc small, adnate to the 4- to 5-celled oblong rusty-pilose ovary. *Style* very short.

Penang: Singapore, Perak: not common.

Except in its pilose ovary this differs but little from *G. pentaphylla* Corr., of which it would be perhaps well to treat it as a form.

7. MICROMELUM, Blume.

Unarmed trees. *Leaves* imparipinnate; leaflets alternate, oblique. *Flowers* in large terminal corymbose cymes. *Calyx* cupular, 3–5-toothed or lobed. *Petals* 5, free, thick, valvate or subimbricate. *Stamens* 10, free, inserted round a short or long disc; filaments linear-subulate, alternately shorter. *Ovary* 5- rarely 2–6-celled; style constricted at the base, deciduous, stigma obtuse or capitate; ovules 2, superposed in each cell. *Berry* small, dry, usually 1–2-seeded, septa spirally twisted. *Seeds* oblong, testa membranous; cotyledons leafy, crumpled, radicle long.—DISTRIB.—Species 3 or 4: tropical Asiatic and Oceanic.

A large shrub or small tree: fruit glabrous ... 1. *M. pubescens.*

A small shrub, never a tree: fruit pubescent... 2. *M. hirsutum.*

1. MICROMELUM PUBESCENS, Blume Bijdr. 137. A large shrub or small tree; the young parts more or less pubescent or puberulous, the older often glabrescent or even glabrous. *Leaves* 6 to 18 in. long: leaflets 9 to 15, alternate or sub-opposite, membranous, broadly lanceolate to ovate, acuminate, the edges undulate, sub-cuneate or entire; the base cuneate, often very oblique; main nerves 9 to 12

pairs, oblique, not prominent; length 1·5 to 3·5 in., breadth ·5 to 2in. *Cymes* large, terminal, much branched, pedunclate, 4 to 8 in. in diam., many-flowered, minutely bracteolate. *Flowers* ·25 to ·5 in. in diam., on pedicels ·1 to ·2in. long, buds oblong. *Calyx* sub-entire or 5-toothed. *Petals* linear-oblong, sub-acute. *Filaments* alternately longer. *Ovary* mostly pubescent, usually 5-celled. *Berry* ovoid or oblong, ·3 to ·4 in. long, pitted, glabrescent, 1-seeded. Hook. fil. Fl. Br. Ind. I, 501; Kurz For. Flora Burmah I, 186: Oliv. in Journ. Linn. Soc. v. Suppl. ii. 40; Bedd. Flor. Sylv. Anal. Gen. xliii. t. 7, f. 1; Thwaites Enum. 46. *Bergera integerrima*, Roxb. Fl. Ind. ii. 376; Wall. Cat. 6371. *Aurantiacea*, Wall. Cat. 8517, 8518.

In all the Provinces. Distrib.—British India, China, the Malayan Archipelago, and Australasia.

2. Micromelum hirsutum, Oliver in Journ. Linn. Soc. V. Suppl. II, 40. A shrub, all parts (but especially the inflorescence) more or less tomentose, rarely glabrescent. *Leaves* 6 to 12, rarely 15 in. long; leaflets membranous, 9 to 25, lanceolate or oblong-lanceolate, rarely ovate, shortly acuminate, the edges obscurely serrate, the base often oblique, lower surface softly tomentose; main nerves 5 to 10 pairs, rather prominent beneath: length 1·5 to 3·5 in., breadth ·8 to 1·5 in. *Cymes* terminal, very tomentose, often lax, and 6 to 8 in. in diam., but sometimes condensed and only 2 in. in diam. *Flowers* ·25 in. in diam. *Calyx* deeply 5-lobed, hirsute. *Ovary* villous. *Berry* oblong or obovoid, pubescent, pitted. Hook. fil. Fl. Br. Ind. I, 502; Kurz For. Flora Burmah I, 187: Wall Cat. 8516.

Penang, Singapore, Perak, but not very common. Distrib.—British India, Burmah, Philippines.

This is closely allied to *M. pubescens*, but is usually a smaller shrub. The chief differences between the two lie in the greater amount of pubescence in this, and the smaller size of its flowers.

8. Murraya, Linn.

Unarmed shrubs or small trees. *Leaves* pinnate; leaflets alternate, petioled, base oblique or cuneate. *Flowers* solitary and axillary, or in terminal corymbs or axillary cymes. *Calyx* 5-fid or partite. *Petals* 5, free, imbricate. Stamens 10, inserted on an elongate disc; filaments subulate, alternately shorter: anthers shortly ovate. *Ovary* 2- to 5-celled, narrowed into the long deciduous style, stigma capitate; ovules solitary, or 2 superposed or collateral in each cell. Berry oblong or ovoid, 1- to 2-celled, 1- to 2-seeded. *Testa of seed* woolly or glabrous; cotyledons fleshy, plano-convex, similar. Distrib.—4 species, tropical Asiatic.

1. Murraya exotica, Linn. A glabrous shrub or small tree: young branches terete, the bark pale when dry. *Leaves* 4 to 5 in. long, 3-to 8-foliolate; leaflets thinly coriaceous, shining, ovate or ovate-lanceolate, occasionally rhomboid, more or less obtusely acuminate, the apex often notched, edges entire; the base cuneate, often oblique. *Corymbs* terminal, few-flowered. *Flowers* campanulate. *Sepals* acute. *Petals* oblong-lanceolate, white. *Ovary* 2-celled, style slender, stigma capitate. *Berry* ovoid or sub-globose, shining, red when ripe, ·5 in. long, 2-seeded. Hook fil. Fl. Br. Ind. I, 502; Miq. Fl. Ind. Bat. I, Pt. 2 p. 522; Kurz For. Flora Burmah I, 190; Oliver in Jour. Linn. Soc. V, Suppl. II, 28: Roxb. Fl. Ind. II, 374; Blume Bijdr. 1363; Wall. Cat. 6368; Thwaites Enum. 45; Wight Ic. t. 96; Brandis For. Flora N. India, 48. *M. exotica* and *brevifolia*, Thwaites Enum. 45. *M. paniculata*, Jack in Mal. Misc. I, 31 ex Hook. Bot. Misc. II, 79; DC. Prodr. I, 537; W. & A. Prodr. 94; Dalz. and Gibs. Bomb. Flor. 29. *M. sumatrana*, Roxb. Fl. Ind. II, 375; Wall. Cat. 6369; Miq. Fl. Ind. Bat. l. c. 523. *Chalcas paniculata*, Linn. *Ch. sumatrana*, Roem. Synops. fasc. I, 49. *M. Glenieii*, Thwaites Enum. 406; Oliv. in Journ. Linn. Soc. v. Suppl. II, 29.

Andaman Islands. Malayan Peninsula, Griff. (Kew Distrib.) No. 520. Distrib.—British India, China, Australia. Much cultivated in gardens on account of the fragrance of its flowers.

9. Clausena, Burm.

Unarmed shrubs or trees. *Leaves* imparipinnate, usually deciduous, leaflets membranous. *Flowers* small, in terminal or axillary cymes panicles or lax racemes. *Calyx* 4–5-lobed or-partite. *Petals* 4–5, free, membranous, margins imbricate. *Stamens* 8–10, inserted round an elongated disc, the alternate shorter; filaments usually dilated or arched and concave below the subulate tip; anthers short. *Ovary* stipitate, 4–5- (rarely 2–3-) -celled; style usually distinct, deciduous; stigma obtuse, entire or 2–5-lobed; ovules 2, collateral, or superposed in each cell. *Berry* small, ovoid, oblong or globose, 2–5-celled. *Seeds* oblong, testa membranous; cotyledons equal, plano-convex. Distrib. Species about 14; chiefly tropical Asiatic, with a few African and Australian.

1. Clausena excavata, Burm. Fl. Ind. 87. A shrub or small tree: young branches pubescent or tomentose, as are the young leaves and the inflorescence. *Leaves* 6 to 12 in. long; leaflets 15 to 29, membranous, lanceolate to oblong-lanceolate, acuminate, obscurely crenate; the base narrowed, very oblique; the upper surface when adult glabrescent or glabrous; length 1·5 to 3·4 in., breadth ·5 to 1 in.; petiolule ·1 in.. *Panicle* terminal, pyramidal, its length 4 to 12 in, of which the peduncle forms a third; branches spreading, alternate. *Flowers* ·25

in. in diam., with globose buds, 4-merous; pedicels longer than the flowers. *Calyx* much shorter than the oblong glabrous petals. *Ovary* ovoid, slightly 4-angled, hairy, stipitate; style stout, about as long as the ovary. *Fruit* broadly ovoid, blunt at each end, 1- to 2-seeded. Hook. fil. Fl. Br. Ind. I., 504: Miq. Fl. Ind. Bat. I, pt. 2, p, 524: Kurz For. Flora Burmah I, 188; Blume Bijdr. 139; DC. Prodr. I. 538; Oliv. in Journ. Linn. Soc. v. Suppl. ii. 31. *Murraya Burmanni*, Spreng. Syst. Veg. ii. 315. *Amyris sumatrana* and *punctata*, Roxb. Fl. Ind. ii. 250, 251. *Cookia graveolens*, W. & A. Prodr. 95; Wall. Cat. 8515. *Gallesioa graveolens*, Roem. Synops, fasc. i. 45.

In all the provinces except the Andaman and Nicobar islands. Distrib.—British India, Malayan Archipelago, near the bases of hill ranges.

10. Triphasia, Lour.

A spiny shrub. *Leaves* alternate, sessile, 3-foliolate; leaflets obtuse, crenate, the lateral smaller. *Flowers* solitary or in 3-flowered cymes, axillary. *Calyx* 3-lobed. *Petals* 3, free, imbricate. *Stamens* 6, inserted round a fleshy disc; filaments free, subequal, dilated at the base, anthers linear. *Ovary* ovoid, 3-celled, narrowed into a slender deciduous style; stigma obtuse or capitate and 3-lobed; ovules solitary in each cell. *Berry* small, ovoid, 1–3-celled, 1–3 seeded. *Seeds* oblong, immersed in mucilage, testa coriaceous; cotyledons plano-convex, often unequal or lobed.

1. Triphasia trifoliata, DC. Prod. I, 536. A small glabrous spiny shrub. *Leaflets* coriaceous with obscure nerves, crenulate, dissimilar; the terminal one shortly petiolate, ovate, obtuse, retuse, the base cuneate; the lateral smaller, oblique. *Flowers* about ·5 in. long, white. *Petals* linear-oblong. *Fruit* ovoid, apiculate, glandular-dotted. Hook. fil. Fl. Br. Ind. I, 507; Miq. Fl. Ind. Bat. I. pt. 2. p. 519; Kurz For. Flora Burmah, I, 191: Blume Bijdr 132; Oliv. Journn. Linn. Soc. v. Suppl. ii 26; W. & A. Prodr. 91; Dalz. & Gibs. Bomb. Fl., Suppl. 12. *T. aurantiola*, Lour. Fl. Fl Coch. I, 189; Wall. Cat. 6381. *Limonia trifoliata*, Linn.; Burm. Fl. Ind. t. 35, f. 1.; Bl. Bijdr. 132. *L. diacantha*, DC. Prodr. i. 536.

Nicobar Islands: Kurz. Distrib. British India and various tropical countries, but often doubtfully wild. It is possible this may not really be indigenous in the Nicobars, as these islands have for ages been frequented by Malayan pirates, who may have inadvertently introduced it.

11. Luvunga, Hamilt.

Glabrous, climbing shrubs, usually armed with axillary (often hooked) spines. *Leaves* 3-foliolate; leaflets coriaceous, quite entire.

Flowers in axillary fascicled or panicled racemes. *Calyx* cupular, entire or obscurely 4–6-lobed. *Petals* 4–5, free, linear-oblong, thick, imbricate. *Stamens* 8 or 10, inserted around a cupular annular or elevated disc; filaments equal or not, linear-subulate, free or cuneate; anthers linear or linear-oblong. *Ovary* 2–4-celled; style stout, deciduous, stigma capitate; ovules 2, superposed in each cell. *Berry* large, ellipsoid, with a thick rind, 2–3-seeded. *Seeds* large, ovoid; testa membranous, nerved; cotyledons equal, oblong, fleshy,—DISTRIB. About 4 species: tropical Asiatic.

Leaflets oblong-lanceolate to oblong-oblanceolate; filaments glabrous, united into a tube ... ... 1 *L. scandens.*
Leaflets elliptic, more or less obovate; filaments free, often woolly ... 2 *L. eleutheranthera.*

1. LUVUNGA SCANDENS, Ham. in Wall. Cat. 6382. A large woody climber. *Leaflets* oblong-lanceolate to oblong-oblanceolate, acute or blunt, the base narrowed, nerves very obscure; length 4 to 12 in., breadth 1 to 2 in., petiolules about ·2 in.; petioles terete, stout, 2 to 5 in. long. *Cymes* many-flowered, short, broad, (1·5 to 2 in. across), on short peduncles. *Flowers* ·5 to ·75 in. long, white. *Calyx-lobes* short, obtuse. *Petals* 4, fleshy, recurved. *Stamens* with glabrous filaments united into a tube (sometimes for three-quarters of their length). *Ovary* 3- to 4-celled. *Berry* of the size of a large olive, yellowish, obscurely 3-lobed, the pericarp smooth. Hook. fil. Fl. Br. Ind. I, 509; Kurz For. Flora Burmah I, 191; Wight Ill. i. 108; Oliv. in Journ. Linn. Soc. v. Suppl. ii. 43; Bot. Mag. t. 4522. Pierre For. Flora Coch. Chine, t. 288. *Limonia scandens*, Roxb. Fl. Ind. ii. 380.

Malacca: Maingay (Kew Distrib.) No. 285. DISTRIB British India.

2. LUVUNGA ELEUTHERANTHERA, Dalz. in Hook. Kew Journ. Bot. II. 258. A woody climber like the last, the spines usually hooked; leaflets elliptic and usually more or less obovate, shortly and abruptly acuminate; main nerves 8 to 12 pairs, slightly prominent. *Cymes* axillary, many- or few-flowered. *Filaments* free, often woolly in the upper part. *Fruit* as in the last. Hook. fil. Fl. Br. Ind. I. 511; Oliv. in Journ. Linn. Soc. v. Suppl. ii. 44; Dalz. & Gibs. Bomb. Flor. 30. *L. tavoyana*, Lindl. in Wall. Cat. 6383. *L. scandens* and *eleutheranthera*, Thwaites, Enum. 47, 48, 406. *Triphasia sarmentosa*, Blume Bijd. 132; Miq. Fl. Ind. Bat. I. pt. 2, p. 520.

Perak: common. Pahang. Penang.—DISTRIB. Malayan Archipelago, W. Peninsula of British India, Ceylon.

This plant differs from *L. scandens* (to which it is closely allied) in having more obovate leaves, with much more distinct nervation, and free filaments which are often woolly. It appears to be pretty widely distributed in Java, and is I think without doubt Blume's *Triphasia sarmentosa.*

12. Paramignya, Wight.

Erect or climbing shrubs, unarmed, or with axillary spines. *Leaves* 1-foliolate, the joint often obscure, quite entire, subcoriaceous, persistent. *Flowers* rather large, axillary, solitary or fascicled. *Calyx* cupular or small, and 4–5-lobed. *Petals* 4–5, free, imbricate or rarely induplicate-valvate. *Stamens* 8–10, inserted round a columnar disc; filaments free, linear, equal or subequal, anther linear-oblong. *Ovary* 3–5-celled; style elongate, deciduous; ovules in each cell solitary, or 2 obliquely superposed. *Berry* ovoid or subglobose, often contracted at the base, 1–5-seeded, rind thick. *Seeds* large, oblong, much compressed, testa membranous; cotyledons fleshy, equal.—Distrib.—Species 6; tropical Indian.

Spines short, solitary, axillary, curved, pubescent; flowers ·7 in. long, on slender pedicels longer than themselves ... ... 1 *P. armata.* var. *andamanica.*

Spines long, in pairs, stipular, straight, glabrous; flowers ·35 in. long, on short pedicels ... 2 *P. longispina.*

1. Paramignya armata, Oliver in Journ. Linn. Soc. V. Suppl. II, 43, var. andamanica, King. A scandent shrub; young branches slender, puberulous, speedily becoming glabrous. *Leaflets* elliptic or elliptic-oblong, sub-acute or acute, the base rounded; glabrous except (when young) the upper surface of the midrib near the base; the reticulations and the 10 to 12 pairs of spreading main nerves slightly prominent on the lower surface when dry, the glandular dots also rather prominent; length 4 to 5·5 in., breadth 1·5 to 2·75 in.; petiole ·5 in., pubescent when young especially on the upper surface. *Spines* short, solitary in the axils below the pedicels, slightly curved, pubescent. *Flowers* axillary, in pairs, on slender sparsely pubescent pedicels longer than themselves; pedicels 1·25 to 1·5 in. long, bracteolate at the base. *Calyx* short, deeply divided into 5 broadly obtuse, spreading lobes. *Petals* about five times as long as the calyx, linear-oblong, obtuse, glabrous, ·6 in. long. *Stamens* 10, free, almost as long as the petals: the filaments rather thick and woolly below, slender and glabrous towards the apex; anthers narrowly oblong. *Disc* short, cylindric; not broader than the ovary. *Ovary* ovoid; style elongate, crowned by the discoid stigma, all glabrous. *Fruit* globular or turbinate, smooth, ·5 to ·65 in. in diam.

Andaman Islands: common.

This differs from the typical *P. armata*, Oliver, as it occurs in

Western Peninsular India and in Ceylon, mainly in the size of its leaves, and in its flowers being less numerous in their axils. In its flowers it agrees well with the typical form. It also resembles *P. monophylla*, W. and A.; but the filaments of the stamens of that species are glabrous or nearly so, and taper suddenly to a short point, while the filaments of this are thick and woolly in the lower three-fourths, the upper fourth being filiform and glabrous. The ovary of this is glabrous, of that pubescent; moreover the flowers of this are on long filiform pedicels which arise by pairs from the axils; while in *P. monophylla* the pedicels are short, and are united above the point of origin from the axil. The calyx of *P. monophylla* is besides longer, but much less deeply lobed; it is also pubescent or tomentose, while the calyx of this is glabrous. The disc in this plant is nothing more than a short gynophore.

2. Paramignya longispina, Hook. fil. Fl. Br. Ind. I, 511. A small rigid glabrous tree; branches rather stout, armed with stout straight spines ·75 to 1·5 in. long, and rising from each side of the insertion of the petioles. *Leaves* elliptic-oblong to elliptic, acute or obtuse, the base rounded, nerves indistinct, length 2·5 to 4·5 in., breadth 1·1 to 1·75 in., petiole ·2 in. *Flowers* ·35 in. in diam., axillary, solitary or 2 or 3 together, pedicels short. *Calyx* 5-toothed. *Petals* oblong, obtuse. *Stamens* 10, equal, glabrous; anthers narrow, as long as the filaments, apiculate. *Ovary* glabrous, standing on the disc (gynophore): style stout, cylindric; ovules in pairs. *Fruit* ovoid, much apiculate, 1·25 to 1·75 in. long, glabrous, 3 or 4-celled; the pericarp coriaceous. *Seeds* compressed, beaked. *Atalantia longispina*, Kurz Journ. As. Soc. Bengal, for 1872, pt. 2, p. 295. *Paramignya angulata*, Kurz For. Flora Burmah, I, 194. *Gonocitrus angulatus*, Kurz in Herb. Calc. *Citrus angulata*, Willd.? *Limonia angulata*, W. & A. Prodr. 91; Miq. Fl. Ind. Bat. I, pt. 2. p. 521. Malacca: Maingay (Kew Distrib.) l. c. 286. Perak: Scortechini

Distrib.—Burmah.

13. Atalantia, Correa.

Unarmed or spinous shrubs or trees. *Leaves* alternate, 1-foliolate, coriaceous, persistent, quite entire or crenulate; stipule-like scales often present at the base of the petioles and spines, which belong to undeveloped leaf-buds. *Flowers* axillary, rarely terminal, fascicled or or in short racemed corymbs, or panicles, rarely solitary. *Calyx* 3–5-lobed or, partite-rarely irregularly split. *Petals* 3-5, free or adnate to the stamens and united with them into a tube, imbricate. *Stamens* 6–8, rarely 15–20, inserted round an annular or cupular disc, filaments free or irregularly connate, subequal or the alternate shorter; anthers short, ovate-oblong, or base cordate. *Ovary* 2- or 4-, rarely 3- or 5- celled: style deciduous, stigma capitate; ovules solitary or 2 collateral in each cell. *Berry* large, sub-globose, 1–5-celled, 1–5-seeded, rind thick. *Seeds* oblong; cotyledons fleshy, plano-convex.—DISTRIB.—Species about 10, chiefly tropical Asiatic.

Armed; leaves 1·25 to 2·5 in. long ... 1. *A. monophylla.*
Unarmed; leaves 4 to 6 in. long ... ... 2. *A. Roxburghiana.*

1. ATALANTIA MONOPHYLLA, Correa Ann. du Mus. VI, 383. A large shrub or small tree: the young branches sometimes pubescent at the very tip, usually more or less armed with short, solitary, straight, axillary spines. *Leaves* lanceolate, oblong-ovate, ovate or elliptic; the apex obtuse, often notched, the edges entire, the base slightly cuneate; both surfaces glabrous, the nerves and reticulations rather distinct when dry; length 1·25 to 2·5 in., breadth ·6 to 1·2 in.; petiole ·2 to ·3 in. puberulous. *Flowers* ·35 to ·5 in. in diam., in lax axillary racemes or cymes, the pedicels puberulous, slender, longer than the flowers; buds sub-globose or obovate. *Calyx* irregularly lobed, glabrous, the edges scarious. *Petals* oblong, obtuse, ·3 to ·4 in. long. *Stamens* 8, or fewer; the filaments broad and united into a tube, their apices free and filiform, the anthers ovate. *Ovary* sessile, on a small annular disc. *Berries* ovoid at first, globose when ripe, ·6 to ·8 in. in diam. Hook. fil. Fl. Br. Ind. I, 511: Miq. Fl. Ind. Bat. I, Pt. 2, p. 519; Kurz For. Flora Burmah I, 195: DC. Prod. I, 535; W. and A. Prodr. 91; Wight Ill. I, 108; Wall. Cat. 6353; Oliv. in Journ. Linn. Soc. v. Suppl. II, 24: Dalz. and Gibs. Bomb. Flor. 28. *A. floribunda*, Wight, Ic. t. 1611. *A. platistigma*, Wight Ill. I, 108. *Limonia monophylla*, Linn.; Roxb Cor. Pl. I, t. 82; Fl. Ind. II, 378. *Turræa virens*, Hellen. in Act. Holm. 1788, t. 10, f. I, (not of Linn.). *Trichilia spinosa*, Willd.; DC. Prodr. I, 623. Rheede Hort. Mal. IV, t. 12; Burm. Fl. Zeyl. t. 65, f. I.

Penang, Kedah, Andaman and Nicobar Islands. DISTRIB.—British India, in Sylhet, and in the Peninsula; Ceylon.

The plant named *A. macrophylla* by Kurz (For. Fl. Burmah I, 195), of which there are excellent specimens in the Calcutta Herbarium, seems to be only a luxuriant form of this. I can find no characters in which it differs, except size.

2. ATLANTIA ROXBURGHIANA, Hook. fil. (not of Oliver), Fl. Br. Ind. I, 513. A glabrous shrub or small tree: young branches slender, spineless. *Leaves* thinly coriaceous, elliptic or elliptic-oblong, tapering to each end, the apex sub-acute or shortly acuminate; the base cuneate, rarely rounded; main nerves 10 to 14 pairs, spreading, slightly prominent underneath when dry; length 4 to 6 in., breadth 1·75 to 2·25 in., petiole ·3 in. *Racemes* short, few-flowered, axillary. *Flowers* nearly ·5

in. in diam., buds globose. *Calyx* with 4 obtuse lobes. *Petals* 4, obovate. *Stamens* 8; the anthers oblong-ovoid; filaments free, short, subulate. *Ovary* ovoid, sessile, 2-celled. *Berry* globose when ripe, glabrous, ·6 to ·8 in. in diam. Hook. fil. Fl. Br. Ind. I, 513. *Sclerostylis Roxburghii*, Wight, Ic. t. 72. *Amyris simplicifolia*, Roxb. Fl. Ind, II, 244.

Perak: common. Penang, Malacca; Griffith (Kew Distrib.) No. 537.

There are in the Calcutta Herbarium a large number of fruiting specimens of this from Perak; but not a single one in flower. These specimens agree so entirely with Roxburgh's figure of *Amyris simplicifolia* in the Calcutta Herbarium (of which Wight's Ic. 72 is a copy) and with Griffith's Malacca specimen (No 537), that I have no hesitation in referring them to the same species. The description of the flowers given above is copied from Sir Joseph Hooker's Fl. Br. Ind. I, 513.

ORDER XXIV. SIMARUBEÆ.

Trees or shrubs, usually with bitter bark. *Leaves* alternate, often large, pinnate or rarely simple; stipules 0 or deciduous. *Inflorescence* axillary, racemose, paniculate or cymose, rarely spicate. *Flowers* usually diclinous, regular, and generally small. *Calyx* 3–5-lobed, valvate or imbricate. *Petals* 3–5, very rarely 0, hypogynous, valvate or imbricate. *Disc* annular or elongate, simple or lobed, rarely 0. *Stamens* as many or twice as many as the petals, rarely indefinite, inserted at the base of the disc; filaments free, often with a scale at the base; anthers oblong, usually introrse, 2-celled, dehiscing longitudinally. *Ovary* free, 1–6-celled, usually deeply lobed, less often entire; styles 2–5, free, or more or less united, stigmas capitate; ovules usually solitary in each cell, rarely more numerous, raphé ventral, micropyle superior. *Fruit* drupaceous, capsular, or occasionally samaroid, usually of 2–6 distinct carpels. *Seeds* usually solitary, erect or pendulous, albuminous; embryo straight or curved, radicle superior.—DISTRIB. Tropical and subtropical regions of both hemispheres; genera 30; species about 130.

Ovary deeply 4- or 5- lobed; fruit separating into cocci; leaves pinnate.
- Stamens 8 to 10, filaments with dilated ciliate bases ... ... 1. *Harrisonia.*
- Stamens 4.
  - Disc entire: flowers in branching panicles; leaves glabrous ... 2. *Picrasma.*
  - Disc 4-lobed; flowers in small cymes, collected in long narrow panicles; leaves pubescent ... ... 3. *Brucea.*

Stamens 5; disc 5-lobed; flowers in long much-branched panicles; leaves glabrous ... ... 4. *Eurycoma.*

Ovary not lobed; fruit not separating into cocci; leaves simple ... ... 5. *Irvingia.*

1. HARRISONIA, Brown.

Glabrous spiny shrubs. *Leaves* unequally pinnate or 1-foliolate. *Flowers* hermaphrodite, in bracteate cymes. *Calyx* small, 4–5-fid. *Petals* 4–5, longer than calyx. *Disc* hemispherical. *Stamens* 8–10, dilated at the base. *Ovary* globose or 4–5-lobed, 4–5-celled; styles connate or distinct at the base; ovules solitary, pendulous. *Fruit* a small globose berry. *Seed* solitary, sparingly albuminous.—DISTRIB. Tropics of Old World and of Australia. Species 3-4.

1. HARRISONIA BROWNII, A. Juss. in Mem. Mus. Par. XII, 517, 540, t. 28. A shrub; young branches slender, glabrous, lenticellate, often armed with sharp conical prickles usually in pairs. *Leaflets* 3, ovate to rhomboid, acuminate, coarsely serrate; the terminal one the largest, petiolulate, and much narrowed at the base; the two lateral sessile and slightly narrowed; length from ·6 to 1 in. *Flowers* 1 to 3, when expanded ·3 in. long, tetramerous, from small axillary tubercles on slender pedicels from ·5 to ·75 in. long, buds globose. *Petals* lanceolate, reflexed. *Stamens* 8, erect, as long as the petals; filaments with dilated concave hairy bases, anthers ovate. *Ovary* deeply 4-lobed, 4-celled, glabrous. *Fruit* pisiform, depressed, 3–2- or even 1-celled by abortion, each cell one-seeded; pericarp coriaceous, glabrous. Planch. in Hook. Lond. Journ. Bot. V. 569; Benth. Fl. Austral. I, 376.

S. Andaman: Kurz, King's collectors. DISTRIB.—Timor., N. Australia. Philippines.

2. PICRASMA, Blume.

Trees or shrubs with bitter properties. *Leaves* unequally pinnate. *Flowers* small, declinous or polygamous, in axillary panicles. *Calyx* very small, 4–5 toothed. *Petals* 4–5, valvate, very often increasing after flowering. *Disc* thick, entire. *Stamens* 4–5, not scaly, hairy. *Ovary* 3–5-partite, free; style distinct at the base and apex, but united in the middle, stigmas simple; ovules erect, solitary. *Fruit* of 1–3 fleshy or coriaceous drupes. *Seed* erect, albuminous.—DISTRIB. India, Malay Archipelago, China, Japan, West Indies, Brazil. Species about 4.

1. PICRASMA JAVANICA, Blume, Bijdr, 248. A tree 30 to 60 feet high; young branches glabrous, dark-coloured, rather slender. *Leaflets* 3 to 7, membranous, elliptic-oblong, elliptic-lanceolate or elliptic, more or less

acuminate or caudate-acuminate, the edges entire or (especially in old leaves) thickened and minutely undulate, the base narrowed or rounded; both surfaces glabrous; main nerves 4 to 6 pairs, ascending, curved, rather prominent and pale beneath in adult leaves. *Panicles* axillary, on long peduncles, branching. *Flowers* numerous, crowded at the extremities of the branchlets, 4-merous, ·15 to ·25 in. in diam. *Sepals* broadly ovate, spreading, pubescent, minute. *Petals* much larger than the sepals, ovate, concave, nerved, puberulous. *Stamens* 4; the filaments pubescent in the male, villous in the female flower. *Ovary* deeply 4-lobed, puberulous; the disc entire, woolly. *Style* single; stigmas 4, reflexed. *Fruit* of 1 to 3 sub-globular coriaceous drupes seated on the enlarged disc, and surrounded by the enlarged coriaceous curved petals. Benn. Plantae Javan. Rarior. 197. t. 41; Planch. in Hook. Lond. Journ. Bot. V, 573; Hook. fil. Fl. Br. Ind. I, 520; Kurz for Flor. Burma, I. 201. *P. nepalensis*, Benn. in Wall. Cat. sub No. 8506. (Lith. Cat. p. 287); Pl. Jav. Rar. 201; Planch. in Hook. Journ. Bot. V, 573. *P. andamanica*, Kurz Andam. Rep. App. IV; Hook. fil. Fl. Br. Ind. I, 520; *Brucea?* Wall. Cat. 7499. *B. dubia*, Steud. Nomencl. Wall. Cat. *indeterminata*, No. 9037.

Malacca, Perak, Andamans. Distrib.—Malayan Archipelago, sub-Himalayan tracts, Assam, Khasia Hills and Burmah, in British India.

I can find nothing to distinguish *P. nepalensis* Benn. and *P. andamanica*, Kurz from *P. javanica*, Blume. In fact Kurz himself reduced his species *P. andamanica* to *P. javanica;* and in his latest book (The Flora of British Burmah), he does not give the name *P. andamanica*, which was in fact originally published in a hastily prepared official report. And, as for *P. nepalensis*, Benn.—its author declares in his original description of it, that it differs from *P. javanica*, Bl., only by having sometimes as many as seven leaflets, and in their being more acuminate than is usual in specimens from Java.

3. Brucea, Mill.

Bitter trees or shrubs. *Leaves* large, unequally pinnate. *Flowers* in minute, numerous, very small cymes, collected into long narrow axillary panicles. *Calyx* minute, 4-partite, imbricate. *Petals* 4, minute, linear, imbricate. *Disc* 4-lobed. *Stamens* 4, inserted beneath the disc, filaments naked. *Ovary* 4-lobed, or consisting of 4 entirely free carpels. *Drupes* 4, entirely free, ovoid, somewhat fleshy. *Seed* solitary, exalbuminous.—Distrib. Tropics of Old World and of Australia. Species 6.

1. Brucea sumatrana, Roxb. Fl. Ind. I., 449. A shrub 4 to 6 feet high; young branches rather stout, tawny-pubescent. *Leaflets* about

9, membranous, lanceolate, acuminate, very coarsely dentate-serrate; the base oblique, acute, or obtuse; both surfaces, but especially the lower, softly yellowish-pubescent, 1·5 to 3·5 in. long (the whole leaf from 10 to 14 in. long), petiolule ·15 to ·25 in. long. *Panicles* often as long as the leaves, very narrow. *Flowers* minute, purple, in short distant cymules; the sepals smaller than the petals, both pubescent. *Stamens* about as long as the petals, the filaments short. *Drupes* black when ripe, oval, glabrous, ·15 to ·2 in. long. DC. Prod. II, 88; Wall Cat. 8482; Blume Bijdr., 1167; Planch. in Hook. Lond. Journ. Bot. v., 575; Hook. fil. Fl. Br. Ind. I, 523; Kurz For. Flora, Burma, I, 202.

In all the provinces except the Andaman and Nicobar Islands.—Distrib. Malayan Archipelago, British India.

4. Eurycoma, Jack.

Shrubs or small trees, with bitter bark. *Leaves* very large, unequally pinnate, with entire glabrous leaflets. *Flowers* polygamous, in much-branched sub-terminal glandular-hairy panicles. *Calyx* minute, 5-toothed, valvate. *Petals* 5, induplicate-valvate. *Disc* consisting of 5 glands alternating with the stamens. *Stamens* in male and hermaphrodite flowers 5, smaller in the latter; filaments attached to the base of the petals. *Ovary* 5-partite, free; styles 5, connate, stigmas distinct. *Drupes* 3–5, stipitate. *Seed* solitary, pendulous, exalbuminous.—Distrib. Malaya, Philippines. Species 2.

Branches 1 in. thick, rusty-pubescent; petals ·25 in. long, thick, pubescent on both surfaces 1. *E. longifolia.*

Branches ·25 in. thick, glabrous, pale; petals ·35 in. long, thin, glabrous inside ... 2. *E. apiculata.*

1. Eurycoma longifolia, Jack Roxb. Fl. Ind. ed. Carey, II, 307. A shrub or small tree; young branches about 1 in. in diam., densely rusty-tomentose, with large cicatrices. *Leaves* 18 to 24 in. long; the leaflets numerous, coriaceous, oblong-lanceolate, acute, entire; the base oblique, cuneate; both surfaces glabrous, the upper shining; length 3 to 4 in., breadth ·75 to 1 in. *Panicles* usually shorter than the leaves, much-branched, many-flowered, clothed (especially in the younger parts) with rufous glandular hairs. *Calyx* much shorter than the corolla, the segments ovate, spreading. *Petals* thick, erect, ovate-lanceolate, purple, pubescent, slightly glandular in the upper half outside, ·25 in. long. *Stamens* longer than the calyx, alternating with 5 rather large bilobed ciliate glands which are large in the male and small in the hermaphrodite. *Fruit* of 1 to 5, stipitate, narrowly ovoid, apiculate, ridged drupes, ·5 in. long and ·25 in. diam.; the pericarp coriaceous, purple, glabrous. DC. Prodr. ii. 86; Wall. Cat. 8522; Planch. in Hook. Lond. Journ.

Bot. v. 584. *E. merguensis*, Planch. l. c.; *E. tavoyana*, Wall. Cat., 8523; Hook. fil. Fl. Br. Ind. I, 521; Kurz For Flora Burmah. I, 202.

In all the provinces except the Andaman and Nicobar islands. DISTRIB.—Malayan Archipelago, Philippines, Burmah.

2. EURYCOMA APICULATA, A. W. Bennett in Hook. fil. Fl. Br. Ind. I, 522. A shrub or small tree; young branches about ·25 in. thick, nearly glabrous, rather pale. *Leaves* 12 to 15 in. long; the leaflets numerous, sub-coriaceous, oblong-lanceolate, shortly and rather abruptly acuminate; the base acute, very slightly oblique; both surfaces glabrous, dull; length 2·5 to 5·5 in., breadth 1 to 1·7 in. *Panicles* shorter than the leaves; the lateral branches short, slender, few-flowered, clothed, especially towards the extremities, with short, black glandular hairs. *Calyx* much shorter than the corolla, the segments sub-erect, ovate, acute. *Petals* thin, erect, linear, glabrous inside, glandular outside, ·35 in. long. *Stamens* about as long as the sepals, alternating with very minute entire glands. *Fruit* as in *E. longifolia.*

Penang: Perak, not so common as the last.

This species comes very near *E. longifolia*, Jack., the chief distinction being in the flowers. The branches are also very much thinner than those of *E. longifolia*, and they are glabrous; the panicles have shorter and fewer-flowered branches.

5. IRVINGIA, Hook. f.

Glabrous insipid trees. *Leaves* simple, coriaceous, entire, with deciduous stipules. *Flowers* hermaphrodite, in axillary panicles, ebracteate. *Calyx* small, 4–5-partite, imbricate. *Petals* 4–5, imbricate. *Disc* very large, cushion-shaped. *Stamens* 10, inserted beneath the disc, filaments long, slender. *Ovary* conical, compressed, 2-celled, entire; style simple, terminal; ovules solitary. *Fruit* drupaceous, large, with 1 pendulous exalbuminous seed. Four species—3 Tropical African, and 1 Malayan.

1. IRVINGIA MALAYANA, Oliver ex Hook. fil. Fl. Br. Ind. I, 522. Young branches glabrous, striate. *Leaves* coriaceous, glabrous, elliptic, acute, entire, the base rounded; main nerves 14 to 16 pairs, spreading, curved, inconspicuous: length 3·5 to 5·5 in., breadth 1·75 to 2·4 in., petiole ·6 to ·7 in. *Panicles* axillary, little-branched, shorter than the leaves. *Flowers* small, hermaphrodite. *Calyx-lobes* ovate, obtuse. *Petals* twice as long as the calyx and equal to the stamens, reflexed after flowering. *Disc* large, bearing the conical ovary in the middle of it. *Fruit* a glabrous compressed drupe, 2 in. long and nearly 1·5 in. in diam.

Malacca; Maingay (Kew Distrib.) No. 468.

ORDER XXV. OCHNACEÆ.

Glabrous trees or shrubs. *Leaves* alternate, simple, (very rarely pinnate) coriaceous; stipules 2. *Inflorescence* panicled or occasionally umbellate (rarely flowers solitary), bracteate. *Flowers* hermaphrodite, conspicuous. *Sepals* 4–5, free, imbricate, persistent. *Petals* 5, rarely 4 or 10, free, hypogynous, imbricate, longer than the sepals, deciduous. *Disc* enlarged after flowering, occasionally 0. *Stamens* 4, 5, 8, 10, or indefinite, inserted on the disc, filaments persistent; anthers basifixed, sometimes deciduous, dehiscing longitudinally, or often opening by terminal pores. *Ovary* short, 2-celled, or elongate and 1–10-celled; placenta axile or parietal; style simple, subulate, acute, rarely divided at the extremity, stigmas simple, terminal; ovules 1–2 in each cell, or indefinite, ascending or rarely pendulous, raphe ventral, micropyle superior. *Fruit* indehiscent, drupaceous or baccate, compound; each drupe or pyrene 1–4 seeded; or capsular and 1–5-celled with septicidal dehiscence. *Seeds* solitary, few or numerous; albumen fleshy or 0; embryo straight or rarely curved, radicle superior or inferior.—DISTRIB. Tropical regions of both hemispheres, but chiefly American. Species about 160.

TRIBE 1. OCHNEÆ. *Ovary* 2–10-celled; ovules solitary in each cell. *Seeds* exalbuminous.

Stamens ∞; flowers paniculate ... ... 1. *Ochna.*
Stamens 10; flowers paniculate or umbellate 2. *Gomphia.*
Sepals, petals, and stamens 4 ... ... 3. *Tetramerista.*

TRIBE 2. EUTHEMIDEÆ. *Ovary* imperfectly 5-celled; ovules 2 in each cell. *Seeds* albuminous.

Stamens 5; with alternate staminodes ... 4. *Euthemis.*

1. OCHNA, Linn.

Glabrous trees or shrubs. *Leaves* alternate, simple, serrate, rarely entire, 2-stipulate. *Flowers* large, yellow, in bracteate panicles or umbels. *Sepals* 5, coloured, persistent. *Petals* 5–10, deciduous. *Disc* thick, lobed. *Stamens* ∞, shorter than the petals, filaments short or elongated; anthers opening longitudinally, deciduous. *Ovary* deeply 3–10-lobed, lobes 1-celled; styles entirely connate or distinct at the apex; ovules solitary in each cell, axile. *Fruit* 3–10 drupes, seated on the broad disc. *Seed* erect, albuminous.—DISTRIB. Tropical Asia and Africa. Species about 28.

1. OCHNA WALLICHII, Planch. in Hook. Lond. Journ. Bot. V, 650. A small tree, with elliptic or elliptic-oblong, sub-crenate, sub-serrate or entire, acute leaves, with cuneate or sub-rounded bases; the main nerves sub-horizontal, faint; length 3 to 5·5 in.; breadth 1·5 to 2·5 in.;

petiole ·15 to ·2 in. *Stipules* very minute. *Flowers* 1·5 in. in diam., in short lateral panicles, the pedicels 1 in. or more in length. *Sepals* ovate or lanceolate, usually reflexed in fruit. *Petals* larger than the sepals. *Anthers* linear, deciduous, shorter than the filiform persistent filaments. *Styles* longer than the stamens, cuneate to the apex, or the apices free and spreading. *Drupes* ovoid, about ·5 in. long. Hook. fil. Fl. Br. Ind. (excl. syn. *O. stipulacea*, Colebr. MSS.). *O. nitida*, Wall. Cat. 2894 (not of Thunbg.); Planch. in Hook. Journ. Bot. V, 653; Kurz For. Fl. Burm. I, 205. *O. squarrosa*, Kurz Andaman Report IV (not of Linn.). *O. andamanica*, Kurz Andam. Rep. Ed. II, 33; Journ. As. Soc. Bengal, for 1872, pt. 2, 295; For. Flora Burm. I, 205. *O. obtusata*, DC. Wall. Cat. 2805, B.

Andaman Islands.—Distrib. Burmah.

Kurz distinguished his species *O. andamanica* by the styles being free and spreading at their apices, while the fruiting sepals are reflexed. But I do not find that these two characters are at all constantly associated. In other respects, Kurz's characters of *O. Wallichii*, and *O. andamanica* are identical. *O. stipulacea*, Colebr., reduced to this by Mr. A. W. Bennett, in Fl. Br. Ind., appears to me to be distinct.

2. Gomphia, Schreb.

Glabrous trees or shrubs. *Leaves* alternate, shining, 2-stipulate. *Flowers* yellow, in axillary or terminal racemes or umbels. *Sepals* 5, coloured, persistent. *Petals* 5, imbricate. *Disc* thick, lobed. *Stamens* 10, inserted at the base of the disc, filaments very short, anthers opening by terminal pores. *Ovary* deeply 5–6-lobed, lobes 1-celled; styles connate, stigma simple; ovules solitary in each cell, erect. *Drupes* 5 or fewer, seated on a broad disc, 1-seeded. *Seed* erect, exalbuminous.—Distrib. Chiefly tropical South American: a few in Asia and Africa. Species about 80.

Flowers in diffuse panicles ... ... 1. *G. sumatrana.*
Flowers in corymbs ... ... 2. *G. Hookeri.*

1. Gomphia sumatrana, Jack in Mal. Misc. No. 5, p. 29; Hook. Bot. Misc. II., 77. A tree 22 to 40 feet high; young branches slender, pale. *Leaves* coriaceous, narrowly elliptic-oblong, tapering to each end, the edges serrulate or sub-entire; main nerves numerous, sub-horizontal, very faint, as are the reticulations; intramarginal nerves from base to apex, two or three, rather distinct when dry; length 3·5 to 7 in., breadth 1·15 to 2·25 in., petiole ·15 in. *Panicles* terminal, longer than the leaves, branching. *Flowers* numerous, ·35 in. in diam. *Sepals* narrowly ovate, veined. *Petals* larger than the sepals, broad, retuse and inflexed at the apex. *Anthers* linear, much longer than

the short filaments. *Ovaries* 5; styles longer than the stamens, quite connate. *Ripe carpels* obovate or reniform, shining. Hook. fil. Fl. Br. Ind. I, 525; Kurz For. Flora Burm. I, 206; Miq. Fl. Ind. Bat. I, pt. 2, 675; Wall. Cat. 2803. *G. sumatrensis*, Planch. in Hook. Ic. Pl. t. 712, and Hook. Lond. Journ. Bot. VI. 2. *Ochna crocea*, Griff. Not. IV. 463. *E ? pulcherrima*, Wall, Cat. 2518.

In all the provinces except the Nicobar and Andaman Islands: common.—Distrib. Borneo, Sumatra.

This is very near indeed to G. *angustifolia*, Vahl.; the only differences that I can find between the two being that in this the petals are larger, with more reflexed edges, and the panicles are larger and more diffuse.

2. Gomphia Hookeri, Planch. in Hook. Lond. Journ. Bot. VI, 3. A tree; young branches dark-coloured. *Leaves* coriaceous, ovate-oblong to oblong-lanceolate, the base narrowed; main nerves faint, much curved upwards, no continuous intramarginal nerve; upper surface shining, the lower dull; length 2·5 to 6 in., breadth 1 to 2 in., petiole 1·5 to ·35 in. *Flowers* ·35 in. in diam., in lateral or terminal, crowded, minutely bracteolate umbels; the pedicels slender, ·5 to ·7 in. long. *Sepals* lanceolate. *Petals* very deciduous, about as long as the sepals, oblong, obtuse, not narrowed at the base. *Anthers* deciduous, elongate, about as long as the slender persistent filaments. *Ovaries* 5; styles much longer than the stamens, quite connate. *Ripe carpels* sub-globular or obovoid, smooth, ·2 in. diam. Hook. fil. Fl. Br. Ind. I, 525.

In all the provinces except the Nicobar and Andaman Islands.

In the flowers of different individuals, the disc varies in thickness, being in some as thick as the ovaries are long, while in others it is comparatively shallow.

Var. *corymbosa;* flowers in corymbs, which are sometimes compound; the lengthened rachis of the inflorescence rough from the transverse cicatrices of the fallen bracts; shrubby.

3. Tetramerista, Miq.

Shrubs or trees. *Leaves* very large, coriaceous, entire. *Flowers* in axillary racemes with large foliaceous bracts. *Sepals* 4, imbricate, persistent. *Petals* 4, persistent. *Stamens* 4, the filaments with dilated bases, the anthers with sutural dehiscence. *Ovary* 4-angled, 4-celled, the style entire. *Fruit* baccate, globose; the pericarp leathery.—Distrib. Malaya. Species 1 or 2.

1. Tetramerista glabra, Miq., Fl. Ind. Bat. Suppl., 534. A glabrous tree 30 to 50 feet high; young branches stout, with shining, rather pale bark. *Leaves* narrowly obovate or oblanceolate, sub-sessile,

the apex obtuse; the base much narrowed, minutely sagittate; upper surface shining, the lower dull, chocolate-coloured when dry; main nerves numerous, sub-horizontal; length 5 to 10 in., breadth 1·25 to 2·75 in., petiole under ·1 in. *Flowers* 1 in. in diam., in long-pedunculate axillary umbellate racemes; pedicels about ·5 in. long, each with a sepal-like bract near the flower. *Sepals* coriaceous, oblong, obtuse. *Petals* linear-lanceolate, about as long as the sepals and reflexed like them. *Stamens* elongate, shorter than the reflexed filaments. *Ovary* ovoid, obscurely 4-angled. *Style* single, stigma minute. *Ripe fruit* ovoid-globose, 1·25 to 1·5 in. long, sub-glabrous, the calyx and corolla persistent; the pericarp thick, fleshy. Bennett in Hook. fil. Fl. Br. Ind. I, 526. *Ancistrocladus ? sagittatus*, Wall. Cat. 1055.

Singapore; Wallich. Perak: Wray, Scortechini, King's collector. DISTRIB. Sumatra.

4. EUTHEMIS, Jack.

Glabrous shrubs. *Leaves* alternate, simple, shining, coriaceous, serrulate, with ciliate deciduous stipules. *Flowers* rose or white, in terminal or leaf-opposed racemes or panicles, bracteate. *Sepals* 5, imbricate, persistent or deciduous. *Petals* 5, longer than sepals, imbricate. *Disc* small, conical. *Stamens* 5, inserted at the base of the disc, with alternate staminodes, anthers opening by terminal pores. *Ovary* semi-5-celled, elongate, viscid; style 1, stigma entire; ovules 1–2 in each cell, pendulous. *Fruit* a berry of 5 pyrenes, each 1–2-seeded. *Seeds* pendulous with a fleshy albumen.—DISTRIB. Species 4; all Malayan.

Leaves spinulose-serrate; fruit white ... 1. *E. leucocarpa.*
Leaves nearly entire; fruit red ... ... 2. *E. minor.*

1. EUTHEMIS LEUCOCARPA, Jack in Mal. Misc. No. V., p. 16. A shrub 2 to 5 feet high: young branches rather stout, pale, glabrous, lenticellate. *Leaves* oblong-lanceolate, tapering to each end, the edge thickened inside the numerous spinulose serrations; main nerves very numerous, curved at first, then sub-horizontal, indistinct; length 3·5 to 8 in., breadth 1·2 to 2 in.; petiole ·5 to 1·5 in., winged. *Flowers* ·6 or ·7 in. in diam, shortly pedicelled, generally in pairs; bracts ovate, acute. *Sepals* ovate, obtuse, ciliate, the two inner rather smaller. *Petals* longer than the sepals, oblong-ovate, obtuse, reflexed. *Anthers* erect, connivent, subsessile, oblong, acuminate at the apex, style filiform; stigma small, simple. *Berry* snow-white, sub-globular, ·2 to ·35 in. in diam., obscurely angled, mesocarp spongy. Roxb. Fl. Ind. (ed. Carey), II, 303; Planchon in Hook. Ic. Plant. t. 711. Bennett in Hook. fil. Fl. Br. Ind. I, 526; Miq. Fl. Ind. Bat. Pt. 2 p. 675.

In all the provinces except the Andaman and Nicobar islands. DISTRIB. Malayan Archipelago.

2. EUTHEMIS MINOR, Jack in Mal. Misc. No. V, p. 18. A small shrub, similar to the last, but with nearly entire, sub-acute, obscurely-veined leaves, and red fruits. Roxb. Fl. Ind. (ed. Carey), ii, 304; Bennett in Hook. fil. Fl. Br. Ind. I, 526; Miq. Fl. Ind. Bat. I, Pt. 2, p. 675.

Penang and Singapore.—DISTRIB. Malayan Archipelago.

I give Penang and Singapore as localities for this species, on the authority of Hooker's Flora of British India. It is, however, now probably extinct in both; and I have seen no specimens from any locality nearer to them than the island of Bangka. In Jack's time, this plant appears to have been common enough in Singapore. The plant named *Euthemis elegantissima*, by Wallich, although doubtfully placed in this genus by its author, has leaves very like those of *E. leucocarpa;* but the main nerves curve in a very different manner. Wallich never found it in fruit; but in his day plants of it were common in Singapore and the neighbouring small islands. This too appears now to be extinct. The reduction of *E. elegantissima* to *Gomphia sumatrana*, Planch, which was first suggested by Planchon, is in my opinion quite wrong, the leaves of the two being very different.

ORDER XXVI. BURSERACEÆ.

Trees or shrubs, mostly resiniferous. *Leaves* alternate (very rarely opposite), imparipinnate or trifoliolate, stipulate or ex-stipulate. *Inflorescence* racemose or paniculate. *Flowers* regular, small, hermaphrodite or often polygamous. *Calyx* free, 3–6-lobed, imbricate or valvate, often minute. *Petals* 3–6, distinct, rarely connate, imbricate or valvate. *Disc* annular or cupular, or absent, usually conspicuous, free, or adnate to the calyx. *Stamens* as many or twice as many as petals, inserted at the base or margin of the disc, equal or unequal; filaments free or connate at the base, smooth; anthers dorsifixed, rarely innate, 2-locular, dehiscing longitudinally. *Ovary* free, rarely 1-, more often 2–5-celled; style simple, stigma undivided or 2–5-lobed; ovules 2, or rarely 1 in each cell, anatropous, usually pendulous, rarely ascending, micropyle superior, raphe ventral. *Fruit* drupaceous, indehiscent with hard putamen, or separating into 2–5 pyrenes, rarely pseudo-capsular and dehiscent. *Seeds* solitary, usually pendulous, testa membranous, albumen 0; cotyledons usually membranous, contortuplicate, rarely fleshy and plano-convex, radicle superior.—DISTRIB. Tropical regions of both hemispheres; genera 15 to 19. Species about 250.

Calyx, corolla, and stamens 5-merous.

Fruit hard, woody, 3-winged, separating into 3 indehiscent pyrenes ... 1. *Triomma.*

Flowers 3-merous.

Flowers polygamous, dimorphorus. Fruit ellipsoid, more or less trigonous, with terminal style; endocarp bony, 1-3-celled, usually 1-seeded ... ... 2. *Canarium.*

Fruit obliquely globose, 1-celled, 1-seeded. Calyx keeled, the segments large, connivent ... ... 3. *Trigonochlamys.*

Flowers hermaphrodite, homomorphous. Fruit ellipsoid or sub-globose, with the stigmatic scar lateral or basal, more or less compressed on two sides, rounded on the third; endocarp rarely bony or woody, 1-celled, 1-seeded ... ... 4 *Santiria.*

1. TRIOMMA, Hook. fil.

A tree. *Leaves* alternate, exstipulate, imparipinnate; the leaflets few, opposite, petiolulate. *Flowers* very small, in terminal panicles, polygamous. *Calyx* 5-fid. *Petals* 5, small, valvate? *Stamens* 10 (?) inserted at the base of the 5-lobed disc. *Ovary* trigonous, 3-celled, style short, ovules 2 in each cell. *Fruit* 3-winged, 3-valved, as much as 2–2½ inches long, containing 3 hard woody separable pyrenes.—DISTRIB. A solitary species.

1. TRIOMMA MALACCENSIS, Hook. f. in Trans. Linn. Soc. XXIII. 171; leaflets oblique, ovate-lanceolate, acuminate, entire; drupe ovate-caudate, acutely cuspidate, 2·5 in. long by 2 in. broad: Bennett in Hook. fil. Fl. Br. Ind. I, 528. *Arytera? macrocarpa*, Miq. Fl. Ind. Bat. Suppl. 199.

Malacca: Griffith, Maingay.

There is an authentic specimen in the Calcutta Herbarium of Miquel's *Arytera? macrocarpa*, collected by Teysmann in the Lampongs, Eastern Sumatra. There is no doubt whatever of its identity with this.

2. CANARIUM, Linn.

Reziniferous trees. *Leaves* alternate, imparipinnate, stipulate or exstipulate. *Flowers* bracteate, in terminal or axillary panicles or racemes, dimorphous, polygamous; those with fertile stamens and rudimentary ovaries being smaller, but in larger inflorescences; those with fertile ovary having rudimentary stamens, being larger, but in smaller inflorescences. *Calyx* campanulate, 3-lobed or 3-fid, valvate. *Petals* 3, imbricate below or valvate, usually exceeding the calyx. *Stamens* 6, distinct, inserted on margin or outside of disc, or filaments confluent below and disc absent. *Ovary* 3-celled; ovules 2 in each cell; style various, or stigma subsessile, capitate. *Drupe* usually ellipsoidal, more or less distinctly trigonous, with a 1–3-celled, 1–3-seeded stone; cotyledons often partite, contortuplicate. DISTRIB. Tropical Asia, chiefly in Malaya. Species probably about 90.

The genera *Santiria* and *Canarium* are not separated from each other by any bold, well-marked distinction. As regards the Indian species of both genera, I find the following characters the most diagnostic:—

CANARIUM.	SANTIRIA.
Calyx cupular or campanulate.	*Calyx* cupular, never campanulate, sometimes quite flat.
Petals longer than broad, slightly narrowed to the base.	*Petals* rotund, with very broad truncate bases.
Disc small, annular, or thin and cupular, or represented only by the tube formed by the united filaments.	*Disc* large, cupular, fleshy, often corrugated.
Filaments dilated at the base and sometimes united into a tube.	*Filaments* dilated at the base, but never united into a tube.
The flowers with fertile anthers (practically the male flowers) smaller than those with fertile ovaries, but in larger inflorescences.	*Flowers* all hermaphrodite and uniform, as are the inflorescences.

In the majority of the species of *Canarium* in which the filaments are united into a tube, I can find no other disc than that tube.

The genus *Trigonochlamys* is also closely allied to *Canarium* and *Santiria*, being distinguished from both by its much larger calyx, depressed-globose ovary, and spherical drupe. In fact the characters of the three genera so overlap each other, that, in my opinion, they must either be kept distinct by characters more or less minute, as Messrs. Bentham and Hooker have done, or united into a single genus. Dr. Engler steers a middle course; he keeps up *Canarium* and *Santiria*, but unites *Trigonochlamys* with the latter, dividing *Santiria* into three sections: (1) *Icicopsis*, with one species (*S. Planchoni*); (2) *Trigonochlamys*, with four species; and (3) *Eu-santiria* with 22 species. The section *Icicopsis* contains one 3-androus plant, which, as it has the dimorphous flowers and inflorescence of *Canarium*, I have transferred to that genus: I admit that the drupes of the plant in question more resemble those of *Santiria* than of *Canarium*: but, in the majority of its characters, it appears to me to agree better with the latter genus. As regards Dr. Engler's section *Trigonochlamys*, it is difficult to see how *Canarium* and *Santiria* are to be kept distinct as genera, if the four plants which form this section are to be included under *Santiria*; for the flowers of *Trigonochlamys* are really more like those of *Canarium* than of *Santiria*. The separation of *Canarium* from *Santiria* by characters taken from the drupe, in my opinion, fails. The drupe of *Canarium* is defined as 1 inch or more in length, ovoid or oblong-ovoid, never gibbous, boldly trigonous, its sides equal and its endocarp hard thick and strong, 3-to 1-celled, and the scar of the style apical; while that of *Santiria* is usually less than 1 in. long, shortly and obliquely ovoid or sub-globose, often gibbous, the endocarp being thin, coriaceous, sub-ligneous, never bony, 1-celled, and the scar of the style lateral and often approximated to the base. Unfortunately several species from Perak (which in other respects have the *facies* of *Santiria*) have the style-scar quite terminal; while, on the other hand, some species with many of the characters of *Canarium* have drupes of which the endocarp is not more bony than that of several species of *Santiria*. The characters drawn from the flower, which I have given above, do not appear to me to have hitherto had sufficient value attached to them.

By transferring *Santiria Planchoni*, Benn. to *Canarium;* by keeping up *Trigonochlamys* as a genus characterised by its very large calyx, and globose drupe; and by restricting *Santiria* to the plants which form the section *Eu-santiria* of Engler, I venture to think that the study of all the plants concerned will be simplified.

Stamens 3.
- Leaves sub-coriaceous with bluntly acuminate apices and 10 to 14 pairs of main nerves, flowers ·1 in. long, drupes ·4 to ·5 in. long ... ... 1. *C. Planchoni.*
- Leaves coriaceous, with caudate-acuminate apices and 7 to 9 pairs of main nerves; flowers ·2 in. long; drupes 2 to 2·25 in. long ... ... 2. *C. caudatum.*

Stamens 6.
- Filaments united into a tube.
  - Leaflets glabrous on both surfaces.
    - Leaflets 5 to 9 with 7 or 8 pairs of nerves; panicles terminal ... 3. *C. parvifolium.*
    - Leaflets 11 to 17, with 12 to 19 pairs of nerves; panicles axillary ... 4. *C. euphyllum.*
  - Leaflets more or less hairy.
    - Leaflets 7 to 9, sparsely pubescent on the lower surface when young, main nerves 10 or 12 pairs; panicles axillary ... ... 5. *C. grandiflorum.*

Leaflets sparsely hispid on both surfaces when young; glabrous, except the hispidulous nerves, when adult; panicles hispidulous ... ... 6. *C. pilosum.*

Leaflets sparsely hispidulous on the upper surface, their under surface and the inflorescence rufous-pubescent or tomentose ... ... 7. *C. hirtellum.*

Leaflets with the midrib tomentose on the upper surface, the whole of the under surface and the panicles rufous-tomentose ... ... 8. *C. rufum.*

Leaflets glabrous on the upper surface, the lower glaucescent, with a few scattered hairs; panicles rusty-tomentose ... ... 9. *C. purpurascens.*

Filaments free.

Leaflets quite glabrous on both surfaces; petals puberulous outside.

Stipules persistent.

Stipules elliptic-oblong, entire ... 10. *C. commune.*

Stipules pectinately lobed ... 11. *C. coccineo-bracteatum.*

Stipules (if any) deciduous ... 12. *C. Manii.*

Leaflets glabrous or nearly so on both surfaces, petals rusty-pilose or pilose outside ... ... 13. *C. Kadondon.*

Leaflets with the midrib and nerves puberulous on the lower surface.

Leaflets not glaucous beneath, entire; drupe less than 1 in. long ... 14. *C. rubiginosum.*

Leaflets glaucous beneath, at least when young.

Leaflets crenulate or sub-crenulate; drupes 1 in. long ... 15. *C. Kunstleri.*

Leaflets obscurely and minutely crenate or serrate, drupes about 2 in. long ... 16. *C. glaucum.*

Leaflets rusty-tomentose or pubescent on the lower surface, the midrib tomentose on the upper ... ... 17. *C. secundum.*

Of doubtful position.
Male flowers unknown, but probably near *C. parvifolium* ... ... 18. *C. nitidum.*

1. Canarium Planchoni, King, A tree, 50 or 60 feet high; young branches glabrous, cinereous. *Leaves* 5 to 10 in. long, stipules deciduous. *Leaflets* 7 to 13, thinly coriaceous, oblong-lanceolate or elliptic-oblong, shortly and bluntly acuminate; the base rounded, slightly oblique; both surfaces glabrous, the upper pale when dry and the nervation obsolete, the lower brown with the 10 to 14 pairs of sub-horizontal nerves slightly prominent; length 2 to 4 in., breadth ·9 to 1·5 in.; petiolules ·15 to ·3 in., the terminal one longer. *Panicles* numerous, slender, axillary, much shorter than the leaves, pale puberulous; the branches distant, ascending, the small flowers crowded near their apices. *Flowers* ·1 in. long, with several very minute deciduous bracteoles just beneath the calyx. *Calyx* campanulate, deeply cleft into 3 ovate, triangular lobes, tomentose outside, glabrous inside. *Petals* slightly larger than the sepals, deltoid, with a short subulate inflected apex, sub-concave, less tomentose outside than the sepals, glabrous inside. *Stamens* 3, connivent; the anthers innate, broadly ovate; filaments shorter than the anthers, flat, dilated at the base and inserted on the edge of the large cupular fleshy disc. *Ovary* in the male flowers imperfect: in the female flowers small, ovate, 3-grooved, glabrous; style terminal, short, 3-grooved, as is the stigma. *Fruit* ovoid, slightly gibbous, globular, glabrous; the persistent style slightly lateral, ·4 to 5 in. long. *Santiria Planchoni*, A. W. Benn. in Hook. Fl. Br. Ind. I, 536; Engler in De. Candolle Monegr. Phanerog. IV, 154.

Malacca: Maingay (Kew Distrib.), Nos. 315, 1972; Griffith, Nos. 1152, 1153. Perak: King's collector, No. 5573; Scortechini, No. 2097.

2. Canarium caudatum, King n. sp. A tree 20 to 40 feet high; young shoots pale brown, lenticellate, all parts except the calyx quite glabrous. *Leaves* 8 to 13 in. long, stipules (if any) deciduous. *Leaflets* 5 to 7, coriaceous, oblong to ovate, tapering to both ends, the apex caudate-acuminate, the edges entire and sometimes slightly undulate; both surfaces glabrous, shining, the reticulations distinct on the upper surface, and the 7 to 9 pairs of ascending curving interarching main nerves pale on the lower; length 3 to 6 in., breadth 1·5 in. to 2·25 in., petiolules ·4 to ·5 in., the terminal one 1·2 to 1·6 in. *Male panicles* terminal, narrowly pyramidal, few-branched, shorter than the leaves, the bracteoles (if any) deciduous. *Flowers* few, at the extremities of the branches, ·2 in., long. *Calyx* widely campanulate, the mouth with 3 broad, shallow teeth, minutely pubescent outside, glabrous inside. *Petals* longer than the calyx, imbricate, ovate, acute, the base truncate,

thickened in the middle; the edges thin, both surfaces glabrous. *Stamens* 3; the anthers oblong, shorter than the flattened filaments, the dilated bases of which are attached outside the glabrous fleshy disc from which emerges the oblong tapering rudimentary ovary: style filiform, stigma minute. *Female flowers* not seen. *Ripe drupes* narrowly ellipsoid, slightly clavate, sub-trigonous, 2 to 2·25 in. long and ·6 in. in diam.; persistent calyx small, flat, 3-angled.

Perak: King's collector, Nos. 8554, 10016, 10182, and 10227. Scortechini, No. 454.

This and the next are distinctly separated from all the other hitherto described Malayan species by their triandrous flowers. The leaves and drupes of this are also very characteristic.

3. Canarium parvifolium, A. W. Benn. in Hook. fil. Fl. Br. Ind. I. 536. A tree; young branches slender, dark brown, all parts ultimately glabrous except the flower. *Leaves* 6 to 12 in. long; leaflets 5 to 9, coriaceous, oblong-lanceolate to elliptic, acuminate, entire, the base rounded or slightly narrowed, both surfaces shining; nerves 7 or 8 pairs, spreading, invisible above (even when dry) and very faint below, length 2 to 3·5 in., breadth ·8 to 1·6; petiolules ·1 to ·2 in., the terminal one ·35 to ·65 in.; stipules (if any) deciduous. *Panicles* terminal, slender, the branches few, short, few-flowered, bracteolate. *Flowers* ·2 in. long, slightly longer than the pedicels. *Calyx* campanulate; the mouth truncate, quite entire or faintly 3-toothed. *Petals* much longer than the calyx, imbricate, elliptic, obtuse, concave, puberulous on both surfaces. *Stamens* 6, as long as the petals: anthers oblong, much shorter than the filaments which are subulate, much dilated in the lower third and very slightly united at the base. *Rudimentary ovary* ovoid, tapering into the thin cylindric style, glabrous. *Female flowers* unknown. *Ripe drupe* ellipsoid, trigonous, glabrous, 1·5 to 1·75 in. long, and ·8 in. in diam. Engler in DeCand. Monogr. Phanerog. Vol. IV, 140.

Malacca: Griffith, No. 1068; Maingay, No. 353 (Kew Distribution). Perak: King's collector, Nos. 2618 and 7870.

The bases of the filaments in Griffith's No. 1068 are less dilated than in those of Maingay's No. 353, or in those of King's collector's specimens; but in other respects the characters agree. This species in externals much resembles *C. nitidum*, Benn.

4. Canarium euphyllum, Kurz in Journ. As. Soc. Bengal, 1872, Pt. 2. p. 295. A tree 80 to 90 feet high; young shoots very stout, puberulous. *Leaves* 2 to 3 feet long, the stipules (if any) very deciduous. *Leaflets* 11 to 17, membranous, ovate, ovate-oblong or oblong, opposite, very shortly and abruptly acuminate, the edges glandular-serrulate; the base unequal, rounded or sub-cordate; both surfaces

glabrous, minutely reticulate, the upper shining; main nerves 12 to 19 pairs, spreading, rather straight, interarching very near the edge; length 4 to 10 in., the lower leaflets much the smallest; breadth 2 to 3·5 in., petiolules ·35 to ·6 in. *Panicles* shorter than the leaves, axillary, puberulous or glabrous, their branches only 1 or 2 inches long, few-flowered, sub-corymbose. *Flowers* ·4 in. long. *Calyx* shorter than the petals, tubular, cut for half its length into 3 broad blunt teeth, puberulous on both surfaces. *Petals* oblong, concave and thickened at the apex, minutely tomentose outside. *Stamens* 6, the anthers linear-oblong, shorter than the glabrous filaments which for two-thirds of their length are united into a tube; rudimentary ovary truncate, glabrous, with a few hairs on the top. *Female flowers* not seen. *Ripe drupes* ovoid-ellipsoid, not trigonous, glabrous, 1·75 in. long and ·8 in. in diam., peduncles stout; the persistent calyx 3-angled, woody. Kurz For. Flora Burmah. I, 208. A. W. Benn. in Hook. fil. Fl. Br. Ind. I, 535. Engler in DeCand. Monogr. Phanerog. IV., 123.

South Andaman: Kurz, King's collector. Burmah: in North Arakan, Hildebrand.

The leaflets on the same leaf vary much in size and shape; those towards the base being short and broad, while those towards the apex are oblong. This species is closely allied to *C. bengalense*, Roxb., but its calyx is more deeply toothed; its anthers are shorter and broader; and its leaves although very similar in texture, are longer, have thicker rachises, while the leaflets are serrate and not entire. The young branches of this are moreover nearly twice as thick as those of *C. bengalense.*

5. Canarium grandiflorum, A. W. Benn. in Hook. fil. Fl. Br. Ind. I, 533. A tree; young branches stout, pubescent, ultimately glabrous and dark-coloured. *Leaves* 9 to 12 in. long, the rachis glabrous. *Leaflets* thinly coriaceous, 7 to 9, opposite, ovate-lanceolate or elliptic-oblong, acuminate, entire, the base rounded, upper surface glabrous; the lower glabrous or sparsely pubescent, with the 10 to 12 pairs of spreading main nerves prominent; length 3 to 4·5 in., breadth 1·35 to 1·75 in.; petiolules ·2 in. long, the terminal one longer. *Male panicles* little more than half as long as the leaves, puberulous or nearly glabrous, with a few long spreading branches; the flowers few, in distant clusters, shortly pedicelled. *Calyx* shortly campanulate, with 3 broad, blunt teeth, pubescent outside, glabrous inside. *Petals* longer than the calyx, oblong, thick, concave, blunt, pubescent outside, glaberulous inside. *Anthers* linear, longer than the filaments, the latter glabrous, dilated, and forming a short tube, rudimentary ovary hairy. *Female flowers* larger than the male, in axillary racemes, or short panicles with racemose branches; the anthers short, ovate; the filaments as in the male. Ovary broadly ovoid, tapering

into the style and like it rufous-pilose; stigma capitate. *Drupe* narrowly ellipsoid, sub-trigonous, glabrous; stone thick, bony, 1·35 in. long. Engler in DeCand. Monogr. Phanerog. IV., 122.

Malacca: Maingay, (Kew Distrib.), No. 312. Singapore: Hullett No. 516.

This is an imperfectly known species. The only male flowers I have seen of it are those in Mr. Hullett's specimen from Singapore. I have seen no ripe drupes. *Canarium dichotomum*, Miq. (*Pimela dichotoma*, Blume Mus. Lugd. Bat. I, 22) closely resembles this as to leaves. But, as neither Blume nor Miquel describes its flowers, it is impossible to decide whether the likeness goes beyond externals. The specific name of this is unfortunate. The flowers described by the author of it are females, and they are not larger than the female flowers of many other species, while they are much smaller than those, for example, of *C. rufum*, Benn.

6. Canarium pilosum, A. W. Benn. in Hook. fil. Fl. Br. Ind. I, 533. A tree 30 to 60 feet high; young branches rufous-pubescent, with strigose hairs intermixed. *Leaves* 12 to 18 in. long. *Leaflets* 3 to 7, thinly coriaceous, opposite, oblong-lanceolate to elliptic, sometimes slightly obovate, shortly and abruptly acuminate, entire or obscurely crenulate; the base cuneate, slightly unequal-sided; both surfaces when young sparsely hispid, when adult almost glabrous except the midrib and 12 or 13 pairs of slightly prominent spreading nerves which are sparsely hispidulous; reticulations distinct beneath; length 4·5 to 5·5 in., breadth 1·5 to 2·5 in.; petiolules ·15 to ·25 in., the terminal one more than 1 in.; stipules in pairs, subulate, hairy. *Male racemes* axillary, about 6 in. long, hispidulous, interrupted. *Flowers* about ·5 in. long, pedicellate, few. *Calyx* much shorter than the corolla, tubular, its mouth nearly entire, minutely tomentose on both surfaces. *Petals* narrowly oblong, thickened and wider upwards, puberulous on both surfaces. *Anthers* linear, about half as long as the filaments which are linear, flattened and united into a tube for about one-third of their length; rudimentary ovary very short, rufous-pilose. *Female flowers* unknown; the fruiting racemes only about 4 in. long, nearly glabrous. *Drupes* narrowly ellipsoid, sub-trigonous, glabrous, 1 in. long, and ·5 in. in diam. (unripe). Engler in DeCandolle, Monogr. Phanerog. IV. 121. Wall. Cat. No. 8100.

Malacca: Maingay (Kew Distrib.) No. 302. Singapore: Wallich. Perak: Scortechini No. 424.

This species is very closely allied to *C. hirtellum*, the chief differences being (1) that the calyx of the male flowers of this is almost entire, while in those of *C. hirtellum*, the calyx is deeply 3-toothed; and (2) that the leaves of this are when young hispidulous, and when adult nearly glabrous; while those of *C. hirtellum* are more or less densely pubescent beneath at all stages.

7. Canarium hirtellum A. W. Benn. in Hook. fil. Fl. Br. Ind. I. 534. A tree 40 to 60 feet high: the young branches, rachises and under surfaces of the leaves and the inflorescence more or densely rufous-pubescent or tomentose. *Leaves* 9 to 15 in. long: *leaflets* 5 to 7, the the pairs opposite, coriaceous, elliptic, shortly and rather abruptly acuminate, entire or minutely serrulate, the base rounded or sub-cuneate; upper surface shining, reticulate, sparsely hispidulous, the midrib tomentose; main nerves 11 to 13 pairs, spreading, curving, prominent on the lower, depressed on the upper surface; length 4 to 7 in., breadth 1·5 to 3 in.; petiolules ·1 to ·2 in., that of the terminal one ·5 to ·75 in. *Male flowers* in axillary or terminal racemes or panicles much shorter than the leaves. *Flowers* ·4 in. long, on short stout pedicels, mostly crowded near the ends of the branchlets. *Calyx* campanulate, with 3 broad blunt teeth, tomentose on both surfaces but especially on the outer. *Petals* longer than the calyx, oblong, concave, thickened upwards, sericeous outside, glaberulous within. *Anthers* linear, about one-third as long as the glabrous flattened filaments which are united into a tube for half their length; rudimentary ovary very small, rufous-sericeous. *Female flowers* not much larger than the males, the stamens shorter than the pistil, the free part of the filaments very short, the anthers with pubescent edges. *Ovary* broadly ovoid, densely rufous-sericeous; the style about as long, sparsely pubescent. *Stigma* capitate, 3-lobed. *Ripe drupe* narrowly ellipsoid, trigonous, glabrous, 1 to 1·25 in. long, and ·4 to ·5 in. in diam. Engler in De Candolle Monog. Phanerog. IV, 121; Hooker Icones Plantar. No. 1575. Wall Cat. 8102 and 9047.

Penang; Wallich, Curtis, Nos. 656, 2251. Selangor: Ridley, No. 1869. Perak: King's collector, Wray; common.

8. Canarium rufum, A. W. Benn. in Hook. fil. Fl. Br. Ind. Vol. 1, 533. A tree 60 to 100 feet high: young branches, inflorescence, petiolules and under surfaces of the leaves rusty-tomentose. *Leaves* 12 to 15 in. long, the rachises glabrous when adult. *Leaflets* 7 to 11, very coriaceous, opposite, elliptic or broadly oblong, shortly and abruptly acuminate, the edges serrate-dentate to the broad rounded sometimes slightly oblique base; upper surface glabrous except the tomentose midrib, shining, the lower boldly and minutely reticulate: main nerves 12 to 15 pairs, spreading, very prominent beneath; length 3 to 6 in., breadth 2 to 2·75 in., the lowest leaflets the smallest; petiolules ·3 to ·4 in., that of the terminal leaflet 1·25 to 1·5 in.; stipules not seen. Male

branches terminal, shorter than the leaves, very stout, the lateral branches very short, the flowers in dense bracteate clusters at their apices: bracts numerous, broadly ovate, blunt, concave, tomentose outside. *Calyx* very coriaceous, narrowly campanulate with 3 short blunt teeth, sericeous-tomentose on both surfaces. *Petals* longer than the calyx, oblong, concave, tomentose outside except the glabrous edges, glabrous inside. *Stamens* 6: the anthers linear, slightly longer than the filaments which are much dilated in the lower half and slightly united at the base into a short tube inserted outside the fleshy disc; rudimentary ovary short, broad, glabrous. *Female panicles* shorter than the male, but the flowers at least twice as large (·5 in. long); the petals narrower, the anthers much shorter than in the males and the filaments completely united for one-third of their length into a tube; ovary depressed-globular, tomentose, narrowing into the thick tomentose style: stigma discoid. *Ripe drupe* narrowly ellipsoid, sharply 3-angled, glabrous, the apex rather blunt, 2·5 to nearly 3 in. long, and 1 to 1·3 in. in diam. Engler in De Cand. Monog. Phanerog. IV, 107.

Malacca: Griffith, No. 1143, Maingay, No. 301. Perak: King's collector, Wray, Scortechini; common.

A very distinct species recognizable at once by its very coriaceous many-nerved rusty leaflets, large flowers, and boldly trigonous fruits.

9. Canarium purpurascens, A. W. Benn. in Hook. fil. Fl. Br. Ind. I, 532. A tree 50 to 70 feet high: young branches densely rusty-puberulous. *Leaves* 8 to 14 in. long; stipules rotund-cordate, rusty-pubescent. *Leaflets* 7 to 9, coriaceous, oblong to elliptic-oblong, rarely obovate-oblong, entire, or slightly serrate towards the abruptly acuminate apex, the base slightly narrowed, upper surface glabrous shining; the lower glabrous and glaucescent, often with a few scattered hairs: main nerves 10 to 14 pairs, spreading; length 2·5 to 5·5 in., breadth 1 to 2 in.; petiolule ·2 to ·25 in., that of the terminal one 1 in. or more. *Male inflorescence*; a racemose panicle often branched, rusty tomentose, 9 to 18 in. long; the ultimate branches few flowered branched cymules. *Bracts* ovate, tomentose, larger than the flower-buds, deciduous; flowers ·25 in. long. *Calyx* tubular, tomentose, with 3 broad shallow teeth. *Petals* broadly oblong, acute, concave, tomentose outside, glabrous inside. *Stamens* 6; the filaments much shorter than the narrowly oblong puberulous anthers, dilated at the base and slightly united so as to form a short tube. Disc none. *Rudimentary ovary* turbinate, glabrous, dark-coloured. *Female flowers* ·5 in. long, in stout few-flowered racemes or panicles only 2 to 4 or 5 in. long; ovary globular-ovoid, pubescent, narrowed into a short thick style: stigma large, capitate, 3-lobed. *Drupe* elliptic-ovoid, rather blunt at each end,

sub-trigonus, glabrous, 2 in. long and 1·15 in. in diam. Engler in De. Cand. Monog. Phan. IV, 115. Canarium, Wall. Cat. 9046.

Malacca: Griffith (Kew Distrib.) No. 1142, Derry. Singapore: Wallich, Ridley. Penang: Curtis, Nos. 803, 862, 959, 2708. Perak: Scortechini, No. 175, King's collector, Nos. 6181, 7885.

10. CANARIUM COMMUNE, Linn. A very tall tree: young branches pale puberulous, or almost glabrous. *Leaflets* 7 to 9, sub-coriaceous, ovate-elliptic, acuminate, entire, the base sub-cuneate, both surfaces glabrous; main nerves 10 to 14 pairs, spreading, rather prominent; length 3 to 5 in., breadth 1·3 to 2 in., petiolules about ·5 in.; stipules persistent, elliptic-oblong, puberulous, veined, about 1 in. long. *Panicles* terminal, lax, spreading, minutely puberulous; the flowers clustered at the apices of the branches, their buds enclosed in rotund, very concave, minutely tomentose bracts. *Calyx* campanulate, broadly 3-lobed. *Petals* 3, ovate-rotund, concave. *Stamens* 6, the filaments shorter than the anthers, free; rudimentary pistil (in the male flower) hairy. *Ovary* (in female flower) oblong-globular, glabrous, the style short and thick; stigma 3-lobed (fide Kænig). *Fruit* ellipsoidal, sub-trigonous, the stone bony, 1-to 3-celled, 2 in. or more long and 1 to 1·25 in. in diam. Kœnig, Ann. Bot. i. 360, t. 7, f. 2; Roxb. Fl. Ind. iii. 137; Blume Mus. Bot. i. 214; Bijd. 1161; DC. Prodr. ii. 79; W. & A. Prodr. 175; Miq. Fl. Ind. Bat. vol. i. pt. 2, 643; Wall. Cat. 8493. Benn. in Hook. fil. Fl. Br. Ind. I, 531. *Sapindus travancorensis*, Wall. Cat. 8047.

Planted in Penang, Singapore and some of the other provinces, but apparently never wild.

Kœnig in his description, which is a very full one, states that the stipules are "crenate, toothed or sometimes fringed." In all the specimens accepted as *C. commune* which I have seen the stipules are entire, and Rumphius thus figures them. For this has well as for other reasons, I suspect that more than one species is included under the name *C. commune*. L.

11. CANARIUM COCCINEO-BRACTEATUM, Kurz in Journ. As. Soc. Bengal for 1872, pt. 2, p. 296. A tree: young branches stout, minutely pale-pubescent. *Leaves* 10 to 18 in. long: stipules rather large, puberulous, pectinately lobed. *Leaflets* 5 to 9, opposite, subcoriaceous, broadly ovate, oblong-ovate to oblong, shortly acuminate, setaceous-serrulate or entire on the same tree; the base oblique, rounded, or sub-cuneate: both surfaces glabrous; main nerves 10 to 12 pairs, slightly prominent beneath; length 3·5 to 7·5, breadth 2 to 3 in.; petiolules ·2 to ·4 in., the terminal one 1·5 in. *Panicles* axillary, shorter than the leaves, deciduously puberulous, their branches rather long and spreading; the flowers crowded towards their apices, rather numerous; bracts longer than the

buds, ovate or oblong-acuminate, tomentose outside, scarlet. *Flowers* ·3 in. long, on pedicels about as long as themselves, sub-globose. *Calyx* campanulate, with three deep broad teeth, tomentose outside, glabrous inside. *Petals* longer then the calyx, valvate, ovate, obtuse, puberulous outside, glaberulous inside. *Stamens* 6; the anthers oblong, about as long as the free flattened glabrous filaments which rise from the edge of the fleshy corrugated disc: rudy. ovary minute. *Female flowers and drupe unknown.* Kurz For. Flora Burmah I, 209; A. W. Benn. in Hook. fil. Fl. Br. Ind. I, 536. Engler in De Cand. Monogr. Phanerog. IV, 149.

South Andaman: Kurz, King's collectors.

12. Canarium Manii, King, n. sp. A tree: young branches slender, pale brown, scurfy-puberulous. *Leaves* 9 to 12 in. long, stipules (if any) deciduous. *Leaflets* 5 to 7, thinly coriaceous, ovate or ovate-rotund, shortly acuminate, entire; the base very broad, rounded or sub-cordate, never narrowed; both surfaces quite glabrous, shining, the reticulations minute: main nerves about 10 pairs, spreading, rather straight, slightly prominent beneath; length 3·25 to 4·5 in., breadth 1·5 to 2·75 in.; petiolules ·2 to ·4 in., the terminal one longer. *Panicles* terminal, slender, shorter than the leaves, minutely pubescent; their branches short (1 in. long), corymbose. *Flowers* ·25 in. long, few; buds globular, each with an oblong, obtuse tomentose bract longer than itself. *Calyx* tomentose, widely campanulate, with 3 broad, shallow teeth. *Petals* slightly longer than the calyx, broadly ovate, sub-acute, minutely pubescent externally, glabrous internally. *Stamens* 6, anthers oblong, shorter than the free glabrous slightly flattened filaments which are inserted outside the glabrous fleshy lobed disc.; ovary none. *Female flowers* unknown. *Ripe drupes* ovoid-ellipsoid, glabrous, not trigonous, 1 to 1·25 in. long and ·6 in. in diam.; the woody persistent calyx flat and 3-angled.

South Andaman Island: Man, King's collectors.

This resembles *C. euphyllum*, Kurz in its fruit, but has very different leaves and panicles: the bracts of the inflorescence in this are moreover brown, not scarlet.

13. Canarium kadondon, A. W. Benn. in Hook. fil. Fl. Br. Ind. I, 535. A tree, young branches glabrous. *Leaves* 6 to 12 (rarely 15) in. long; their rachises terete, nearly glabrous, stipules (if any) deciduous. *Leaflets* 7 to 9, elliptic-oblong to elliptic, obtusely acuminate, entire, both surfaces glabrous or nearly so, the base often unequal rounded or sub-cuneate; main nerves 6 to 9 pairs, spreading, incurved, slightly prominent beneath; length 2·5 to 5 in., breadth 1 to 2·25 in; petiolules ·35 to ·5 in., the terminal twice as long. *Panicles* sparsely rusty-

tomentose; the lateral branches short and corymbose, minutely bracteolate. *Flowers* globose in bud, about as long as the pedicels; bracteoles minute, subulate. *Calyx* fleshy, cup-shaped, shortly pilose outside, the mouth with three shallow broad teeth. *Petals* valvate, rotund, densely ferruginous, pilose outside, pubescent inside. *Stamens* 6; the anthers broadly ovate, about as long as the filaments which are dilated at the base, free, and inserted outside the broad fleshy lobed glabrous disc. *Ovary* ovoid, glabrous, stigma (in the bud) sub-sessile. *Ripe drupe* ellipsoid-ovoid, apiculate, not trigonous, glabrous, 1·15 in. long and ·6 in. in diam. Engler in DeCand. Monogr. Phanerog. IV., 138.

Malacca: Maingay (Kew Distrib.) No. 365. Perak: King's collector, many numbers. Penang: Curtis Nos. 495, 1432, 1433, 1434; Hullett, No. 186. Pahang: Ridley No. 2575.

A species distinguishable by its globular buds; its petals densely rufous-pilose externally; and by the long slender petiolules of the leaflets.

14. Canarium rubiginosum, A. W. Benn. in Hook. fil. Fl. Br. Ind. I, 534. A tree: young branches and inflorescence minutely tawny-tomentose. *Leaves* 9 to 12 in. long, the rachises glabrous when adult; stipules (if any) deciduous. *Leaflets* 5 to 7, coriaceous, elliptic-oblong, shortly and obtusely acuminate, entire, the base rounded or slightly narrowed; both surfaces glabrous when adult, the lower puberulous along the stout midrib and 10 to 13 pairs of spreading curving main nerves, the reticulations also distinct: length 3·5 to 4·5 in., breadth 1·25 to 2 in.; petiolules ·6 in., the terminal one 1·5 in. *Panicles* of male flowers terminal and axillary, 4 to 10 in. long, the branchlets bearing the flowers at their extremities in condensed many-flowered dichotomous cymes. *Buds* globular, ·1 in long, longer than the stout pedicels. *Calyx* a shallow entire cup. *Petals* deltoid, valvate, concave, much exceeding the calyx, minutely tawny-tomentose outside, glabrescent inside as is the calyx. *Stamens* 6, shorter than the petals, inserted on the outside of the lobed cushion-like fleshy disc; the anthers oblong, about as long as the flat free filaments. *Female flowers* unknown. *Ripe drupe* ellipsoid, nearly 1 in. long, and ·6 in. in diam., obscurely trigonous, glabrous. Engler in DeCandolle Monogr. Phanerog. IV, 136.

Malacca: Maingay (Kew Distrib) No. 309.

15. Canarium Kunstleri, King, n. sp. A tree 60 to 70 feet high: young branches rather stout, pale brown, minutely and deciduously scurfy-tomentose. *Leaves* 14 to 20 inches; stipules deeply laciniate, puberulous, persistent. *Leaflets* 7 to 11, sub-coriaceous, oblong to elliptic-oblong, shortly acuminate, the edges crenulate or sub-entire; the base rounded or sub-cuneate, slightly oblique; upper surface glabrous, the lower glaucous (at least when young), puberulous on the

midrib and nerves, minutely scaly; main nerves 12 to 15 pairs, spreading, curving, rather prominent beneath; length 4 to 8 in., breadth 2·25 to 3·25 in.; petiolules ·3 to ·4 in., the terminal one twice as long. *Male panicles* terminal, rusty-puberulous, 10 to 12 in. long, spreading, compound, the flowers crowded on the ultimate branchlets; the pedicels short, tomentose, each with 1 or 2 oblong tomentose brown bracteoles which are longer than the globular buds. *Flowers* ·3 in. long. *Calyx* shorter than the petals, cut nearly to the base into 3 ovate obtuse spreading lobes, tomentose outside, puberulous inside. *Petals* ovate, tapering to each end (sub-rhomboid), the outer surface keeled, tomentose with glabrous edges, the inner glabrous. *Stamens* 6; anthers oblong, shorter than the slightly flattened free filaments which are inserted outside the glabrous corrugated disc; ruddy; ovary minute or 0. *Female panicles* as large as the male, fewer-flowered and the flowers larger, the bracts at the bases of the branches laciniate; *stamens* rudimentary; ovary ovoid, style short, thick, both glabrous, stigma large and faintly 3-lobed. *Ripe drupes* ellipsoid, rather blunt at each end, glabrous, very slightly trigonous, 1 in. long and ·6 in. in diam., the style persistent; the pedicel stout, ·6 to ·8 in. long, bearing several persistent bracteoles.

Perak: King's collector Nos. 7041, 7393 and 7509; Curtis, No. 2710.

The nearest ally of this is *C. denticulatum*, Blume, but that has much shorter filaments and smaller leaves; its fruit is unknown.

16. Canarium glaucum, Blume Mus. Bot. Lugd. Bat. I, 219. A tree 40 to 60 feet high: young branches rather slender, lenticellate, deciduously rusty-puberulous. *Leaves* 12 to 15 in. long, the rachis at first rusty-puberulous, ultimately glabrous. *Leaflets* 7 to 9, oblong or elliptic, acute or shortly acuminate, the edges obscurely and minutely crenate or serrate or sub-entire; upper surface glabrous, the midrib pubescent; the lower glaucous, rusty-pubescent on the midrib and sometimes on the 10 to 14 pairs of rather prominent spreading main nerves. *Stipules* rotund-reniform, ·4 in. long. *Panicles* terminal, the male as long as, or longer than the leaves, with lax spreading branches which become shorter upwards. *Male flowers* ·2 in. long., in small bracteate clusters at the ends of the branchlets; bracteoles broadly ovate, tomentose outside, deciduous. *Calyx* campanulate with 3 broad shallow blunt teeth. *Petals* longer than the calyx, broadly ovate-oblong, concave, tomentose outside and glabrescent within like the calyx. *Stamens* 6, the filaments shorter than the anthers, free, dilated at the base, attached outside the glabrous disc; rudimentary ovary glabrous. *Panicles of female flowers* shorter than the males, but the flowers two or three times as large. *Ovary* globose and glabrous below, grooved and pubescent upwards and tapering into the style.

Stigma large, capitate, 3-grooved. *Ripe drupe* ellipsoidal, tapering to the top, glabrous and shining, 1·75 to 2·25 in. long and 1 to 1·25 in. in diam., the persistent thickened calyx forming an open sub-entire cup at its base.

Penang: Curtis Nos. 803, 862, 2708. Perak: King's collector, No 7885.

17. Canarium secundum, Benn. in Hook. fil. Fl. Br. Ind. I, 532. A tree 30 to 50 feet high; young branches slender, and like the rachises under surfaces of the leaves and inflorescence rusty-tomentose or pubescent. *Leaves* 12 to 18 inches long; leaflets 7 to 9, thinly coriaceous, oblong, shortly caudate-acuminate, minutely serrate-dentate to sub-entire, the base rounded or slightly cuneate, upper surface glabrous except the minutely tomentose midrib; the lower much reticulate; main nerves 10 to 15 pairs, obscure above, bold beneath, curved, spreading; length 3 to 6 in., breadth 1·6 to 2 in.; petiolules of lateral leaflets only ·2 to ·3 in., those of the terminal one twice as long. *Stipules* reniform, densely tomentose outside, ·35 in. long, and about ·5 in. broad. *Panicles* terminal, rather slender, 10 to 18 in. long, and with lateral branches several inches long at the extremities of which the flowers are crowded in little heads; bracts numerous, more or less ovate or oblong, rusty-tomentose, enveloping the buds. *Flowers* sub-sessile. *Calyx* with 3 broad lobes. *Petals* oblong, sub-acute, concave, rusty-tomentose outside, glabrous within. *Stamens* 6, the narrowly oblong anthers longer than the dilated filaments which are inserted outside the disc. *Disc* adherent to the ovoid glabrous rudimentary ovary. *Female flowers* unknown. *Drupe* elongated-ovoid, sub-trigonous, sub-acute, glabrous, about 2 in. long and 1 in. in diam., the pedicel stout and the persistent calyx 3-angled. Engler in DeCand. Monogr. Phanerog. IV., 116. *Canarium*, Wall. Cat. 9046. ? *C. Bennettii*, Engler in DeCand. l. c. 119.

Singapore: Wallich, Hullett, Ridley No. 1812, King's collector No. 345. Malacca: Griffith No. 1141 and 1145, Maingay, No. 300 (Kew Distrib.). Perak: King's collector, Nos. 4330, 6101, 7610 and 10722; Scortechini, No. 2081.

This is allied to *C. rufum*, A. W. Benn., but its leaflets are thinner and the panicles much longer and more slender, with longer branches; and the drupe is much less distinctly trigonous. Dr. Engler has founded his species *C. Bennettii* on Griffith's specimen No. 1141. But on dissection of the flowers of the single specimen of that number in the Calcutta Herbarium, I cannot find that they differ from those of the same collector's No. 1145 which Engler refers to. *C. secundum*, Bennet and I therefore venture to reduce his species to this. The filaments are slightly conjoined at the base and appear as if joined into a tube, but they are easily separable.

16. CANARIUM NITIDUM, A. W. Benn. in Hook. fil. Fl. Br. Ind. I, 532. A tree 30 to 50 feet high; young branches at first puberulous, but speedily glabrous. *Leaves* 7 to 12 in. long, glabrous, the rachis slender and the petiolules rather long. *Leaflets* 7 to 9, coriaceous, shining, oblong, shortly acuminate, quite entire, the base rounded or slightly narrowed; main nerves 7 to 9 pairs, spreading, almost horizontal, very faint; length 3·5 to 6·5 in., breadth 1·2 to 1·8 in.; petiolules ·4 to ·6 in., that of the terminal leaflet 1 to 1·5 in.; stipules deciduous (not seen). *Fruit* in short terminal racemes: the drupes when ripe ovoid, tapering to each end, glabrous, 1·25 to 1·75 in. long, and about 1 in. in diam. Engler in De Cand. Monog. Phaner. IV, 108; Wall Cat. 8546 *in part.*

Singapore: Wallich. Malacca: Griffith 1147; Maingay No. 358, (Kew Distrib). Perak: King's collector, Nos. 4604, 4263, 5658 and 10916.

Male flowers of this are not known. The ripe drupe is much more ovoid than in the majority of the species, and this is the character by which, so far as the material goes (for male flowers of this are unknown) it is most readily distinguished from *C. parvifolium,* Benn. A flowering specimen recently collected in Singapore by Mr. H. M. Ridley (No. 3799) may belong to this. Ripe fruit from the same tree is required to settle the matter.

2. TRIGONOCHLAMYS, Hook. f.

A tree with pustulate tomentose-pubescent branches. *Leaves* alternate, imparipinnate, with opposite petiolulate leaflets. *Flowers* polygamous. *Calyx* large, keeled, with 3 large connivent valvate segments. *Petals* 3, valvate, about equalling the calyx. *Disc* annular. *Stamens* 6, inserted on the margin of the disc; filaments very short. *Ovary* 3-celled, nearly globose; style straight, short, stigma 3-lobed; ovules 2 in each cell, axile. *Drupe* obliquely globose, 1-celled, 1-seeded.—A single Malayan species.

1. TRIGONOCHLAMYS GRIFFITHII, Hook. fil. in Trans. Linn. Soc. XXIII, 170, t. XXVII. A tree 50 to 100 feet high: young branches rather slender, sparsely lenticellate, rusty-puberulous. *Leaves* 6 to 12 in. long, their rachises minutely tomentose; leaflets 13 to 15, thinly coriaceous, oblong-lanceolate, acuminate, entire, the base rounded or slightly narrowed: upper surface glabrous except the tomentose midrib, pale when dry; the lower sparsely pubescent, pale brown when dry and the 13 to 15 pairs of sub-horizontal main nerves rather prominent:

length 1·5 to 3 in., breadth ·65 to ·1 in. *Panicles* shorter than the leaves, few-flowered, rusty-tomentose; branchlets and pedicels with linear-oblong bracts. *Flowers* polygamous, ·35 in. long. *Calyx* large, keeled, with 3 deep broad triangular connivent rusty-tomentose segments. *Petals* narrowly elliptic, slightly exserted, densely pale tomentose with a glabrous spot on the base inside. *Stamens* 6, inserted by short filaments on the edge of a thin hypogynous annular glabrous disc, very small in the pistillate flowers. *Ovary* depressed sub-globular, glabrous, the style basi-lateral; the stigma depressed, capitate, obscurely 3-lobed. *Drupe* obliquely sub-globose, glabrous, about ·5 in. in diam. Bennet in Hook. fil.Fl. Br. Ind. I, 539. *Santiria Griffithii*, Engler in DC. Monog. Phanerog. IV, 155.

Malacca; Griffith, No. 1148; Maingay (Kew distrib.) No. 316. Perak; King's collector Nos. 4625, 1828, 8817.

4. Santiria, Blume.

Reziniferous trees. *Leaves* alternate, 3-foliolate or imparipinnate, firm; leaflets opposite, slightly oblique, entire. *Flowers* in uniformly hermaphrodite, axillary or terminal branched panicles; the stipules, (if any) fugacious, bracts usually obsolete, bracteoles minute. *Calyx* cupuliform, 3-lobed or 3-fid, valvate. *Petals* 3, valvate or sub-imbricate, broad and truncate at the base, exceeding the calyx. *Disc* annular, fleshy, adnate. *Stamens* 6, distinct, usually inflexed, inserted on the margin or outside of the disc. *Ovary* 3-celled, with 2 ovules in each cell; style short, stigma capitate or 3-lobed. *Drupe* ellipsoidal or sub-globose, more or less laterally compressed on the ventral side, and the scar of the stigma usually lateral or basal, 1-celled, 1-seeded; the stone crustaceous, rarely woody, *Cotyledons* contortuplicate.—Distrib. Malayan Archipelago. Species probably 35.

Panicles longer than the leaves.

Panicles and leaves glabrous; leaflets 9 to 20 in. long ... ... 1. *S. floribunda.*

Panicles hispidulous-pubescent; leaflets sparsely hispidulous on the lower surface 4 to 8 in. long flowers on long slender pedicels ... ... 2. *S. laxa.*

Panicles puberulous; leaflets glabrous; leaflets 3 to 9 in. long flowers on short pedicels ... ... 3. *S. fasciculata.*

Panicles shorter than the leaves.
Panicles solitary, axillary or terminal, with rather long peduncles.
Branches of the panicles few, lax, slender, very long and bearing the flowers on short distant cymules ... 4. *S. puberula.*
Branches of the panicle numerous, stout, divaricate; the flowers in corymbose cymes towards their apices.
Flowers ·2 to ·25 in. long; ripe fruit more than 1 in. long ... 5. *S. macrocarpa.*
Flowers ·1 in. long or less: ripe fruit ·6 to ·7 in. long.
Flower-buds conical ... 6. *S. lævigata.*
Flower-buds globular ... 7. *S. oblongifolia.*
Panicles sessile, branching from the base, sometimes more than one from a leaf-axil.
Leaflets quite glabrous.
Scar of stigma terminal in the ripe fruit; leaflets narrowly oblong, their main nerves 12 to 14 pairs ... ... 8. *S. longifolia.*
Scar of stigma of ripe fruit approximated to its base.
Leaflets oblong to elliptic-oblong; nerves 10 to 15 pairs ... ... 9. *S. Wrayi.*
Leaflets elliptic-oblong to ovate; nerves about 8 pairs or fewer ... ... 10. *S. apiculata.*
Leaflets more or less hairy beneath.
Leaflets quite glabrous on the upper surface.
Lower surface of leaflets boldly reticulate and rusty-pubescent ... ... 11. *S. costata.*
Lower surface not conspicuously reticulate, rusty-puberulous when young; main nerves about 10 pairs 12. *S. conferta.*

Leaflets glabrescent on the upper surface, the midrib tomentose; lower surface densely rusty-tomentose; main nerves 15 to 20 pairs ... ... 13. *S. multiflora.*

1. SANTIRIA FLORIBUNDA, King n. sp. A tree 20 to 30 feet high: young branches stout, scurfy, rusty-pubescent. *Leaves* 2 or 3 feet long, the rachises flattened and channelled on the upper surface below the lowest leaflets, auricled at the very base, puberulous at first but speedily glabrous. *Leaflets* 13 to 15 or 17, coriaceous, oblong, shortly acuminate; the base rounded, slightly unequal; glabrous on both surfaces, the midrib alone sometimes puberulous on the lower, reticulations minute; main nerves 20 to 30 pairs, spreading, curving at the tips, interarching but slightly; length 9 to 20 in., breadth 2·35 to 5 in.; petiolules very stout, 5 to 7 in. long. *Panicles* 2 to 3 feet long, slender, much branched, striate, glabrous, bearing numerous scattered horizontal short branchlets ·5 to 1·5 in. long which bear two or three 3- to 5-flowered cymules. *Flowers* 1 in. long; their pedicels longer, unequal, slender, puberulous, with a few subulate bracteoles at the base. *Calyx* flat, 3-angled, glabrescent. *Petals* erect, deltoid, fleshy, concave, keeled along the middle, glabrous outside. *Stamens* 6, the filaments shorter than the oblong anthers, slightly dilated below, inserted on the outer surface of the edge of the thick fleshy cupular disc. *Ovary* small. *Style* short, stout, 3-angled like the stigma. *Ripe drupes* elliptic, apiculate, glabrous, ·8 in. long and ·5 in. in diam; the peduncles slender, ·5 to ·75 in. long; stigmatic scar terminal.

Perak: King's collector, Nos. 7510, 7632 and 10151.

There are in the Calcutta Herbarium flowering specimens of a species closely allied to this; but in the absence of fruit I hesitate to describe it.

2. SANTIRIA LAXA, King. A tree 50 to 70 feet high: young branches, rachises of the leaves, and the inflorescence densely clothed with rusty, hispidulous, spreading and mostly deciduous hairs. *Leaves* 14 to 22 in. long, the stipules (if any) deciduous. *Leaflets* 7 to 9, oblong to oblong-elliptic, sometimes slightly obovate, shortly and abruptly acuminate, the edges entire, the base often unequal-sided, cuneate: length 5 to 8 in., breadth 1·75 to 2·5 in., petiolule ·4 or ·5 in.; both surfaces reticulate, the upper glabrous, the lower sparsely hispidulous especially on the midrib and nerves: main nerves 12 to 14 pairs, slightly prominent on the lower surface, spreading, curving, interarching near the edge. *Panicles* usually much longer than the leaves, terminal, their branches short, lax, rather few-flowered, the ultimate branchlets gla-

brous, the larger hispidulous-pubescent. *Flowers* ·3 in. in diam., glabrous, shorter than the slender minutely bracteolate pedicels. *Calyx* with 3 broad, spreading, very blunt teeth, much shorter than the corolla. *Petals* 3, thick, slightly keeled on the back, ovate, obtuse. *Stamens* 6, free, about as long as the petals, inserted on the outer margin of the 6-lobed, glabrous, cushion-like disc; anthers ovate, about as long as the thick rather flattened filaments: rudimentary ovary submerged in the disc, small, sub-cylindric, glabrous as is the thick fluted style; stigma 3-lobed. *Female flowers* unknown. *Ripe drupes* narrowly ellipsoid, trigonous, one side wider and flatter than the other two, glabrous, 1 to 1·4 in. long and ·6 to ·7 in. in diam; stone thin. *Canarium laxum*, A. W. Benn. in Hook. fil. Fl. B2. Ind. I. 535; Engler in DeCand. Monog. Phanerog. IV, 139.

Malacca; Maingay (Kew Distrib.,) No. 366. Perak: King's collector, Nos. 3192 and 3516. Penang: Curtis No. 1431. Pahang; Ridley No. 2451.

The drupes of this have the remains of the stigma terminal, and in this respect they agree technically with the diagnosis of *Canarium*. But they are not equally 3-sided as in that genus, one side being wider and more rounded than the other two. The structure of the flower is not at all that of *Canarium*, and I therefore transfer the species to *Santiria*.

3. Santiria fasciculata, A. W. Benn. in Hook. fil. Fl. Br. Ind. I, 539. A tree 40 to 50 feet high: young branches at first rusty-pubescent, becoming glabrous, the bark pale cinereous. *Leaves* 10 to 15 in., the rachis terete, at first puberulous, afterwards glabrescent, slightly flattened on the upper surface near the base. *Leaflets* 5 to 7, membranous, elliptic to elliptic-oblong, more or less caudate-acuminate, the base cuneate, both surfaces glabrous; main nerves 7 or 8 pairs, spreading, much curved, interarching, bold and prominent on the lower, inconspicuous on the upper surface; length 4·5 to 9 in., breadth 2 to 3 in.; petiolules ·75 to 1 in., much thickened at each end, the terminal one much longer. *Panicles* slender, puberulous, terminal, as long as or longer than the leaves, with few long, narrow, angular, lax branches bearing at intervals short 6- to 10-flowered cymules. *Flowers* ·05 in. long; the pedicels unequal, tomentose, bracteolate. *Calyx* cupular, hispid-tomentose outside with 3 bold, deltoid, acute teeth. *Petals* imbricate, slightly longer than the calyx, deltoid, glabrescent. *Stamens* 6, filaments about as long as the broadly ovate anthers and inserted outside the edge of the ring-like glabrous disc. *Ovary* ovoid, glabrous. *Ripe drupes* narrowly and obliquely ovoid, flattened on one side, slightly gibbous at the base, glabrous, the scar of the stigma terminal, ·8 in.

long and ·6 in. in diam. Engler in DeCand. Monogr. Phanerog. IV, 164.

Malacca: Maingay (Kew Distrib.) No. 307. Penang; Curtis No. 1544. Perak: King's collector, Nos. 3123, 3319, 3716, 3500, 6610; Scortechini No. 1988.

4. SANTIRIA PUBERULA, A. W. Benn. in Hook. fil. Fl. Br. Ind. I, 537. A tree 30 to 50 feet high: young branches slender, pale gray, at first puberulous afterwards glabrous. *Leaves* 8 to 10 in. long, the rachises glabrescent or glabrous, terete, flattened on the upper surface just above the base. *Leaflets* 5 rarely 7, thinly coriaceous, elliptic to oblong, acute or shortly acuminate, the base slightly cuneate; upper surface quite glabrous; the lower minutely puberulous, reticulate, the 9 to 11 pairs of spreading, curving, interarching nerves prominent: length 4 to 6 in., breadth 1·5 to 2·5 in.; petiolules ·4 to ·6 in. long, the terminal one 1 to 1·75 in., all swollen at the upper end. *Panicles* terminal or axillary, shorter than the leaves, minutely tomentose, with a few lax spreading branches bearing rather distant, 5- to 8-flowered, sub-sessile cymules. *Flowers* about ·05 in. long, the pedicels about as long, unequal, stout, tomentose. *Calyx* cupular; with 3, deltoid, acute teeth, tomentose outside. *Petals* valvate, ovate-rotund, concave, with a slight inflected point at the apex, glabrous, much longer than the calyx. *Stamens* 6; filaments longer than the ovate anthers, inserted on the edge of the crenulate fleshy disc: ovary ovoid, glabrous. *Ripe drupes* narrowly ellipsoid, straight on one side, curved on the other, obscurely 3- or 4-angled, glabrous, the scar of the stigma terminal; length ·75 in., diam. ·35 in. Engler in DC. Mon. Phan. IV, 161.

Perak: Wray, No. 3210: King's collector, No. 3438, 3529, 6832.

This comes very near to *S. fasciculata*, A. W. Benn., and I much doubt its being really distinct from that species.

5. SANTIRIA MACROCARPA, King n. sp. A glabrous tree, 40 to 70 feet high: young branches with brown lenticellate bark. *Leaves* 5 to 9 in. long, the rachis slightly flattened on the upper surface near the base. *Leaflets* thinly coriaceous, oblong-elliptic to obovate or sub-rotund, very shortly and bluntly apiculate; the base cuneate, rarely rounded; main nerves 7 or 8 pairs, spreading, slightly curved, interarching boldly, slightly depressed on the upper surface (when dry) and sub-prominent on the lower; length 3 to 4·75 in., breadth 2 to 2·75 in.; petiolules ·35 to ·5 in., the terminal one 1 in. or more. *Panicles* axillary, solitary, shorter than the leaves, with distant lateral branchlets ·5 to 1 in. long and bearing at their apices 2- to 6-flowered bracteolate cymules. *Flowers* ·2 to ·25 in. long. *Calyx* thick, deeply cupular or sub-campanulate, with 3 bold triangular lobes, glabrescent. *Petals* twice as long as the calyx, fleshy,

glabrous, broadly oblong, very concave, the apex much thickened and deeply inflexed and the sides partly inflexed to form a kind of hood. *Stamens* 6; the filaments much shorter than the oblong anthers, lanceolate, dilated at the base and inserted outside the quadrate lobes of the thin ring-like disc. *Ovary* ovoid-globose, glabrous, tapering into the short thick style: stigma discoid. *Ripe drupes* obliquely ovoid, flattened on one side, glabrous, 1·25 to 1·5 in. long, and about ·75 in. in diam; peduncle slender, ·5 to 1 in. long, scar of stigma terminal.

Perak: King's collector, Nos. 5304, 5580 and 7298.

6. SANTIRIA LAEVIGATA, Blume Mus. Bot. I, 211. A tree 50 to 100 feet high: young branches dark-coloured, lenticellate, glabrous. *Leaves* 9 to 17 in. long, glabrous: the rachises flattened below the lowest leaflet and channelled at the base. *Leaflets* coriaceous, elliptic-oblong to oblong, shortly acuminate; the base usually rounded or sub-cordate, but sometimes narrowed and sub-oblique: both surfaces reticulate, the lower brown when dry: main nerves 11 to 17 pairs, sub-horizontal, slightly prominent on the lower surface; length 4·5 to 9 in, breadth 1·5 to 2·8 in., petiolules about ·5 in. *Panicles* shorter than the leaves, axillary or slightly supra-axillary, solitary, 6 to 8 in. long (including the rather long peduncles), spreading; the branches ascending, puberulous near the apices where the flowers are crowded in conical ebracteolate cymes. *Flowers* less than ·1 in. long, shorter than the pedicels. *Calyx* cupular, the mouth almost entire or waved, minutely tomentose outside. *Petals* deltoid-rotund, the apex inflexed, valvate, glabrous. *Stamens* 6; anthers ovate, about as long as the filaments which are inserted by dilated bases outside the ring-like disc: rudimentary ovary small, ovoid. *Female flowers* not seen. *Ripe drupes* ·6 in. long, glabrous, broadly ovoid, blunt, flattened on one side, the remains of the stigma near the apex of the flattened side, peduncle ·5 in. long. A. W. Benn. in Hook. fil. Fl. Br. Ind. I, 538; Engler in DeCand. Monog. Phanerog. IV, 165. *Canarium laevigatum*, Miq. Fl. Ind. Bat., Vol. I, Pt. 2, p. 648. *Canarium altissimum*, Herb. Korth.

Malacca; Griffith No. 1149, Maingay. Perak; King's collector, Nos. 4438, 5441, 5839 and 7961; Scortechini.—DISTRIB. Sumatra.

The leaves of this vary a good deal as to the number of the main nerves and as to the shape of the base, some having broad and even sub-cordate while others have cuneate bases.

7. SANTIRIA OBLONGIFOLIA, Blume in Mus. Bot. Lugd. Bat. I, 211. A tree 50 to 80 feet high: young branches pale, lenticellate, at first scurfy, afterwards glabrous. *Leaves* 12 to 18 in. long; their rachises terete, not winged at the base but slightly flattened, glabrous, the stipules (if any) deciduous. *Leaflets* 7 to 9 in., thinly coriaceous, oblong,

occasionally ovate-oblong or ovate, slightly unequilateral especially at the base; the apex very shortly abruptly and bluntly acuminate, edges entire; base in the oblong forms sub-cuneate, in the ovate forms broad and rounded; upper surfaces glabrous and reticulate, olivaceous when dry; the lower pale brown when dry, very minutely lepidote; main nerves 10 to 13 pairs (in the ovate forms only 7 or 8 pairs), spreading, interarching near the edge; length 4 to 6 in., the ovate forms shorter; breadth 1·75 to 2·25 in.; petiolules ·5 to ·7 in., the terminal one 1·5 in. *Panicles* axillary or terminal, shorter than the leaves, pale scurfy when young, divaricate, cymose, spreading, the flowers crowded near the extremities of the branches, ebracteolate. *Buds* ·1 in. in diam., sub-globular, about as long as the clavate pedicels. *Calyx* campanulate, deeply cut into 3, rotund, deltoid, sub-concave teeth, scurfy outside. *Petals* sub-rotund with a truncate base, slightly concave, longer than the calyx, puberulous outside, glabrous inside. *Stamens* 6. *Anthers* oblong, about as long as the filaments: the latter flattened, narrow, inserted outside the glabrous, thin, fleshy, lobed disc. *Ripe drupes* ovoid, ellipsoid or globose, flattened on one side, oblique, obscurely 3-gonous, glabrous, ·7 in. long, and ·5 in. in diam., the scar of the stigma at the apex of the flattened side. Engler in DeCand. Monog. Phanerog, IV, 162. *Santiria Maingayi*, A. W. Benn. in Hook. fil. Fl. Br. Ind. I, 538: Engler l. c. IV, 165. *Canarium oblongifolium*, Miq. Fl. Ind. Bat. I, Pt. 2, p. 645. *Canarium eupteron*, Miq. Fl. Ind. Bat., Vol. I, Pt. 2, p. 648.

Malacca, (Kew Distrib.) No. 310. Perak: a common tree, King's collector.—DISTRIB. Sumatra, Java, Borneo.

Blume's original description (drawn up from specimens from Java and Sumatra) suits this plant well. An authentic specimen of Miquel's *Canarium eupteron* shows that that species must be reduced here, as must Bennet's *Santiria Maingayi* of which Maingay's specimen No. 310 (Kew Distrib.) is the type. *Canarium sub-repandum*, Miq. is, according to its author, closely allied to *C. eupteron*, Miq. and should probably also be reduced to this.

8. SANTIRIA LONGIFOLIA, King n. sp. A tree 10 to 20 feet high: young branches very stout, (·5 to ·75 in. in diam.), their bark brown, glabrous, lenticellate. *Leaves* 2 to 3 feet long, glabrous; the rachises stout, flattened below the lowest leaflets, not winged at the bases. *Leaflets* 11 to 15 pairs, narrowly oblong, gradually tapering to the acuminate apex, the base oblique or rounded; main nerves 12 to 14 pairs, spreading, curved, not prominent: length 9 to 11 in., breadth 1·75 to 2·5 in.; petiolules ·65 to 1 in., stout, enlarged at each end. *Flowers* unknown. *Fruiting panicles* much shorter than the leaves, one or two in the axil of a leaf, unequal, only 4 to 7 in. long, glabrous, the branches short.

Ripe drupes ovoid, flattened on one side, the scar of the stigma terminal, glabrous, 1 in. long. and ·65 in. in diam.

Perak: King's collector, Nos. 3594, 6838.

This is so unlike any described species of *Santiria* that, in spite of the absence of flowers on the only specimens I have seen, I have ventured to name it. The small size of the tree and the large size of its leaves make it easy of recognition in the genus.

9. SANTIRIA WRAYI, King n. sp. A tree 20 to 30 feet high: young branches very thick, (·75 to 1 in. in diam.) *Leaves* 12 to 30 in. long; the rachises trigonous, channelled in the lower part and almost winged at the base, puberulous. *Leaflets* 13 to 15, membranous, oblong to elliptic-oblong, very shortly and bluntly acuminate; the base rounded, slightly oblique; upper surface shining, olivaceous when dry, the lower pale brown, both glabrous and reticulate; main nerves 10 to 15 pairs, spreading, curving, slightly prominent beneath, length 6 to 11 in., breadth 2·5 to 4 in.; petiolules thickened at both ends, ·5 to 1 in., the terminal one more than twice as long. *Panicles* 3 or 4 in. long, several densely crowded in the axils of one leaf, ebracteolate, puberulous or glabrescent below, the ultimate branches scurfy rufous-puberulous. *Flowers* ·1 or ·15 in. long, shorter than the pedicels. *Calyx* cupular, the mouth with 3, broad, shallow teeth, glabrous, with a few hairs near the edge. *Petals* valvate, rotund, glabrous, rather fleshy. *Stamens* 6; the anthers ovate, longer than the flattened filaments which are inserted on the outside of the edge of the ring-like, fleshly, glabrous, corrugated disc. *Rudimentary ovary* small, ovoid. *Female flowers* unknown. *Ripe drupes* obliquely ovoid, slightly compressed, blunt at each end, ·6 to ·75 in. long, glabrous, the scar of the stigma approximated to the peduncle, peduncle ·5 in. long.

Perak: Wray, Nos. 1423, 2970; King's collector, No. 3689; Scortechini No. 2095.

Allied to *S. conferta*, but with larger leaves and fruit, much less hairy panicles, and perfectly glabrous leaves.

10. SANTIRIA APICULATA, A. W. Benn. in Hook. fil. Fl. Br. Ind. I, 537. A tree 20 to 50 feet high: young branches with pale bark, puberulous. *Leaves* 6 to 8 in. long, stipules (if any) deciduous. *Leaflets* membranous, oblong, elliptic-oblong to ovate, more or less bluntly acuminate, the base rounded or cuneate, glabrous on both surfaces and reticulate especially on the lower; main nerves rather irregular, about 8 pairs, ascending, curved, slightly prominent beneath, length 3·5 to 5·5 in., breadth 1·75 to 2·25 in.; petiolules ·4 to ·6 in., the terminal longer. *Panicles* axillary, slender, shorter than the leaves, more or less pyramidal, glabrous, the flowers small and crowded near the puberulous

apices, bracteoles minute. *Flowers* ·1 in. or less in diam., their pedicels twice as long. *Calyx* cupular with 3 broad, shallow, blunt teeth, nearly glabrous. *Petals* rotund, glabrous. *Stamens* 6, inflexed; anthers ovate, about as long as the flattened filaments which are inserted by their slightly dilated bases outside the glabrous fleshy lobed and corrugated disc. *Rudimentary ovary* ovoid, sunk in the disc, pubescent; style very short; stigma 3-lobed, small, terminal. *Female flowers* in panicles like the males, the stamens with broader filaments: ovary broadly ovoid, pubescent, style very short: stigma large, discoid, cupulate, terminal, *Ripe drupes* ovoid-globose, ·5 in. long, glabrous, the scar of the stigma near the base, the pericarp thinly coriaceous. Engler in DeCand. Monogr. Phanerog. IV, 163.

Malacca: Maingay, Nos. 303, 308, 314 (Kew Distrib.) Perak: Scortechini 1701: King's collector;—Distrib.; Sumatra.

The fruit is remarkable for the close approximation of the remains of the stigma to the peduncle. The venation of the leaves is variable: in many specimens the main nerves bifurcate about half way between the midrib and the edge of the leaf, while in others there is no bifurcation at all.

11. Santiria costata, A. W. Benn. in Hook. fil. Fl. Br. Ind. I, 537. A tree: young branches with gray bark, rusty-puberulous at first, ultimately glabrous. *Leaves* 6 to 9 in. long: stipules (if any) deciduous; the rachises broadly channelled above in the lower part, but not winged at the base. *Leaflets* coriaceous, oblong-lanceolate to elliptic, shortly and bluntly acuminate, the base acute or rounded: upper surface quite glabrous and shining, the midrib prominent on both surfaces; lower surface boldly reticulate and with a few scattered hairs; the 9 to 11 pairs of main nerves spreading, curving, very prominent, rusty-pubescent; length 3·5 to 4·5 in., breadth 1·25 to 2 in.,; petiolules ·35 to ·5 in., thickened at both ends. *Panicles* solitary, much shorter than the leaves, (only about 3 in. long) few-branched, rusty-tomentose, deciduously bracteolate. *Flowers* ·1 in. long, in small fascicles at the ends of the branchlets; the slender pedicels about as long or longer. *Calyx* cupular, truncate, dentate, glabrescent. *Petals* much longer than the calyx, broadly ovate, blunt, concave, nearly glabrous. *Stamens* 6; the filaments about as long as the anthers, slender and inserted beneath the margin of the outside of the small ring-like disc. *Ripe drupes* narrowly ovoid, slightly flattened on one side, ·75 in. long and ·5 in. in diam., the scar of the stigma apical. Engler in DeCandolle Monogr. Phanerog. IV, 157.

Malacca: Maingay (Kew Distrib.) No. 313. Perak: King's collector, No. 7597.

The short rusty-tomentose panicles, and almost glabrous flowers on slender pedicels distinguish this from *S. fasciculata*, to which it is closely allied. The leaves also give diagnostic marks, those of this species having more nerves and being pubescent beneath.

12. SANTIRIA CONFERTA, A. W. Benn. in Hook. fil. Fl Br. Ind. I, 537. A tree: young shoots rather stout (·35 in. in diam.), rusty-puberulous, afterwards glabrous and striate. *Leaves* 12 to 18 in. long; stipules (if any) deciduous, the rachis rufous-puberulous when young. *Leaflets* coriaceous, 9 to 13, oblong to oblong-lanceolate, gradually tapering to the acuminate apex, the base rounded: upper surface glabrous, shining, minutely reticulate, olivaceous when dry; the lower brown when dry, minutely rusty-puberulous when young; main nerves about 10 pairs, spreading, curving, slightly prominent on the lower surface: length 3·5 to 6 in., breadth 1·6 to 2 in., petiolules ·6 to ·7 in. *Panicles* 3 to 4 in. long, several from an axil and much shorter than the leaves, rufous-pubescent, densely crowded, bracteoles minute; pedicels slightly shorter than the flowers. Flowers ·1 to ·15 in. long. *Calyx* cupular, with 3 shallow broad teeth, rusty-tomentose outside. *Petals* imbricate, rotund, concave, puberulous. *Stamens* 6, inflexed, the anthers ovate, about as long as the flat filaments which are inserted on the edge of the fleshy ring-like disc; *rudimentary ovary* small, glabrous, ovoid. *Female flowers* not seen. *Ripe drupes* obliquely ovoid, dark-coloured, glabrous, rather less than ·5 in. long, the scar of the stigma near the base, pericarp stoutly coriaceous. Engler in De Candolle Monogr. Phanerog. IV, 160.

Malacca: Maingay (Kew Distrib.) No. 306, Griffith No. 1150.

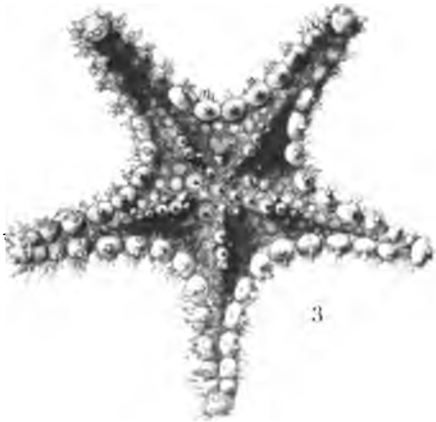
This is readily distinguished by its crowded condensed rufous-tomentose panicles and small glabrous fruit.

13. SANTIRIA MULTIFLORA, A. W. Benn. in Hook. fil. Fl. Br. Ind. I, 538. A tree, 60 to 100 feet high: young branches rather stout (·35 to ·5 in. in diam.), densely and minutely rusty-tomentose like the rachises and under surfaces of the leaves and the inflorescence. *Leaves* 9 to 15 in. long; the rachises terete in the upper part, but channelled near the base. *Leaflets* 5 to 7, coriaceous, oblong or elliptic-oblong, tapering slightly to the shortly acuminate apex; the base cuneate or obliquely rounded; upper surface glabrescent except the tomentose midrib and 15 to 20 pairs of sub-horizontal main nerves which are bold and prominent on the lower surface; length 4·5 to 10 in., breadth 2 to 3 in., petiolules ·4 to ·5 in. *Panicles* axillary or terminal, solitary, shorter than the leaves, ebracteolate, (? bracteoles caducous) spreading. *Flowers* crowded at the extremities, ·1 in. long, slightly longer than their tomentose pedicels. *Calyx* a shallow cup, the mouth almost entire or with 3 shallow wavy teeth, tomentose outside. *Petals* much longer than the

calyx, slightly imbricate, thick, broadly ovate, obtuse, with short slightly inflexed apical appendix, glabrous. *Stamens* 6, the ovate anthers about as long as the thick flattish filaments which are inserted on the edge of the thick fleshy ring-like disc; *rudimentary ovary* ovoid, minute. *Female flowers* not seen. *Ripe drupes* ovoid-globose, flattened on one side, ·75 in. long, glabrous, the scar of the stigma below the apex of the flattened side. Engler in DeCand. Monogr. Phanerog. IV, 160.

Malacca: Griffith, No. 1151; Maingay (Kew Distrib.) No. 305. Perak: King's collector.

I quite agree with the author of this species that, when better material of *Santiria tomentosa*, Blume (Mus. Lugd. Bat. I, 211), shall be forthcoming, the two will probably be found to be identical.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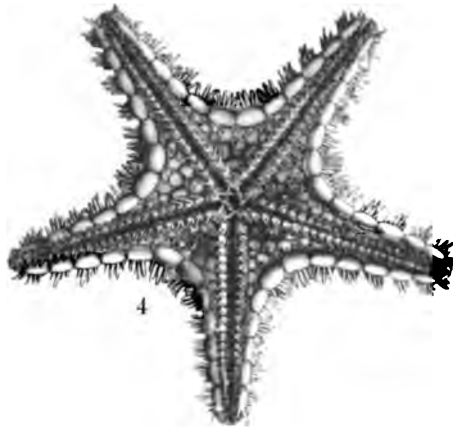
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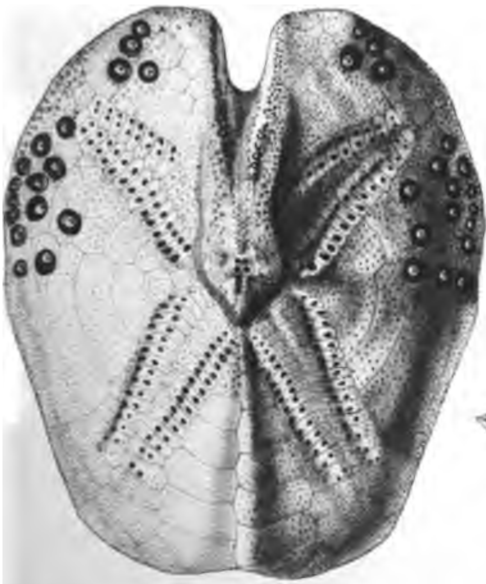
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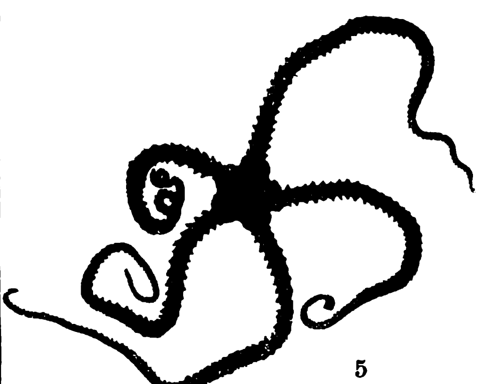
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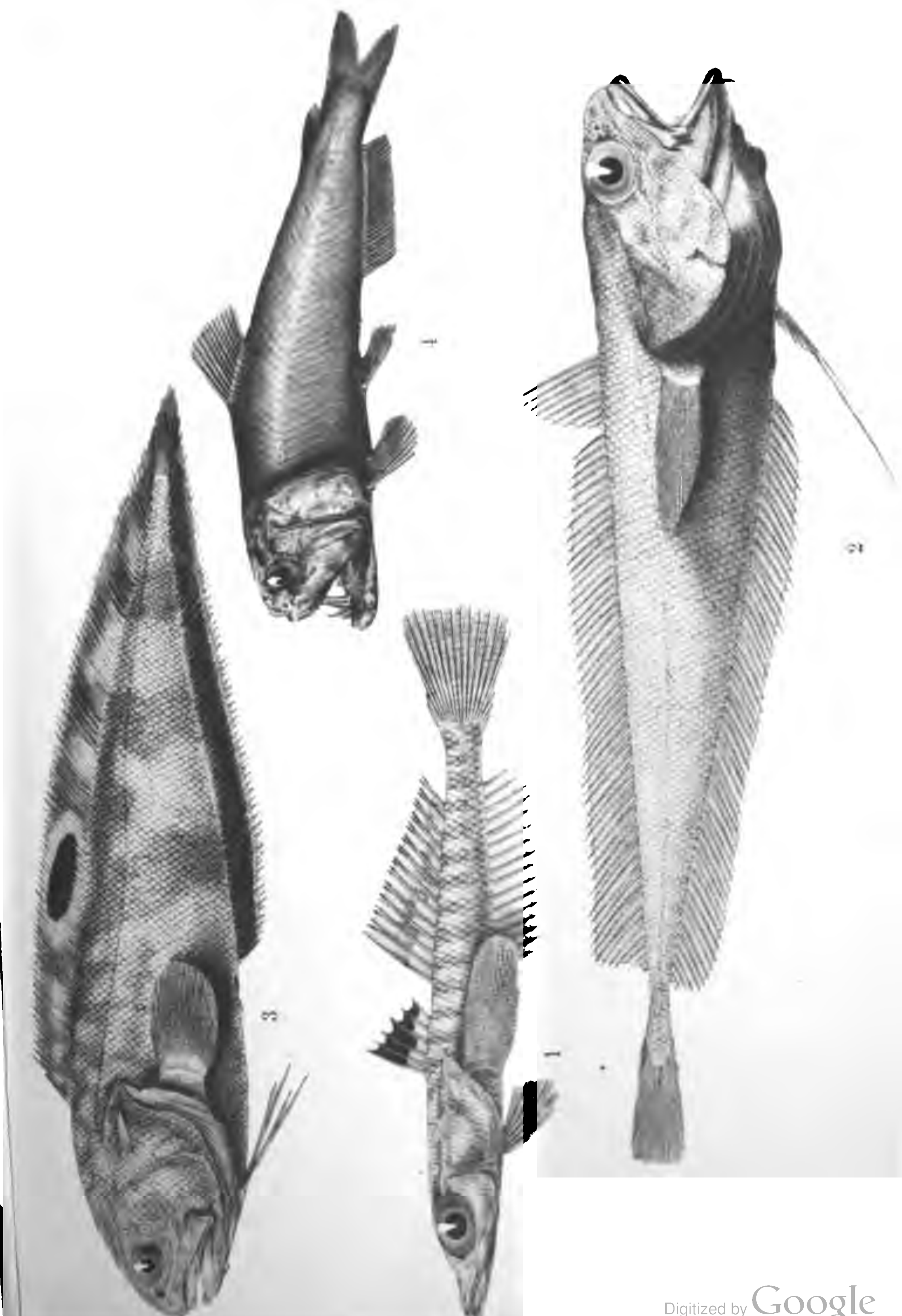
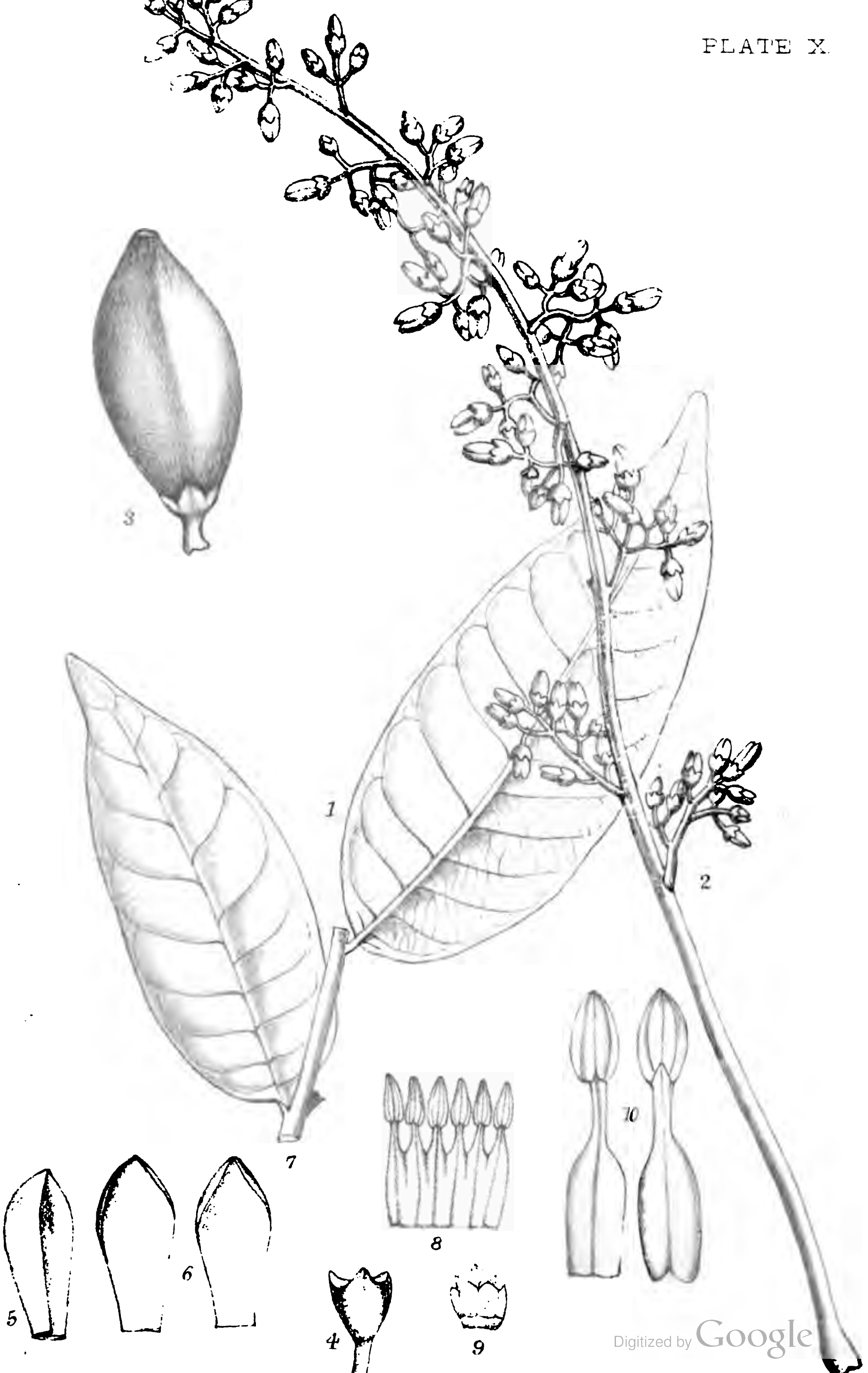
CALCUTTA PHOTOTYPE COMPANY.



INDIAN DEEP-SEA FISHES.

LCUTTA PHOTOTYPE COMPANY.

PLATE X.



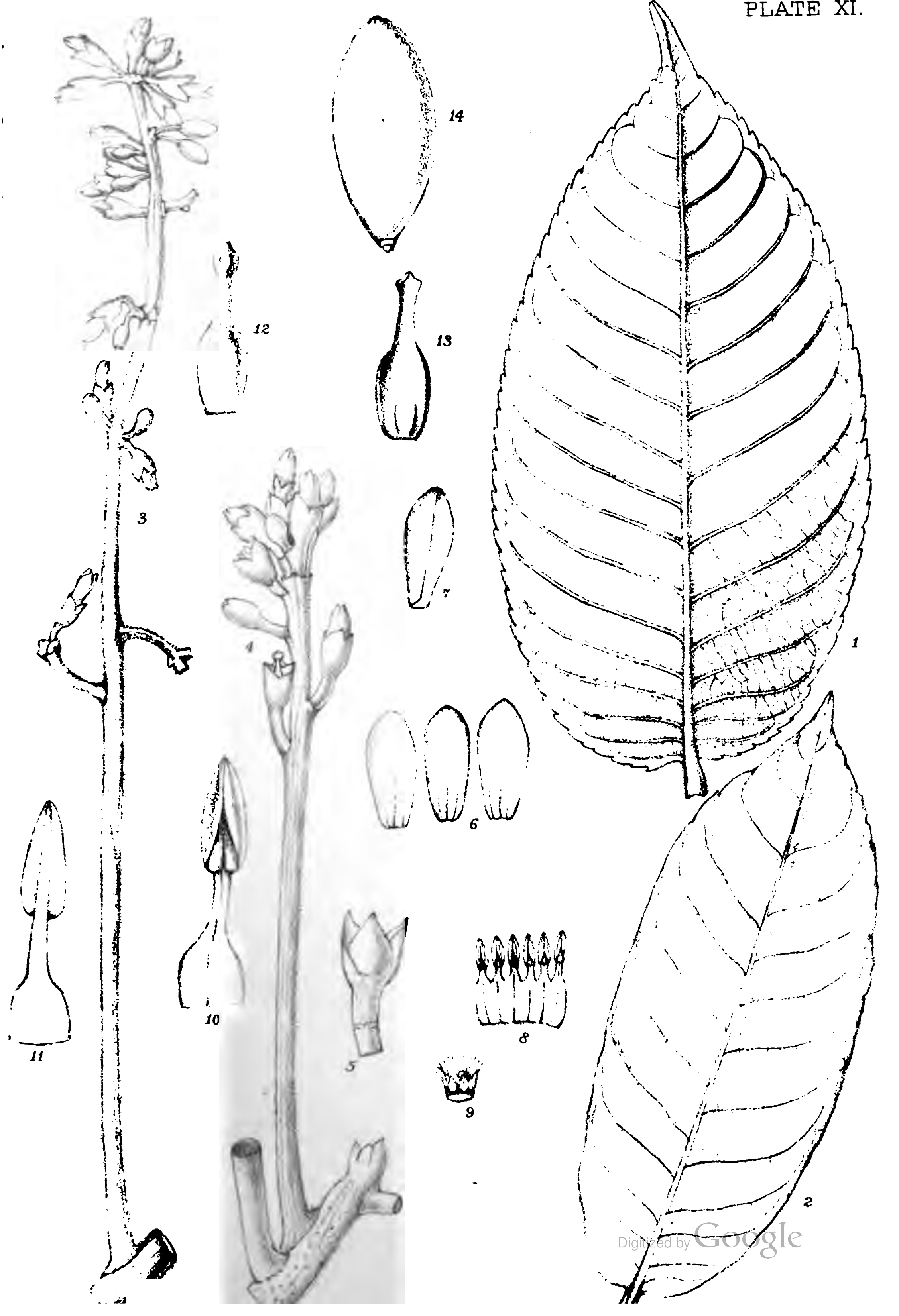

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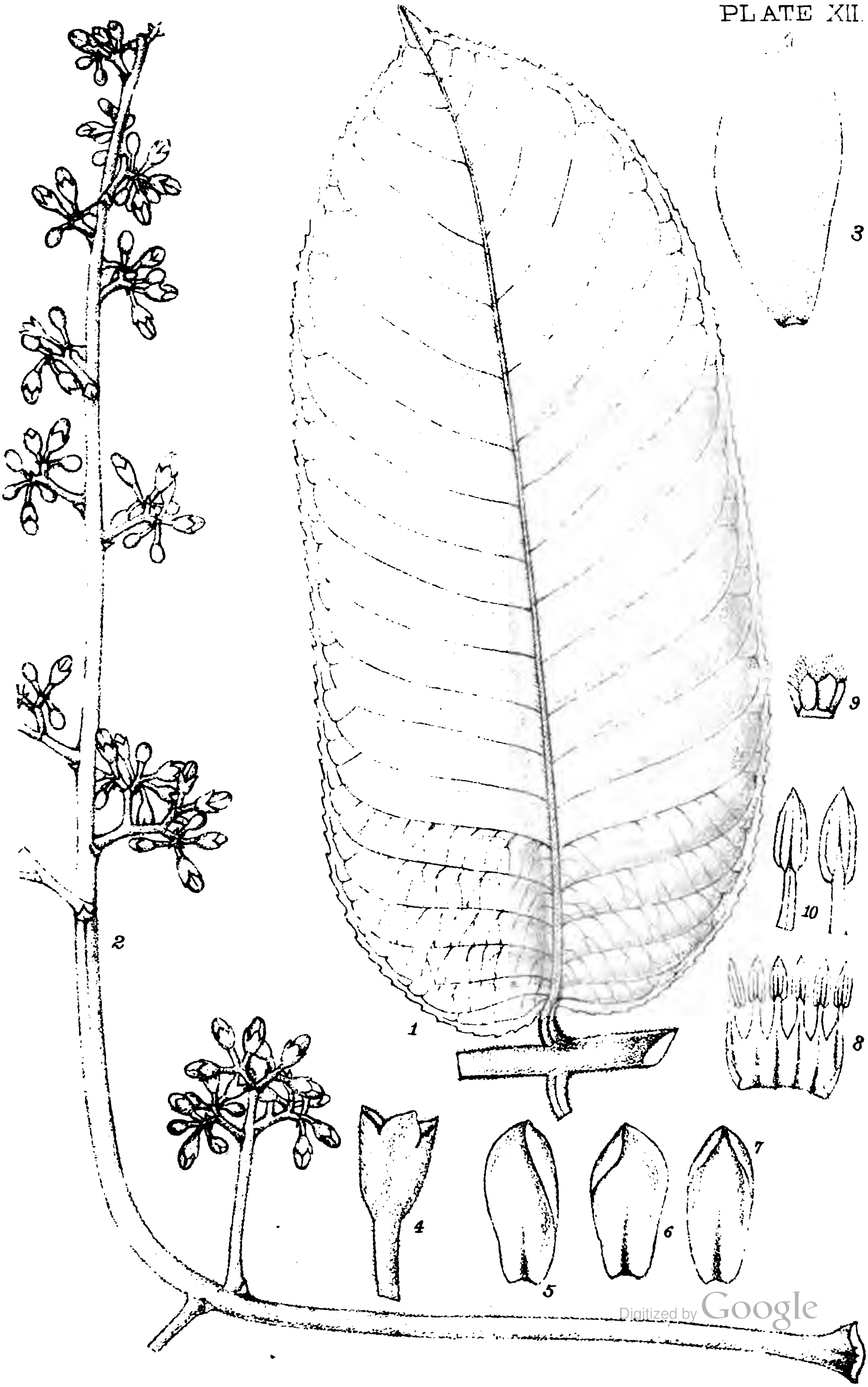
PLATE XII.



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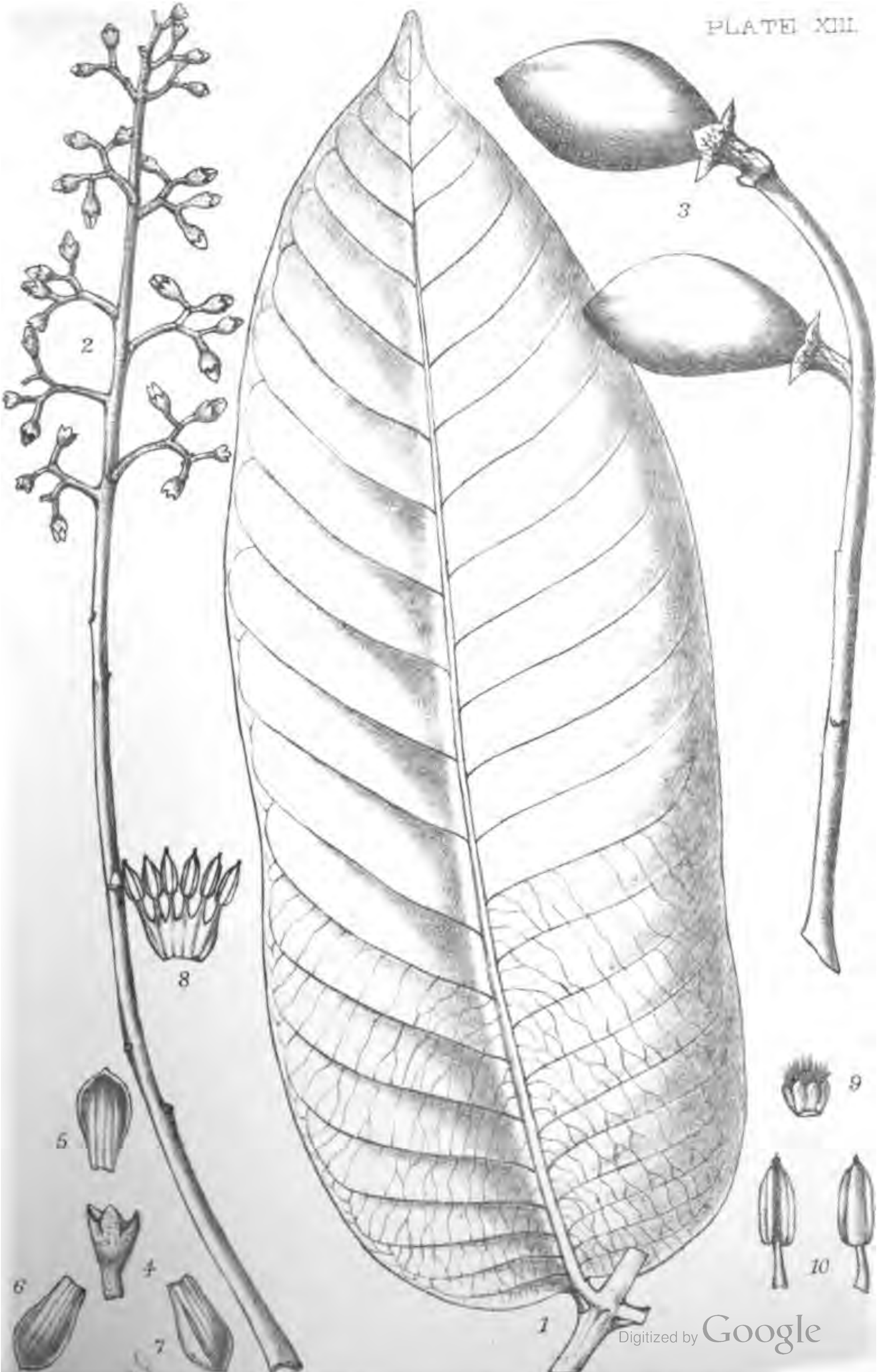

Lith: by A L S

INDEX.

Names of New Genera and Species have an asterisk (*) prefixed.