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THE  
GARDENS' BULLETIN

STRAITS SETTLEMENTS (Nos. 1-3)

SINGAPORE (No. 4)

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# THE GARDENS' BULLETIN

STRAITS SETTLEMENTS (Parts 1—3)

SINGAPORE (part 4)

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STRAITS SETTLEMENTS

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Part 1

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STRAITS SETTLEMENTS

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Vol. XI

31st May, 1939

Part 1

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AMENDMENTS PROPOSED TO THE INTERNATIONAL  
RULES OF BOTANICAL NOMENCLATURE (1935)

by C. X. FURTADO,  
*Botanic Gardens, Singapore.*

1. Introductory Remarks

1. In proposing amendments to the Rules, I make the following distinctions in names: valid and invalid, priorable and impriorable, legitimate and illegitimate.

2. VALID AND INVALID. Names that are invalid have no status under the Rules and therefore no claim to recognition by botanists (Art. 19A of present amendments\*). Such names are easily recognized by their defects in one or more of the points enumerated in Art. 2B (for exception *see* para. 3 below). The names that satisfy the Rules on all the points concerning validity are called valid (Arts. 2B and 19A).

3. The main and really important difficulty in connection with judging the validity of names concerns the quality of their description, which, while it may be considered by some as sufficient to validate a name, by others may be judged insufficient (*see* FURTADO in *Blumea*, Suppl. I, 1937 pp. 128-132). But provision has been made in these amendments for empowering the Congress to declare, by means of a decision, the validity or invalidity of such questionable names (Art. 21B-b), so that they may not "throw science into confusion" (Art. 4).

4. PRIORABLE AND IMPRIORABLE. It is admitted in the Rules that the use of certain valid names "may cause error or ambiguity" in nomenclature (Art. 4). Such

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\* Where letters A, B, etc. follow the number of Articles quoted in this discussion, the reference is to the present proposed amendments.

names are rejected simultaneous homonyms, later homonyms of equal rank and later non-typonymous (formal) homonyms of unequal rank (Arts. 61A & B). These are the only valid names (besides those on which a special decision has been made by the Congress) that I consider should be impriorable, that is, they must not be included in priority considerations (Arts. 56A, 61A & B).

All other kinds of valid names, including those published in violation of the priority rule (Art. 56A), can be used without causing "error or ambiguity" in nomenclature, provided they are well typifiable. These should in my opinion be included in priority considerations (priorable names).

If not certainly typifiable, or if their inclusion in priority considerations would cause either confusion or many undesirable changes in the current nomenclature of plants, the Congress is empowered to suspend in such cases the rule of priority and prevent the changes. (Arts. 21 A-D and 62A).

No doubt the existence of well typified or well-typifiable synonyms causes much inconvenience, but under the new Rules they must be tolerated as a necessary though burdensome legacy from the past. As it will be seen later, this burden is made even greater by giving a valid status to such synonyms while denying them any claim to priority. Moreover the priority rule decides the legitimacy of names (vide infra), and its violation can render a name only illegitimate (vide infra). The priorability of names should therefore be decided without any reference to the priority rule, for this is applied only to such names as are priorable; hence it is fundamentally unsound to make priorability of names dependent in certain cases on the application of the priority rule.

5. LEGITIMATE AND ILLEGITIMATE. Names that are priorable may, under the present ruling, be either correct (legitimate) or incorrect (illegitimate), according to the circumscription, position and rank of the taxonomic group. A taxonomic group in given circumstances can bear only one legitimate name, the one that satisfies the priority rule (Arts. 16A and 56A). All other synonyms of the group under the circumstances are illegitimate names for the group.

6. A name published in contravention to the principles embodied in Arts. 16A, 17A-B, and 56A cannot be the oldest priorable name if the circumscription, position or rank given by its author is correct. Consequently occasions when it would be possible to legitimize such a name, or its epithet, will not often arise; but they may occur for instance when



older priorable names or epithets have later become unusable either in the required position or according to subsequent correction of typification or circumscription. But when such an occasion arises it would be better to allow the name or its epithet (if unambiguous and not to be abandoned because of a special decision of the Congress) to be legitimized on the principles of economy and seniority, as embodied in the priority rule (Art. 56A), than, by denying priorability to such a name, to complicate the application of the rules both of priority and of priorability. For the greatest objection against outlawing unambiguous valid names published in violation of the priority rules arises from nomenclatural jurisprudence itself, which, as shown in Section 4 above, cannot logically allow the priorability of names to become dependent on the application of a rule (the priority rule) which is applied only to priorable names or epithets; the violation of the rule of priority should only render a name illegitimate in the sense defined in these amendments.

Moreover no advantage is gained by denying priorability to such unambiguous specific names as are capable of rendering their later homonyms impriorable: on the contrary such a denial not only does not maintain the principle of economy in epithets but also creates a class of unusable names which are both valid and unambiguous. No doubt such names were unusable also according to the 1905-1910 Rules; but under those Rules such names were also invalid and so incapable of rendering their later homonyms impriorable. The 1935 Rules give valid status (Art. 37) to names published in contravention to the priority rule; and it is absolutely essential that the rules concerning validity, priorability and priority (or legitimacy) should not be confused so as to render their application difficult.

Moreover, as the example discussed below will show, there is no proper reason why certain offences against the priority rule should be singled out for penalization and others escape it.

### Example:

In a hypothetical case DOE describes a new monotypic genus called *Codactyla* DOE (1920) and publishes a non-validable specific name *C. floribus plenius longipendunculatus* DOE (1920). In 1921 ROE redescribes the genus as *Dactycola* ROE and renames the type species of *Codactyla* as *D. multiandra* ROE. Later in 1922 ROE describes another species *D. quinquefolia* ROE. In 1923, however, DOE claims priority to *Codactyla* DOE (1920) over *Dactycola* ROE (1921) and manifests his predilection to Greek by renaming the species *C. polyandra* DOE nom. nov. (*C. floribus plenius longipendunculatus* DOE = *D. multiandra* ROE) and *C. pentaphylla* DOE nom. nov. (= *D. quinquefolia* ROE).

Now here ROE was wrong because the taxonomic group *Dactycola* as circumscribed by him included the type of *Codactyla* which name he ought to have adopted under one or more of the Rules not only as the correct name for the genus but also as the first part of the specific names. Consequently both *D. multiandra* and *D. quinquefolia* are "illegitimate" names under Art. 2. and the names or the combinations not being "strictly in accordance with the Rules" cannot be taken into consideration for the purposes of priority (Art. 45); and so *C. polyandra* and *C. pentaphylla* should be legitimized. But the definition of "illegitimate" names or combinations in Art. 60 of the 1935 Rules does not cover offences of this category; and, consequently, under Arts. 60 and 69, *D. multiandra* and *D. quinquefolia* are good priorable names and *C. pentaphylla* and *C. polyandra* must be rejected as "illegitimate" impriorable names.

Now a specific name consists of two parts and in my opinion there is no justifiable reason why an offence concerning the second part should be penalized and not the offence concerning the first part. Under the present Rules all the four specific names are valid; it is therefore but just that the names should be made priorable also. Normally the specific epithets created by DOE (1923) could not be legitimized because they are younger than the ones created by ROE; but circumstances may arise when ROE's epithets become non-legitimable under *Codactyla* (e.g. when they have been employed under *Codactyla* before transference to it of ROE's epithets). Under such circumstances rather than create new specific epithets and complicate the rule of priority, DOE's specific epithets *polyandra* and *pentaphylla* should be legitimized.

Dr. T. A. SPRAGUE's definition (approved by the Amsterdam Congress) of superfluous names reads thus: "A name is illegitimate 'if it was nomenclaturally superfluous when published, i.e. if the group to which it was applied, as circumscribed by its author, included the type of a name [or epithet?] which the author ought to have adopted under one or more of the Rules' (Art. 60, 1)." Under this definition *D. multiandra* ROE is a superfluous name because it includes the type of *Codactyla* DOE which ROE ought to have adopted "under one or more of the Rules" as the first part of the binomial; but *D. quinquefolia* ROE cannot (?) be called superfluous. Whether it was the intention of the legislators to include *D. multiandra* ROE as a superfluous name it is not clear.

7. HOMONYMS AND ORTHOGRAPHY. Owing to the varying taxonomic opinions of botanists, it is impossible to apply uniformly the old precept "once a synonym always a synonym." But the maxim "once a later homonym always a synonym" has been upheld in all names of equal rank and in all non-typonymous names of unequal rank where formal homonymy can occur under these amendments. It is therefore now no longer possible to invoke the plea of typonymy and illegitimacy of an earlier valid name in order to legitimize a later name having the same spelling and position and rank as the earlier name (Art. 61A & B).

8. I also submit that the Committee of Nomenclature might be empowered to investigate into the full consequences of the rules concerning homonymy and orthography of

names and to make some general rules by which botanists might be able to decide in the majority of cases whether or not a certain name is a homonym or a orthographic variant. I further submit that until this problem is fully reported upon, proposals for the rejection or conservation of homonymous names should not be approved. (see FURTADO in Gard. Bull. Straits Settl. IX, 1937 pp. 249-255). It is also necessary to decide whether or not the groups of epithets of the following category are homonymous: *javensis*, *javanensis*, *javana*, and *javanica*; *annamensis* and *annamitica*; *philippina*, *philippinensis*, *philippensis* and *philippica*; *ceylonensis*, *ceylanica*, *zeylanica*, *singalana*, *singalensis*, *singhalensis*, *sinhalensis*; *celebica*, *selebica* and *celebesiana*; *lisbonensis* and *ulyssiponensis*; *malayana*, *malaiana*, *malajana*, *malayensis*, *malaiensis* and *malesica*; *burmensis*, *birmanensis*, *birmensis*, *burmanica* and *birmanica*; etc.

9. In the proposed amendments which follow, I have gathered together all the provisions pertaining a particular aspect of the names of each kind of taxonomic groups in order to effect a condensation in the Rules. This condensation is desirable to prevent the invocation of one rule for defending the validity of a name which is invalid under another rule. (In some recent papers Art. 37 has been invoked to maintain as valid certain generic names which are invalid under Art. 42). The proposed re-arrangement would also enable anyone to detect more readily any flaws that later proposals might introduce into the Rules.

10. TAUTONYMS: I propose the elimination of the rule of tautonyms because the present definition, or its interpretation, is ambiguous. It is true that, in 1930 at Cambridge, tautonyms were rejected as invalid ("illegitimate" according to the terminology adopted in 1935 Rules) and the rule was later confirmed at Amsterdam (1935); but this rejection was apparently made without considering the status of many names that can be called tautonyms. It also appears that the intention of 1930 legislation was only to reject absolute tautonyms like *Linaria Linaria*, and *Radiola Radiola*, but not names like *Linaria Linariana*, *Radiola Radiolaris* and *Nasturtium Nasturtium-aquaticum*, though the last name is mentioned in the 1935 Rules as an example of invalid tautonyms. Moreover the rejection of absolute tautonyms was not considered in relation to the rule of the orthography of names (Art. 70); for though *Bradlea Braddleya*, like *Cuminum Cuminum*, may not be regarded as an absolute tautonym, yet when the generic names is spelt as *Braddleya*, which according to Art. 70 is a mere orthographic variant of *Bradlea*, then the correction



of *Bradlea Braddleya* would produce the absolute tautonym *Braddleya Braddleya*. And *vice versa*, the absolute tautonym *Braddleya Braddleya*, when corrected as to the generic name, would produce a non-tautonymous name *Bradlea Braddleya*.

An absolute tautonym must therefore be defined as a specific name in which the specific epithet is homonymous with the generic name. If this definition were admitted and if it were further admitted that *Asplenium Trichomanes* and *A. Trichomanes-dentatum* are not pairs of homonyms, then *Nasturtium Nasturtium-aquaticum* and *Radiola Radiolaris* cannot be regarded as absolute tautonyms; and *vice versa*, if *Nasturtium Nasturtium-aquaticum* were admitted as an absolute tautonym under this definition, then *A. Trichomanes* and *A. Trichomanes-dentatum* would have to be regarded as a pair of homonyms. It is therefore not possible to legislate on tautonyms without considering the rules of orthography and homonymy of names.

The objection that the admission of absolute tautonyms would involve many changes in the names that have become long current also holds good in the case of quasi-tautonyms; for formerly absolute tautonyms and quasi-tautonyms were treated on the same footing. And perhaps more name changes are involved by admitting quasi-tautonyms like *Cajanus Cajan*, *Kandelia Candell*, *Normanbya Normanbyi*, *Sullivantea Sullivantii* and *Timonius Timon* than by admitting absolute tautonyms.

Furthermore it should not be overlooked that, in the majority of cases, the existence of absolute tautonyms is a legacy of a nomenclatural system which did not regard the economy of epithets in naming taxonomic groups as a fundamental principle and which therefore permitted, in naming a new genus, the use of the oldest priorable epithet of the type species on which the new genus was based.

Now that economy in epithets has become a fundamental principle in the new Rules, the correct procedure should have been to reject the generic names published in contravention to this principle. But since such a rejection is now not possible because it would involve many name changes, the remedy does not lie in outlawing the specific epithets which, by applying the principles of seniority and economy to the epithets of unambiguous (priorable) names, have produced, or would produce, absolute tautonyms. It would be indeed advantageous to admit the tautonyms in such cases, for they would help to indicate the generic types. However, the advisability of restricting their employment in future only to name the generic types

might be considered. It may be remarked here that zoologists have found it useful to admit all tautonyms as valid legitimate names.

In view of these considerations it appears to me that the decision to outlaw indiscriminately all absolute tautonyms is not only arbitrary but also impracticable and in many cases disadvantageous to the present nomenclatural system. The decision is also against the principle which directs that "the rules of nomenclature should be . . . . . founded on considerations sufficiently clear and forcible for everyone to comprehend and be disposed to accept" (Art. 3).

#### 11. NOMINA CONSERVANDA AUT REJICIENDA.

An amendment to the Rules is here proposed for eliminating the possibility of securing the conservation of a name under false pretexts and of then claiming for the conserved name a force far in excess to that given to it by the Congress. (Art. 21A-B). Under the 1935 Rules the conservation of a name secured merely on orthographical grounds could have been used to render non-legitimate or impriorable its earlier synonyms and homonyms. Under the present proposed Amendments this contingency would not be possible.

12. Further, the generic names rejected *vis-à-vis* a nomen conservandum are termed at present nomina rejicienda; but the names thus rejected can be legitimized when they are neither homonymous nor synonymous with any of the conserved names. Yet nomina ambigua and nomina confusa are also regarded as nomina rejicienda, though they can never be legitimized. This equivocation or ambiguity is removed in the present proposals by adopting a classification which shows the precise effects of a Congress decision to conserve or to reject a name (Art. 21B).

13. I also submit that the Committee may be empowered to explore into the problem with a view to establishing some definite principles by which to appreciate the proposals concerning the conservation of names under Art. 21B-C. Until this is done I submit that no name should be permanently added to the lists of nomina conservanda made in 1905-1912 except to protect a use of a name current for a hundred years or more (*see* FURTADO in Gard. Bull. Straits Settl. X, 1939 pp. 180-181). The list of 1905-1912 and the names which have more recently been conserved on orthographic grounds should be re-arranged so as to conform with the proposed amendments in Art. 21B.

14. NOMINA AMBIGUA. The rule of nomina ambigua (Art. 62) is here revised so as to conform with its

original meaning. There has been of late a tendency to attach little or no importance to the word "permanent" in the rule. This, coupled with the abbreviation of the discussion given under *Rosa villosa*, has enabled the newer interpretations of the rule to pass as equivalent to the correct and traditional one. But from the discussion given of *Rosa villosa* under the 1905-1910 Rules and from the remarks elicited from eminent nomenclaturists who attended the 1930 as well as the 1935 Botanical Congress, it is evident that the legislators intended to consider as nomina ambigua only those names which have not only owing to their use in different senses, become a source of confusion, but also are admittedly incapable of any certain interpretation, so that the impossibility of removing the existing confusion is generally conceded to be *permanent*. On the other hand the Rules provide for disregarding all interpretations (irrespective of their number and of the length of their currency) if they are contrary to the type (Arts. 18 & 50-55). The existence of certainly identifiable types is also recognized as the chief means of correcting misinterpretations or misapplications of names.

15. TWO NEW APPENDICES: In 1935 at Amsterdam a proposal to invalidate certain works was put before the Botanical Congress by Dr. A. J. WILMOTT; but the Congress, regarding a statistical investigation into the effects of the proposal upon the current nomenclature as an essential preliminary to its consideration, referred the proposal to a special Committee for the necessary exploration. The task assigned to the Committee is not a light one, and it is doubtful whether all the necessary data will become available at the next meeting of the Congress. Hence in Arts. 21C-D means are proposed by which the principal aim of Dr. WILMOTT'S proposal might be secured without the statistical data.

The principal object of the proposal evidently is to prevent botanists from delving into the works proposed for invalidation in order to resuscitate generic and specific names, or their interpretations, such as might lead to many changes in the long established nomenclature and thus greatly impede botanical research. An examination of the opinions expressed on Dr. WILMOTT'S proposal and of similar ones submitted at previous Congresses by several botanists (cf. also SPRAGUE, Preliminary Opinions, 1935 p. 5) reveals no objections either to the principle, or to the main purpose, of the proposal. Consequently both its principle and its purpose may be taken to have the approval of botanists in general.



The importance of the principle underlying the proposal lies in the fact that it recognizes implicitly the existence of some strong reasons why certain works were either generally ignored, or allowed only a partial validity, by contemporary and subsequent botanists, and consequently, that it is now inconvenient, if not unreasonable, to force the entire nomenclature from such works upon the modern botanist, even if he has pledged himself to the rules of priority and retroactivity.

Just as a provision has been made in Art. 21 of the Rules to suspend in certain cases, the undesirable effects of the rules of priority and retroactivity, so also a provision appears to be necessary against the undesirable consequences of having to accept as valid the works, or some names in them, which had been generally disregarded by previous botanists. A suitable provision in the Rules, to guard against such a contingency, would also induce botanists to consider the advisability of denying validity to obscure tracts such as they may have unearthed from a long botanical oblivion and to prevent them from basing on these tracts changes in the long established nomenclature of plants.

The two proposed new Articles, each with its own Appendix, would secure this result. Art 21-C practically embodies the whole of Dr. T. A. SPRAGUE'S suggestion made in the *Preliminary Opinions* (1935 p. 8); and Art. 21D is aimed to secure the invalidation of the long disregarded names in works proposed for rejection by Dr. WILMOTT. But it may be remarked that the binomial combinations adopted in GANDOGGER'S *Flora Europae* for the subdivisions of species must be rejected as invalid, because they are not formed in accordance with the Rules which prescribe trinomials or multinomials for the taxonomic groups below the rank of species (Art. 28). Hence the binomials cannot be included in consideration of homonymy. Even if the question of their valid formation were overlooked, their existence could not be invoked to render impriorable specific names which are later orthographical homonyms of the "ternary" binomials; for the rule of homonymy operates only when the names considered are of the same rank (Art. 61) or formally of the same rank (Art. 61A-B). The principle involved here is the same which prevents the activation of the rule of homonymy against generic names when confronted with homonymous earlier univocal designations for species. The fear that GANDOGGER'S binomials for the subdivisions of species, if not invalidated by a special decision of the Congress, "are likely to necessitate the rejection of a large and increasing number of names by

Art. 61 (later homonyms)" (SPRAGUE *l.c.*) is, therefore, unfounded. Hence the necessity of including GANDOGGER'S work in this Appendix X should be further explored.

16. HYBRIDS. The Rules seem to be rather ambiguous on the status of the names of hybrids, and current practice is too contradictory to be of any use in expounding the correct application of the Rules.

One school of botanists would associate the name of a hybrid with the taxonomic group represented by the type and would disregard all proofs and speculations concerning the hybridity or origin of the group. "The purpose of giving a name to a taxonomic group," they would say, "is not to indicate the characters or the history of the group, but to supply a means of referring to it" (Art. 15). This contention accords fully with another fundamental principle in nomenclature which requires every name to be associated with the type of its description, the ultimate type of every description being a specimen (Arts. 18 and 50-55).

But another school of botanists would disagree with this view and would change the name of a hybrid every time a different ancestry were attributed to the hybrid, even when the ancestry were different nomenclaturally only and not taxonomically. This procedure allows not only the association of names of hybrids with their parents or ancestors in place of the taxonomic group represented by the type specimen, but also the creation of names to cover hypothetical groups which have not been produced at present and which might never be produced in the future. Thus, according to this view, the name *Cistus Skanbergii* LOJAC, published on the assumption that it represented a good species, ought to have been changed when TURRILL considered it to represent a hybrid between *C. monspeliensis* and *C. parviflorus* (Bot. Mag., 1938, t. 9514); similarly the name *Amelasorbus Jackii* REHDER, published on the assumption that it represented a hybrid between *Amelanchier florida* LINDL. and *Sorbus sitchensis* ROEM., ought to have been changed when JONES considered it to be a hybrid between *Amelanchier florida* and *S. scopulina* GREENE (Journ. Arnold Arb. XX, 1939 p. 22), even though it may not be possible to produce any cross between the parents originally indicated for this hybrid. The reason why the botanists of this school ignore the fundamental principles respected by the botanists of the first-mentioned school, is that hybrids, according to their view, are pseudo-taxonomic groups and not real taxonomic groups, though for the purposes of homonymy they claim for the names of hybrids equal footing with the names of non hybrid groups of the

corresponding rank. They defend their contention on the following provisions:

"All plants raised by crossing the same two species receive the same 'specific' name, variations between the seedlings being indicated where necessary by varietal names....."  
(Appendix VII-g).

"All hybrids.....between the same two genera bear the same 'generic' name" (Art. 32).

A curious anomaly in this procedure is that, while a proper description based on a type is considered as essential for the validation of a "specific" name of a hybrid (though both the type and the description are to be ignored under this procedure should there be a change in the speculations concerning the parentage), a similar description is considered unnecessary, if not misleading, to validate a "generic" name of an intergeneric hybrid (the formula indicating the parents being considered as absolutely essential for its validation).

A third school of botanists would invalidate all names of hybrids of uncertain origin and quote the following in support of this their contention:

"If a Latin name has been given to a hybrid form of uncertain origin which cannot be referred to a Latin binomial, it must be treated like a vernacular (fancy) name; e.g. *Rhododendron* 'Atrosanguineum'....." (Appendix VIII-f).

Here the rule is also ambiguous: Is the name to be invalidated only when the hybrid is of uncertain origin, or when the name cannot be referred to a Latin binomial? If the former, then the procedure defended by this school of botanists is justified; if the latter, then the rule is superfluous because all non-binomial names of species (real or hybrid) are invalid. Or does it mean that names are invalid only when they satisfy both these conditions, so that a name has to be regarded as valid if it is either a Latin non-binomial denoting a hybrid of certain origin, or a Latin binomial denoting a hybrid of uncertain origin?

Obviously such a state of affairs is not conducive to the stability in nomenclature. And unless new fundamentals are clearly propounded to defend a contrary procedure, I submit that the procedure expounded by the first named school should be admitted as the correct one, because it complies with the fundamentals of the present nomenclature. Moreover it recognizes the well-known facts that it is sometimes possible either to produce the same kinds of hybrids from different pedigrees, or to obtain, from a progeny of a cross, plants which are exactly identical with either of the parents; consequently it is unsystematic either to distinguish the same kinds of plants by different names merely because they are of different ancestry, or to lump



together different kinds of plants under the same name merely because they have the same ancestry. The procedure recommended here, therefore, disallows a formula indicating the parents (real or putative) to take the place of the description required to validate a name under Art. 37.

The rejection of a formula as insufficient to validate the technical names of hybrids would also contribute to restore some order in the nomenclature of hybrids. Some gardeners, in publishing names to the hybrids raised by them, have deliberately assigned a wrong parentage in order to delay the production of the same hybrids by their rivals. Yet such names become current long before the public come to know of the true parentage. If the ordinary procedure of a description in Latin were required in the case of all valid names of hybrids of all degrees, the names created by gardeners would be technically invalid, unless they were also accompanied by appropriate descriptions; and so botanists would be able to straighten the nomenclature of the hybrids.

However in the case of "generic" names of intergeneric hybrids, this procedure, if approved, might provoke resentment among horticulturists: firstly, because they have come to associate such a "generic" name as a convenient abbreviation of a formula denoting the generic status of the hybrid; and secondly, because many such "generic" names, although established by reference to their parents only, have become long current and their rejection now would cause many name changes. In order, therefore, to avoid such name changes, it would be desirable to appoint a Committee to investigate the status of "generic" names of intergeneric hybrids and to recommend their conservation and typification where necessary.

On the other hand, an asexual "hybrid", if not a monstrosity falling within the meaning of the provision in Art. 65, is at least a compound or composite individual formed by the fusion or union of somatic parts of two or more individuals, each often retaining its specific character. In some respects an asexual "hybrid" is comparable to the compound individual resulting from a symbiotic or parasitic association of one organism with another: *e.g.* the association of the parasite *Cuscuta* with the host *Myrica*, or of the scion *Achras sapota* with the stock of *Mimusops hexandra*; and so such an individual cannot be regarded as representing a taxonomic group and should not have a valid name under the proposed Art. 22-c (cf also Art. 64). The names of asexual "hybrids" must therefore be given the same status as the horticultural names, which have no power to render their later homonyms impriorable.



However such chimaeras and the "monstrous" hybrids as are reproduceable by seed should become the subjects of a taxonomic inquiry even though their reproduction be by apomitic seed only; and so their names, if duly published by a description, should be nomenclaturally valid.

If these principles were admitted, appropriate changes in the wording of Arts. 31-34 would be necessary.

17. TYPES: I also submit that the nomenclature of types and the regulations to determine them as worked out by me in *Gard. Bull. Straits Settl.* IX 1937, pp. 285-309, may be considered by a special Committee with a view to investigating the feasibility of their being incorporated in Appendix I.

18. REPRESENTATIVE BOTANICAL INSTITUTIONS. I also submit that the Committee might consider the utility of working out a list of the Representative Botanical Institutions under Art. 36 on the principles elaborated by me in *Gard. Bull. Str. Settl.* IX 1937 pp. 273-279.

## 2. Amendments

(Where the letter A follows the number of an Article, the amendment is to the text of that Article in the existing Rules. Where other letters are used, the amendments are additions to or transpositions of the existing Rules).

Art. 2A: DELETE: "Names or forms of nomenclature contrary to a rule (*illegitimate names or forms*) cannot be maintained."

[This forms a rule by itself; moreover, the definition of an illegitimate name or form given here does not accord with its definition given elsewhere].

ADD the following to this Article: "Where necessary *notes* are added in order to make the meaning of the rules, or of the words used in them, unequivocal and precise."

Art. 2B: The rules are divisible into two main classes:

- (a) those dealing with fundamentals or validity, and
- (b) those dealing with applications or legitimacy.

(a) The rules concerning validity of names are again divisible into the following groups: (1) the admissible order of the different taxonomic groups; (2) the formation of botanical names to denote these categories and their order; (3) the nature of a description or citation upon which the name may be based; (4) decisions of the Congress to meet special cases; (5) the nature of publications or literature, wherein the descriptions and names are published; and (6) the dates, the typification and the interpretation of names.

(b) The rules of legitimacy are divisible into the following groups: (1) the correct name for a given taxonomic group under given circumstances; (2) the correct orthography of names; (3) the correct gender of names; (4) priorability of names.

Art. 13A: DELETE the last sentence which is by itself a rule. (It is embodied in Art. 19A.)

Art. 16A: REVISE as follows:

Each taxonomic group with a given circumscription, position, and rank can bear only one *legitimate* name, the one that is in accordance with the type and priority principles (cf. Arts. 18A, 19B, 21B, 53A, and 56A).

Art. 17B: No one may change, modify, or refuse to accept a name, or epithet, merely because it is badly chosen, or disagreeable, or because another is preferable or better known.

[A name published in contravention to Art. 59 may still be valid and if so would be included in considerations of homonymy. Art. 59 is thus a commentary on Art. 17 and should be placed with it].

Art. 18A: In the first paragraph instead of "see Art. 66" in brackets READ: "see Arts. 50-52, 53B and Appendix I."

Art. 19A: REVISE the rule as follows:

Names, descriptions, publications, interpretations, typifications, or procedures contrary to a rule of validity are *invalid*, that is, they have no status under the Rules, and no claim to recognition by botanists; while those names, descriptions, etc., that satisfy every one of the validity rules are *valid*, that is, they have a status under the Rules and a claim to recognition by botanists. Names and descriptions denoting a classification contrary to Arts. 10-14 or published in invalid literature are not valid.

Art. 19B: Rules of legitimacy regulate the use of names which are valid under Art. 19A. The use of a valid name is correct or legitimate only if it satisfies every one of the legitimacy rules: otherwise the use is illegitimate.

Art. 20A: SUBSTITUTE for the first sentence the following:

No literature can be valid unless it is validly published (cf. Art. 36A). Valid botanical literature begins for the different groups of plants at the dates and with the books specified below:

Art. 21A: DELETE Notes 3 and 4 and Examples.

[It is desirable that every proposal for the conservation or rejection of names should be accompanied with an indication of its full force, so that decisions of the Congress may not be given a force far in excess to that given by the Congress. The Congress act on the premises submitted, so that if the premises are essentially invalid, the decision given under those premises should also be invalid. Thus, if the Congress were to conserve *Endlicheria* NEES (1833) (Lauraceæ) against *Endlicheria* PRESL. (1832) (Rubiaceæ) on the assumption that these two are homonymous names, this decision should stand as long as the Rules permit botanists to consider these two names as homonymous, but not otherwise. If the two names were not homonymous and if it were still desired to abandon *Endlicheria* PRESL. (1832) altogether, then a different decision of the Congress would be necessary and under the text of Art. 21 motives for outlawing the names would have to be explained. Further, even if *Endlicheria* and *Endlicheria* were admittedly a pair of homonymous names, *Endlicheria* NEES (1833), if conserved against *Endlicheria* PRESL. (1832), should not take precedence over all synonyms and homonyms which are older than *Endlicheria* PRESL. (1832). Proposals for conservation or rejection of a name should be accompanied with the fullest possible details concerning the necessity for conservation or rejection especially now when there is a tendency among some botanists to split older genera so as to render a synonym of one into a legitimate name of another. It is also undesirable that the conservation of a name made only on grounds of orthography should be the means to invest that name with all the power embodied in Notes 3 and 4 which would render all its earlier synonyms and homonyms impriorable; if the latter was also desired, then the required data should be presented at the time of making the proposal. The amendments proposed below (Art. 21B) eliminate these undesirable elements in the original Art. 21].

Art. 21B: The conserved and rejected names must be classified in the following groups: (a) Orthographia nominum approbata; (b) Nomina rejecta aut invalidata; and (c) Nomina precedenda.

(a) *Orthographia nominum approbata*. The decisions given here affect only the orthography of the names placed in the list, but the dates of their publication (under the rejected orthography) are retained. Examples: Thus when *Humiria* JAUME ST. HIL. (1805) is conserved against *Houmiri* AUBL. (1775) on orthographic grounds, *Houmiri* AUBL. (1775) must be spelt as *Humiria* and its full citation is *Humiria* AUBL. (1775) emend. orth. JAUME ST. HIL. (1805) vice *Houmiri*. Similarly, *Heleocharis* R. BR. (1814) emend. orth. vice *Eleocharis*.

(b) *Nomina rejecta aut invalidata*. Names lose their valid status when placed here: if used again for



the same or another taxonomic group with adequate description, these have the status of new names.

[Certain names of a doubtful status (e.g. *nomina confusa*) and those that are generally ignored as insufficiently described (*nomina semi-nuda*, e.g. *Giganthemum* WELW. 1859) should be placed here. Placing such names among *nomina invalidata* would save a good deal of trouble to botanists and avoid unnecessary changes in nomenclature on the grounds of priority or homonymy. Perhaps here could also be included the *nomina ambigua* as defined below in Art. 62A].

- (c) *Nomina precedenda*: A name placed by the Congress in this category acquires a right of precedence in matters of priority or homonymy over certain other names specified in the decision and their later synonyms and homonyms, and over no others, provided the specified names over which precedence is given are either synonymous or homonymous with the *nomen precedendum*.

Examples: (1) In the Rules *Spergularia* J. & C. PRESL. (1819) has been conserved against *Buda* ADANS. (1763) and *Tissa* ADANS. (1763). This means that either of these names are to yield precedence to *Spergularia* whenever they are synonymous with the latter, but not otherwise. It also means that all later synonyms of *Buda* and *Tissa* cannot claim priority over *Spergularia*, even though they be earlier than *Spergularia* itself. But should there be a priorable synonym to *Spergularia* which is earlier than *Buda* or *Tissa*, it would be able to claim right of priority over *Spergularia* until special decision of the Congress makes it yield that right to *Spergularia*.

(2) If it is desired to conserve *Endlicheria* NEES (1833) (Lauraceæ) against *Endlichera* PRESL. (1832) on the grounds of homonymy, then the latter must be mentioned *vis-à-vis* the former. Such a conservation would make *Endlicheria* NEES (1833) take precedence over *Endlichera* PRESL. (1832) and its later homonyms, but would not give *Endlicheria* NEES (1833) precedence over the synonyms or homonyms that are *earlier* than *Endlichera* PRESL. (1832). But this decision would lose its validity as soon as an amendment were introduced in the Rules to make *Endlichera* PRESL. and *Endlicheria* NEES as non homonymous names.

Art. 21c: Works listed in Appendix IX are treated as invalid, because their acceptance would constitute a



serious impediment to botanical research. Only works of doubtful validity, or published posthumously thirty or more years after the deaths of the authors, or ignored generally by the contemporaries of the authors, may be listed in this Appendix.

(1) RAFINESQUE, *Autikon Botanikon*, 1840; (2) MOCIÑO et SESSÉ, *Flora Mexicana*, 1888 et 1894; (3) *ibid*, *Plantae Novae Hispaniae*, 1886 et 1893; (4) TEYSMANN et BINNENDIJK, (Plant Catalogue of the Buitenzorg Gardens), 1855; (5) Sir WILLIAM HUNTER, *Plants of Prince of Wales Island*, (ed. H. N. RIDLEY), 1909; (6) VOIGT, *Hortus Suburbanus Calcuttensis*, 1845; (7) Numerous Theses including those of some of the pupils of LINNAEUS, THUNBERG, etc., Catalogues, Nomenclators and Indexes which have been ignored in larger works up to very recent times: e.g. ROXBURGH, *Hortus Bengalensis*, 1814; MOON, *Catalogue of Indigenous and Exotic Plants of Ceylon*, 1824; ZINN, *Catalogus Plantarum . . . . . Gottingensis*, 1757; BURMAN, *Index to RUMPHIUS'S Herbarium Amboinense*, 1755 et 1769; STICKMIAN, dissertation on RUMPHIUS'S *Herbarium Amboinense*, 1754 et 1759; BERZELIUS, dissertation on *Nomenclator Botanicus*, 1759; etc.

[Most of the names from the works listed in (7) should be invalid according to my interpretation of the Rules—see Gard. Bull. Straits Settl. X, 1939, pp. 162–172].

Art. 21D: Both generic and specific names published in the works listed in Appendix X are treated as invalid if they have consistently been either ignored, or reduced to synonymy, in monographs and important floristic works published between 1798 (the date of WILDENOW'S *Species Plantarum*, Vol. I) and 1890 (the year preceding the publication of KUNTZE'S *Revisio*) both inclusive; but such names from books listed in Appendix X as have been either conserved in the Rules or used in one or more monographs or important floristic works (*i.e.* floristic works running to more than one volume) issued between 1798 and 1890 are treated as valid. Mere registration of names in nomenclators and indexes does not constitute their subsequent use under this rule. Only works published between 1753 and 1800 both inclusive may be included in this Appendix X.

[All works proposed for invalidation by Dr WILMOTT in Appendix VIIbis of 1935 are to be included in this Appendix X provided the reasons given be satisfactory. See Preliminary Remarks, Sect. 15].

Art. 22B: The long accepted interpretation of a name must not be disregarded without proofs or adequate botanical reasons. When retypification is necessary, under equality of circumstances, the lectotype or neotype selected must conform with the long accepted interpretation of the name.

*Note.*—By PROOFS or ADEQUATE BOTANICAL REASONS are meant reasons why the name must be attached to a particular taxonomic group and not to any others, or proofs that the description given under the name agrees with the taxonomic group newly identified with it and conflicts with the older identifications.

Art. 25A: DELETE: “and written with an initial capital”. (This belongs to the orthography of names. cf. Art. 70C).

ADD: But no generic name is valid unless: (1) it is intended definitely as a botanical name, and not merely a non-botanical designation of the genus; (2) when coinciding with a technical term currently used in morphology, it was both published before 1912 and accompanied simultaneously by one or more duly validated specific epithets under it; and (3) it is a univocal consisting either of a single word or of two or more words united or hyphenated when originally published.

ADD: Examples (1), (2) & (4) from Art. 67.

[This addition is from Art. 67 which would be better united with Art. 25. Reference to “unitary designation of species” is unnecessary, because specific names cannot be generic names, cf. also Art. 19A and Art. 27A].

Art. 26A: READ: “Epithets denoting subgenera and section” instead of “Names of subgenera and sections” in the first line; and “Epithets denoting subsections” instead of “Names of subsections” in the second line.

ADD: It is permissible to reduce more complicated names to biverbal combinations provided an appropriate sign or word precedes the epithet to denote its category.

OMIT: “Agreeing in gender with the generic name and written with an initial capital”.

[Since the old phrase “specific name” has given way to “specific epithet”, it is necessary also to abolish the phrases “subgeneric name”, “sectional name”, etc., because the epithet denoting a subgenus, section, etc. is not the full name and cannot stand by itself without referring to the appropriate genus. The portions referring to gender and orthography are transferred to their appropriate sections].

Art. 27A: REVISE thus:

Names of species are binary combinations consisting of a valid name of the genus to which the species is referred followed by a single specific epithet. Symbols forming a part of specific epithets proposed by LINNAEUS must be transcribed. But no specific epithet is valid unless: (1) it is a univocal, consisting either of one word or of two or more words united or hyphenated at the time of publication (an epithet of two disunited or unhyphenated words being allowed as exceptions in books and papers in which univocal epithets have been generally employed); (2) it is intended definitely to be a botanical specific epithet and not merely a non-botanical designation; (3) it is not merely an ordinal adjective being used for enumeration; and (4) it is published in a work in which the bivalent binomial system of nomenclature for species as defined in the first sentence and the first alinea of this rule has been consistently employed (an occasional exception only in any work shall not render such work invalid).

ADD: Examples: (1), (2) and (4) in Art 68, but delete the last sentence in (4) because *Apocynum foliis Androsaemi* L. is a good binary binomial like *Adiantum capillus veneris* L. and *Atropa bella dona* L. discussed in Art. 27).

Art. 28A. OMIT: "When adjectival in form and not used as substantives, they agree in gender with the generic names."

[This has been transferred to the section on gender].

Art. 28B: No varietal or subvarietal epithet may be given to the variety of a species which includes the type.

Different ecologic variations in plants and in parts of plants belonging to species, subspecies, variety or sub-variety may be indicated with appropriate epithets preceded by the words *forma* and *subforma*; and the names thus formed are not reducible to simpler combinations without intercalating the epithet of the species, subspecies, variety or subvariety to which the forms belong.

*Note.*—When a species is interpreted *sensu lato* and it is desirable to indicate the division to which the type belongs, the type variety of the species may be indicated by repeating the specific name preceded by the prefix *eu* or by the epithet *typicus* or *genuinus* but none of these epithets shall have a status under the Rules.

Examples: The name *Nelosuma polynesianum* var. *typicum* H. J. LAM (Bern. Bishop Mus. Hawaii, Occ. Pap. XIV, 1938 p. 148) is invalid because it is given



to the type of *N. polynesianum* (HILLEBR.) BAILL. (1891), but the formæ *genuinum*, *longipetiolatum*, and *longipetiolatum* subforma *originarium*, published by Dr. LAM, under *N. polynesianum* sensu stricto are valid and are not formal homonyms (Art. 61B) of formæ *genuinum*, *longipetiolatum* and *genuinum* subforma *originarium* published respectively under *N. polynesianum* var. *glabrum* H. J. LAM (1938).

[The Rules do not admit a ternary system of names for species; and giving varietal and subvarietal names to the type variety amounts to giving a ternary name to it. Strictly speaking formæ and subformæ are not taxonomic groups, because the variations may be found even in the same individual, e.g. the bathyphyll and the acrophyll stages of figs, ferns and aroids. The names of formæ and subformæ should therefore be taken on the same footing as horticultural names of plants. Under Art. 30 some of Dr. LAM'S formæ and subformæ would have to be renamed, while his var. *typicum* would be valid. The nomenclatural complications that would arise by admitting as valid varietal names to the type of a species have been discussed by me in Gard. Bull. Straits Settl. IX, 1937 pp. 242-244. That the use of such epithets as *typicus*, *genuinus*, *originarius*, *verus*, *viridicus*, etc. to form varietal names to the holotype of species produce undesirable complications have been shown by Dr. F. BOLLE (Notizbl. Bot. Gart. u. Mus. Berlin-Dahlem, XIII, 1937 pp. 524-530); and in the appendix to the same paper two divergent opinions, the one of Dr. T. A. SPRAGUE, and the other of Drs. H. HARMS, J. MATTFELD, and R. PILGER, have been recorded concerning the status of the epithets of the above mentioned category. Recently Drs. H. ST. JOHN and E. Y. HOSAKA (Bern. Bishop Mus. Hawaii, Occ. Pap., XIV, 1938 pp. 118-119) have shown that the typification of species becomes difficult, if epithets other than *typicus* (and perhaps also *genuinus*, *originarius*, *verus*, and *viridicus*) were accepted in giving ternary names to the holotypes of species. They have also tried to prove that, under Art. 6C (1) *Lobelia Gaudichaudii* var. *coccinea* ROCK (1917) is a superfluous name because it is an exact synonym of *L. Gaudichaudii* A. DC. pro parte typica, but they have not shown how their naming the type of the same species as *L. Gaudichaudii* var. *typica* ST. JOHN et Hos. (1938) with ROCK'S trinomial as a synonym, is justified under the existing Rules].

Art. 30: DELETE. Incorporated in Art 61B. See remarks under Art. 28B.

Rec. XVIII: DELETE: Contradicts Art. 28B.

Art. 31-34: SEE Introductory Remarks, Section 16.

Section 5A: READ "valid" instead of "effective".

Art. 36A: READ "validated" for "effected", "valid" for "effective".

REVISE the 1935 amendment concerning the separates thus: "The issue of advance separates is not



valid unless their distribution satisfies the conditions required in Art. 36A concerning the sale or the private distribution of independent works."

ADD: "From 1942 no work published independently and offered for sale can be valid unless the author (or its publisher) either conforms with the requirements for books not placed on sale, or announces the work previous to, or simultaneously with, its issue in three botanical periodicals of international circulation to be specified under this rule, and unless he makes not less than 100 copies available to the botanical public.

"From 1942 new nomenclatural entities and new taxonomic descriptions will not be valid unless published in monographs or botanical periodicals and appropriately indicated as new.

[There are cases where new species have been published in school text-books, seed-lists, and political periodicals. *Elisabethia miniata* Trev. nov. gen and nov spec. was for instance published in a political daily, Gazzeta Ufficiale di Venezia, n. 53 (1885, 6th March) p. 3. *Eryngium Grosii* F. Q. spec nov. was published in Index Seminum quæ Hortus Botanicus Barcinonensis mutua commutatione offert, 1938, p. 12. It is desirable to prohibit the publication of new nomenclatural entities in such books or periodicals].

Art. 37A: REVISE as follows:

A name of a taxonomic group is not valid unless it is (1) correctly formed, (Sect. 4), (2) published in valid literature (Arts. 20A & 36A), and (3) accompanied by (a) a valid description of the group (Notes 1-3), or (b) by a reference to a previous valid description of it published under either a valid or invalid but different name (Note 4), (see also Arts. 40A-B and 41A).

*Note 1.* Names in LINNAEUS'S *Species Plantarum* eds. 1 & 2, and in other books adopted as the starting points of valid botanical literature for different groups of plants cannot be rejected as invalid merely on the grounds of absence, or invalidity, of either description or reference. (see Art. 20A).

*Note 2.* The citation of the type locality or the peculiar habitat of a species is not sufficient to establish a name under this rule. If specific characters are given in addition to the type locality or the habitat, the type locality or the habitat becomes a part of the description and is to be considered as an important element in determining the identity of species. However economic uses and vernacular names do not become a

part of the description and so they cannot be used in determining the identity of species.

[Particulars concerning the locality and the nature of a habitat can, like the morphological characters of plants, be obtained or observed by an ordinary plant-collector in the field without any fear of a serious mistake, and can also be verified by subsequent collectors; but the particulars concerning the vernacular names and economic uses cannot be gathered in the field and the correctness of the information depends either on the collector's special ability, or that of his guides, to recognise the plants in the field and to associate them with economic uses].

*Note 3.* In this Article by the word description is meant a botanical description published in valid literature printed in any European language written in Roman characters if before 1935, or in Latin only if published after 1934, the two exceptions to this being the following:—

(A) In the case of *bacteria* and *fossil* plants, a description in any above-mentioned European languages is admitted. But from January 1st, 1912, no description of *fossil* plants can be valid unless it is accompanied (a) by illustrations or figures showing essential characters, or (b) by a reference to such illustrations or figures published previously in valid literature; if the required illustrations or figures are published after the description, then the later date alone must be taken into consideration for the purposes of the validity of the description or of its simultaneously published name.

(B) In the case of other (*recent*) plants, a *plate* or *figure with analyses showing essential characters* can take the place of a description provided it was published before 1908.

*Note 4:* (a) The *reference* must be made in the form of a conventional formula or expression intelligible to systematists in general, a full reference to the text and page being necessary when the citation is to a valid description published under an invalid name.

(b) In the case of a *generic name*, the *reference* must be to a previous valid description either published under another generic name (valid or invalid), or under any name (valid or invalid) of a generic subdivision of any category higher than a species.

(c) In the case of a *specific* (or *subspecific*) *name*, the *reference* must be either to a valid description published of the group under a subspecific (or specific) or another specific (or subspecific) name, or to a valid description of a monotypic genus provided the description (in the last case) is new and the name to be

validated is of the type species (*descriptio generico-specifica*). It is permitted to give the description of a new monotypic genus under the name of the type species.

ADD examples from Arts. 42, 43 & 44.

[At present the regulation which should form a part of Art. 37 is distributed to Arts. 38, 39, 42, 44 and 45].

Arts. 38 & 39: DELETE. Incorporated in Art. 37A.

Art. 40A: ADD: But it is permissible to validate alternative names (simultaneous isonyms) provided the alternative name is a combinatio nova equal in rank to its simultaneous basonym.

[The alternative names were declared valid at the Amsterdam Congress. But no provision was made against publishing alternative names of unequal rank or that are not new combinations, e.g. *Minima* gen. nov. vel *Mesembryanthemum* sect. *Minima* sect. nov.; *Cymbopogon riparium*. spec. nov. vel *C. fluminense* var. *riparium* var. nov. vel *C. riveriense* spec. nov].

Art. 40B: A name proposed provisionally (nomen provisorium) to be adopted by future investigators in case certain possible circumscription, position or rank be accepted, or merely mentioned incidentally, is not valid.

[This gives a more precise definition to the nomen provisorium than the one adopted at the Amsterdam Congress].

Art. 41A: ADD: An exception is made for the generic names published in LINNAEUS'S *Species Plantarum* ed. 1 (1753) and ed. 2 (1762-1763) and in other books which have been adopted as the starting points of valid botanical literature for the different kinds of plants, so that the taxonomic groups in these books are treated as having been validly characterized. (see Art. 37A: Note 1).

Art. 42-44: DELETE. Incorporated in Arts. 37A & 41A.

Art. 45A: REVISE as follows:

"The date of a name or a combination is that of its valid publication (see Arts. 19A & 37A). In the absence of proof to the contrary, the date given in the work containing the name must be regarded as correct."

[DELETE the other parts of the rule as they are irrelevant here. cf. Arts. 37A & 61A-B].

Art. 50B: If the name of an order, suborder, family, subfamily, tribe or subtribe is taken from the name of a genus, the latter must be taken as the nomenclatural type of the former.

Examples as in Art. 66.

[This is Art. 66 revised. It forms a part of this Section].



Section 9A: REVISE the wording: Naming and interpreting taxonomic groups on transference to another position of the same rank.

[This Section should also deal with the names or epithets denoting the subdivisions of order or families].

Art. 53A: REVISE as follows:

When a taxonomic group is transferred to another nomenclatural position without change of rank, the epithet denoting the group must be retained or, if it has not been retained, must be re-established unless one of the following obstacles exists: (1) that there is available an epithet having a better claim under the priority rule (Art. 56A); (2) that the original name was not priorable (Art. 61B); (3) that the resulting combination is an impriorable homonym (Art. 61A-B).

If any of these obstacles occur, then the name or epithet must be legitimized which satisfies the rule of priority (Art. 56A).

[This combines the rules in Arts. 53, 54-55 partly, and 69 partly, from which the examples referring to this should be transferred here. The rule of tautonyms has been ignored (See Introductory Remarks, Sect. 10). In dividing this rule into many parts or Articles, not only no advantage is gained but many contradictory procedures are also made possible. Thus when in 1804 POIRET transferred *Pinus taxifolia* LAMB. (1803), non *Pinus taxifolia* SALISB. (1796), to *Abies*, Art. 54 obliged POIRET (retroactively) to make the combination *A. taxifolia*, and, if he had not made that combination, a subsequent author would have been justified in making the combination; but under Art. 69 POIRET was not obliged to make the combination *A. taxifolia*, nor would a subsequent botanist have been justified in making it if POIRET had adopted another combination for the species].

*Note.*—The oldest valid name on which the new combination is based is the *basinym* of the combination, and the new combination is the *isonym* of the basinym. All isonyms must be typified on the types of their respective basinyms. (see Art. 53B).

Art. 53B: When the epithet, on transference to another position, has been applied erroneously in its new position to a different type, the new combination must be retained for the type on which the epithet was originally based.

[The example of *Pinus Mertensiana* discussed at the Amsterdam Congress, 1935, should form a part of this Article].

Arts. 54 & 55: DELETE. Incorporated in Arts. 53A & 53B.

Art. 56A: REVISE as follows:

When two or more groups of the same rank are united, the oldest priorable name, or epithet, (Art. 61B) must be retained. When the epithet is not in the required position, it must be instated in that position



provided it does not produce an impriorable homonym; but if, when so placed, it would produce an impriorable homonym, then the next oldest priorable name or epithet that would not produce an impriorable homonym in the required position must be legitimized. If no such name, or epithet is available, then the author is at liberty to legitimize any epithet that becomes priorable in the new position, even an epithet from an invalid, or impriorable, name. For the nomenclature of Fungi with a pleomorphic life-cycle, *see* Art. 57.

If two or more priorable names, or epithets, have equal claim under this rule, precedence must be given to the name, or epithet, that is earlier in the correct position, or to a new combination over a new name (*see* also Art. 61A). In other cases the author who unites the groups has the right of choosing one of them as the legitimate name for the group; the author who first exercises the right under this, definitely treating one name as a synonym or a subordinate group of the other, must be followed, so long as the priority of the names is considered under the same position, but not otherwise.

ADD the following four examples:

(a) *Monospora grandifolia* HOCHST. and *M. rotundifolia* HOCHST. were published simultaneously in the same book (Flora, XXIV, 1841, p. 661). The isonyms to these two species under *Trimeria* Harv. (1838) are *T. grandifolia* (HOCHST.) WARB. (1893) and *T. rotundifolia* (HOCHST.) GILG (1921) respectively. When these two species are treated as synonymous, *T. grandifolia* (HOCHST.) WARB. (1893) is the correct name for the united group under *Trimeria*.

[Mr. E. MILNE-REDHEAD discussed the above case in Kew Bull. 1939, pp. 34-35. He appears, however, to have overlooked the fact that WARBURG, in uniting *Monospora* to *Trimeria*, by implication regarded *M. rotundifolia* as an unusable synonym. It may therefore fairly be argued that he was the first to select the name *M. grandifolia* for the species. There is also another decision earlier than GILG's, by DURAND and SCHINZ (Conspectus Fl. Afr. I, 2, p. 225).

An enquiry into the treatment of the specific epithets *grandifolia* and *rotundifolia* under the genus *Monospora* itself might lead to still further complications. The amendment above proposed, therefore, would furnish botanists with an easy means by which precise decisions could be given in such complicated cases, both without undertaking a lengthy investigation into the history of all rival names or epithets of equal age, and without violating the principle of priority].

(b) When *Rhizophora conjugata* L. (1753) and *R. gymnorrhiza* L. (1753) are united together under *Bruguiera*, precedence must be given to *B. gymnorrhiza*

(L.) LAM. (1797) over *B. conjugata* (L.) MERR. (1914) and any decisions given concerning the precedence of these two epithets under *Rhizophora* must be ignored.

(c) The combination *Talinum polyandrum* HOOK. (in Bot. Mag., 1855, t. 4833), being a later homonym of *T. polyandrum* RUIZ. et PAV. (1798), is impriorable: when BENTHAM transferred *T. polyandrum* HOOK. to *Calandrinia*, he called it *C. polyandra* (Fl. Austral. I, 1863 p. 172). Now *C. polyandra* (HOOK.) BENTH. itself is not a later homonym, and so it is a priorable name. Since there is no earlier priorable name to the species, *C. polyandra* (HOOK.) BENTH. becomes also its legitimate name.

(b) *Nicotiana? minima* PHIL. (1864) is impriorable because it is a later homonym of *N. minima* MOLINA (1782). But the name *Petunia minima* [PHIL.] REICHE (1910) is priorable although it is based on the impriorable *N. minima* PHIL. Hence *Combera minima* SANDW. (Hook. Ic. Pl., 1939, t. 3400) must be not only cited as *C. minima* (REICHE) SANDW. (or as *C. minima* ([PHIL.] REICHE) SANDW.), but also typified on the holotype of *N. minima* PHIL. in the Museo Nacional in Santiago, Chile.

[Mr. N. Y. SANDWICH has argued (cf. Arts. 54 and 69), that he was not bound to adopt the epithet *minima* when he transferred *N. minima* PHIL. = *Petunia minima* [PHIL.] REICHE to the genus *Combera*, that *C. minima* SANDW. should be called a nomen novum and not combinatio nova, and that a specimen in the Kew Herbarium should be taken as the holotype of *C. minima* SANDW.].

Section 12A: REVISE: Priorability of Names.

Art. 59: DELETE: Incorporated in Art. 17B.

Art. 60: DELETE:

[The important part of this is incorporated in Arts. 2B, 19A & 19B, 36A, 37A & 61A & B. The rest is unnecessary and equivocal. In a code of rules one cannot enumerate the various ways in which an offence may be committed against the code, without adding to its bulk or creating ambiguity; but one can classify offences, according to their nature (cf. Arts. 19A, 19B). Besides by putting invalid names on the same footing as those valid names which have been published in violation of the priority rule much confusion has been created in the Rules].

Art. 61A: When there are two or more *simultaneous homonyms* (that is, when the same name, or its formal equivalent, is validly published simultaneously for more than one taxonomic group of equal rank), the first reviser who adopts one of them, or substitutes another name for one of them, must be followed, provided that

a new priorable combination having an older, or the oldest, priorable basonym of equal rank is given precedence. (see Art. 61B).

*Note 1.*—A *homonym* is a valid name identical with another valid name, or an orthographic variant which is regarded as identical. A homonym that has been validated earlier is an *earlier homonym*; while one validated later is a *later homonym*. When the same name or its orthographic variant has been simultaneously applied to more than one taxonomic group, each valid publication of the name constitutes a *simultaneous homonym*.

*Note 2.*—In the case of epithets denoting subdivisions of a family, a genus, or of a species, *formal homonymy* occurs if two identical combinations are obtained by connecting the epithets concerned *directly* with the names of their respective major groups (*i.e.* family, genus, or species).

Art. 61B: Later homonyms, and such simultaneous homonyms as have been correctly discarded under Art. 61A are *impriorable*, typonymous formal homonyms representing subdivisions of unequal rank of a family, genus or a species being excepted (Art. 28B): typonymous formal homonyms of unequal rank and other valid names that are not covered by the first part of this rule are *priorable*.

In special cases, the Congress is empowered to make names *impriorable* under certain circumstances (see Arts. 21A–D, 62A, & 63A).

*Note 1.*—When a real (not formal) homonym is typonymous with an earlier homonym, it is permissible to consider the former as either distinct from, or identical with, the latter (see also Arts. 46 & 47); but neither treatment makes the later homonym *priorable*.

*Note 2.*—A name is called *priorable* when it must be included in priority considerations; or *impriorable*, when it must not be included in priority considerations. *Impriorable* names and combinations cannot be legitimized, but they can be used as basonyms for making new *priorable* isonyms. (cf. Art. 53A Note 1 and 56A).

[The reason why later homonyms and such simultaneous homonyms as are rejectable under Art. 61A should be made *impriorable* is that their use “may cause error or ambiguity” (Art. 4). Since it is permissible to simplify more complicated names of the subdivisions of a family, genus or species (see also Arts. 26A & 28A–B), the use of the same epithet for



two or more subdivisions of different rank having different types would, when simplified, produce formal homonymy and cause error or ambiguity: Hence the necessity of making impriorable all non-typonymous formal homonyms. But no ambiguity or error would result in the case of typonymous formal homonyms, for they would all represent a taxonomic group having the same type: hence the priorability of typonymous formal homonyms. See also Introductory Remarks Sect. 4 & 6].

ADD: Examples from Arts. 30 & 61.

Art. 62A: REVISE as follows:

A name of a taxonomic group whose type is not extant, or if extant is inadequate for any decisive interpretation, must not be used in priority considerations or legitimized if, owing to its use with different meanings, it has become a permanent source of confusion or error. A list of names to be abandoned for this reason (*Nomina ambigua*) will form Appendix IV.

[In view of the wording of the 1905–1910 Rules and the opinions expressed by competent nomenclaturists at the Amsterdam Botanical Congress (1935) it appears that this rule was originally intended by the legislators to cover only those names which, owing to the absence or the imperfection of types, did not admit of a definite interpretation. The example in the old Rules reads thus:

“Linné a décrit sous le nom de *Rosa villosa* une plante qui a été rapportée à plusieurs espèces différentes et dont l'interprétation certaine paraît impossible; pour éviter la confusion qui résulte de l'emploi du nom *Rosa villosa*, il est préférable dans ce cas, comme dans d'autres analogues, d'abandonner complètement ce nom.”

In the 1935 Rules, the discussion of this example has been abbreviated. This abbreviation coupled with the lack of a definition of the word “permanent” as used in the rule itself, has been responsible for interpretations which were not foreseen when Art. 62 was revised in 1930. The new interpretations contradict the type principle, which obliges botanists to disregard all interpretations of a taxonomic group that do not include the type. See also the Introductory Remarks, Sect. 14].

Art. 62A: DELETE the example concerning *Alsine* L.

[In view of the official typification of the genus on *A. media* L.—the correct lectotype for the genus (see also SPRAGUE in Kew Bull. 1920 p. 308)—the misinterpretations cannot be said to be permanent. Under Art. 56A, *Alsine* L. (1753) becomes a synonym of *Stellaria* L. (1753), VILLARS (Hist. Pl. Dauph., 1789) being the first person to choose between these two synonymous names of equal age].

ADD: *Note 1.*—A *nomen confusum* is a special instance of a *nomen ambiguum* whose description, being based on a type composed of two or more discordant elements pertaining to different species, genera or orders, was supposed to be of the same species or even of the same individual, and is moreover incapable of



a certain typification. A list of names to be abandoned for this reason will form Appendix V. (see also Art. 21B-6).

Examples as in Art. 64.

*Note 2.*—A *nomen monstrositatis* is another special case of a *nomen ambiguum* whose description, being based on a monstrosity, cannot give any certain clue to the identity of the taxonomic group to which the monstrous type specimen belongs. A list of names to be abandoned for this reason will form Appendix V *bis*.

Examples as in Art. 65.

[It is difficult to give a definition of a monstrosity that would be acceptable to all systematists. Opinions would differ whether a specific name based on a specimen which had produced either hexamerous flowers instead of the normally pentamerous ones, or entire leaves instead of the usually divided ones, should be included under the category of *nomina monstrositatum*. It is therefore desirable to enumerate in a list all the names to be rejected under this part of the provision].

*Note 3.*—If a *nomen confusum* or *nomen monstrositatis* has, subsequently to its publication, been typified on any one part of the original specimens and the error excluded, and moreover, if the new typification is accompanied by an amended description and by a citation of one or more new specimens agreeing with the new typification, then the name becomes priorable from the latter date.

[*N.B.*—It may be useful to deny validity to *nomina ambigua, confusa, vel monstrositatum*. No useful purpose is served by allowing the names validity and, at the same time, by denying priorability. On the contrary, by denying the names a valid status, changes would be avoided in such homonyms as were published in accordance with the old Rules which regarded all kinds of *nomina ambigua* as invalid. (Cf. Art. 21B-b)].

Art. 63A: REVISE as follows:

A name of uncertain application (*nomen dubium*) must neither be included in priority considerations nor be legitimized until its application has been made quite precise on botanical grounds. (see also Art. 22B).

[The word *reject* has been used in different senses in Arts. 61-62, 64, 65, etc., so that to reject sometimes means also "to render impriorable". (cf. Art. 62, and also the current phrase: *nomina specifica rejicienda*). Hence the necessity of the paraphrase to make the rule quite unambiguous].

Art. 64 & 65: DELETE: Incorporated in Art. 62A Notes 1 & 2.

Art. 66: DELETE: Incorporated in Art. 50B.

Art. 67: DELETE: Incorporated in Art. 25A.

Art. 68: DELETE: Incorporated in Art. 27A.

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Art. 69: DELETE: It is a part of Arts. 53A-B & 56A.

Art. 70B: Epithets of species and of lower groups must be written with a small initial.

[The Recommendation for capitalizing specific epithets in certain cases causes a good deal of trouble and is based on the false assumption that pre-Linnean generic names have a status under the Rules. In many parts of the world, foresters and economic botanists decapitalize specific epithets; so do also the majority of American systematists and all zoologists. No useful purpose is served by maintaining this Recommendation].

Art. 70C: Names or epithets of taxonomic groups higher than species are written with an initial capital letter.

[Parts of Arts. 25 and 26].

Rec. XLIII: DELETE: Annulled by Art. 70B.

Section 14: READ: "Gender of names" instead of "gender of generic names".

Art. 72B: Epithets denoting either species or the subdivisions of a genus or species, when adjectival in form and not used as substantives agree in gender with the generic name.

[Parts of Arts. 26, 27 and 28].











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 STRAITS SETTLEMENTS

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Part 2

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Part 2

PALMÆ MALESICÆ

VIII.—THE GENUS LICUALA IN THE  
MALAY PENINSULA

By C. X. FURTADO

*Botanic Gardens, Singapore*

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1. Introduction

The results embodied in this paper are of a study undertaken with the view of arranging systematically the Singapore herbarium specimens of the *Licuala* species indigenous in the Malay Peninsula. The present world conditions, entailing the cessation of intercourse with certain botanical institutions, the dislocation of the staff at some others, and the risks to parcels during transit across oceans have precluded my obtaining either critical notes of the type specimens preserved outside the Malay Peninsula, or a loan of the specimens themselves. Under such limitations the results of my undertaking would have been of little systematic value but for the valuable assistance derived from BECCARI'S monographic work on the genus published first in an abbreviated form in *Webbia* V, 1921, pp. 22-55, as a part of *Recensione delle Palme del Vecchio Mondo Appartenenti alla Tribu delle Corypheeae* and then in an extended form in the *Annals of the Royal Botanic Gardens, Calcutta*, XIII, printed in 1931 and published in 1933 (cited

below as *Calcutta Annals* or *Calc. Annals* XIII, 1933). In this latter work BECCARI incorporated the results of the opportunities he had not only of consulting the type material of most of the species he studied and of comparing newer material with it, but also of making lengthy critical descriptions, analytical drawings and photographic plates of such specimens.

## 2. Hints to Collectors

*Licuala* is a genus of small palms the largest of which attain about 15-20 feet in height and a few ( $\pm 3$ ) inches in stem diameter. However, most of the species are almost stemless or only a few feet in height. Compared therefore with the long, thorny rattans or tall giants like *Corypha*, *Borassus* and *Oncosperma*, the *Licuala* species present very few obstacles to the collector making good herbarium specimens. The tallest ones can be cut down with an ordinary jungle knife within a few minutes, and the specimens of leaves and of spadices with flowers and fruits do not form very weighty or bulky specimens. Though the petioles of most species are provided with thorns, yet the specimens are easily handled even without leather gloves, which are required in handling specimens of Rattans or *Oncosperma*. Hence one would have expected this genus to be well represented in most herbaria, and also to be specifically well known in areas botanically fairly well explored. From the study of the species in the Singapore herbarium and from the notes given by BECCARI, I conclude that this is far from the case. This country has been explored botanically for the last fifty years or more by different botanical collectors and I find the *Licuala* species are very badly represented in the herbarium. Even in regions botanically well known, species formerly not recorded are being discovered. The principal reason for this is that in the field most of the species look alike and are not easily distinguished one from another except when the collector has made a special point to study them in the field. The number of segments present on a leaf often depends on the age of the plant and to a certain extent on the conditions under which it grows. Many times really acaulescent species may be mistaken for others which flower and fruit when quite small or stemless. In many species, moreover, the flowers and fruits remain hidden among the leaves so that they may be passed as the sterile stages of others.

If the collector is therefore to see that he does not miss any uncommon species he meets with in the jungle, he must learn to distinguish the species in the field. To

do this satisfactorily the following pointers may be useful:—

1. The average number of main nerves (costae) radiating from the apex of the petiole is a more stable character than the average number of leaflets into which a leaf is divided, though the latter is sometimes useful in the identification of a species.
2. Some species have always undivided leaves (not noticed in any species wild in the Peninsula).
3. In some species the median segment of the leaf is three or more times as broad as the other lobes, in others the segment is nearly as broad as the other segments.
4. In some species the broad median segment is entire, in others it is divided half-way.
5. In some species the middle segment becomes distinctly petiolulate, in others it is always sessile.
6. In some species the lateral margins of the leaf segments are arcuately cuneate, in others the margins are straight.
7. Some species are always solitary, others form tufts.
8. Some are always stemless, others produce stems though they may begin to flower when stemless.
9. In some species the spadices reach high above the height of the leaves so as to become visible from a distance; in others the spadices remain hidden among the leaves.
10. In some species the spadices are simple, terminating with one or more floriferous branchlets (spikelets); in others the spadices are compound.
11. In some species the lower branches of the compound spadices are subdivided into 10 or more spreading spikelets; in some others the branches contain only 2-5, usually digitate, branchlets; in still others the branches are simple, undivided.
12. Different species are characterised by different colour of spadices, flowers and fruits.
13. In some the fruits are 3-4 times as long as they are thick; in others the fruits are globose.

In a given field, all Licualas may have many of the above-mentioned characters in common, but they will differ in others, which, though a few, will suffice to distinguish



between the species, even disregarding such variable characters as the height of the plant, and the nervation and the number of the leaf-segments. But it is desirable to record in the field notes as many particulars as possible concerning the habit, stem height (without leaves), etc., of the plants, size of the petioles, leaf-lamina and spadix, the average number of segments to a leaf, the average number of main branches to a spadix, the colour of fruits, flowers, etc.

For herbarium purposes the leaf specimens should be taken from flower-bearing crowns; and if there is some variation in size, etc., in the leaves of non-flowering crowns, some few specimens may be made to indicate this variation. Care, however, should be taken to use appropriate tags so that the leaves may be sorted and mounted in the herbarium according to their status without any fear of confusion (*vide* my remarks on numbering the specimens in the field in *Gard. Bull., Straits Settl.* IX, 1937 p. 155, 286-287, and 303 in example).

If it is desired to reduce the bulk of the specimens one may split the leaves longitudinally, taking care to leave the middle segment intact; the half without median segment becomes practically useless, unless the species is rare and a sufficient number of leaves is not available for making up the sets.

### 3. Subgenera and Sections

Apart from the collector's difficulties, the genus *Licuala* presents many difficulties to a systematist. There is a good deal of variation in the vegetative parts of the plants. Though the branching of the spadices frequently occurs in a definite manner and forms a useful character to differentiate between species, it is not one that can be employed to subdivide the genus into subgenera or sections; such a classification not only places very closely related species in different sections or subgenera, but also divides subgenerically or sectionally polymorphic specific units.

BECCARI, who in 1886 had relied on the branching of spadices to divide the genus *Licuala* subgenerically into EU-LICUALA (implicit), LICUALOPSIS, LICUACELLA and LICUALINA (*Malesia* III, 1886, pp. 69-90), was obliged in 1921 to reduce these subdivisions to two, namely, EU-LICUALA and LICUACELLA, the latter to include LICUALOPSIS and LICUALINA (*Webbia*, V, 1921, pp. 22-55). Here BECCARI made also a new subgenus DAMMERA, but the main character used to define this subgenus is derived from the flower. This disposition has also been adopted in BECCARI'S monograph published in the *Calcutta Annals*, XIII (1933). Leaving the subgenus DAMMERA out of consideration for



the present, this modified subgeneric division of *Licuala* is still unsatisfactory, because the basis used to distinguish these two subgenera is still the character of the branching of the spadices. Under such a classification, for instance, *L. lanuginosa* and *L. Kingiana* fall into two subgenera, when the species are so very closely related that they may be regarded as two varieties of the same species. Further, this classification obliges one to split such variable species as *L. modesta* Becc. *sensu lato* into *L. modesta* Becc. *sensu stricto* and *L. Wrayi* Becc. according to the development of the spadix, and then to place these two species thus defined into two different subgenera.

The other grouping of the *Licuala* species is one published by DRUDE (ENGL. u. PRANTL, *Pflanzenf.* II, 3, 1887, p. 35), subsequently modified by RIDLEY. DRUDE was apparently unaware of the subgenera published by BECCARI, for, without making any reference to the latter's subgenera, DRUDE proposed independently two subgenera, namely: EU-LICUALA to include the species with a dorsal embryo, and PERICYCLA (Bl.) Drude (spelt by error *Pericyla*) to include the species with a basilar embryo. The type of this second subgenus was *L. penduliflora* (Bl.) Miq., published previously as *Pericycla penduliflora* Bl. It is apparent that, in reducing *Pericycla* Bl. to a subgenus of *Licuala*, DRUDE relied on the characters mentioned by BLUME, who had examined the position of the embryo in the flower only, where the position is often misleading. I point this out because I have not seen any species of *Licuala* having a basilar embryo, and BECCARI, who had opportunities to examine a very large collection of fruiting specimens, does not mention any such species.

In 1903 RIDLEY reduced *Pericycla* Bl. to a section of *Licuala*, defining it to include all species having a "panicled inflorescence" (*Journ. Roy. Asiat. Soc., Straits Settl.*, 41, 1903, p. 42). The section was naturally typified on *L. penduliflora*, of New Guinea, for which RIDLEY adopted the name *L. pericycla* Zipp. Mss.; but the only Malayan species that RIDLEY included in the section was *L. paniculata* Ridl., though *L. longipes*, *L. paludosa*, etc. have inflorescences similarly branched. RIDLEY adopted this section also in his later works, *viz.*: the *Materials for a Flora of the Malay Peninsula, Monocotyledons* (cited below as *Materials* or *Mat.*), II, 1907, pp. 159-165, and the *Flora of the Malay Peninsula* (cited below as *Flora*), V, 1925, pp. 24-30. But if, following RIDLEY'S definition, one were to place all the species having "panicled inflorescences" in the section PERICYCLA, the group would consist of utterly unrelated species, several closely related species remaining outside.

In view of these drawbacks of previous definitions, an inquiry was made into the problem of subdividing the genus. The most stable characters were found to lie in the flowers, the nature of the divisions of the androecium affording characters to group the species into well defined subgenera. The utility of these characters was recognized by BECCARI (op. cit 1921 & 1933); but he employed them only in the analytical keys provided for the identification of the species, and not to define his subgenera. On the basis of these characters, I divide the genus *Licuala* into three subgenera, namely: LIBERICULA (new), EU-LICUALA and PERICYCLA. The second is further divided into four sections, but LICUACELLA is not retained.

### I. LIBERICULA. Furtado **subgen. nov.**

Staminum filamenta 6 erecta aequalia, basi lata superne subulata, ad basin libera vel fere, nec in annulum prominentem ad corollæ faucem connata. Flores inter majores, circa 15 mm. longi, 5 mm. crassi.

Species unica, *L. peltata* Roxb., in regionibus humidis inter septentriones et orientem Indiarum spectantibus ex Assam, Khasia, Sikkim, etc. ad meridiem in Insulis Andamanicis, Tenasserim, et Thailandia (Siam) meridionali habitat.

### II. EU-LICUALA Drude in Engl. u. Prantl, Pflanzenf. II, 3 (1887) 35; Ridl., Flora V (1925) 24 loco sectionis, nom. nud.

*Licualopsis* Becc., Malesia III (1886) 85.

*Licualina* Becc. op cit p. 88.

*Licuacella* Becc. op cit p. 86, in Webbia V (1921), 24 et 37, in Calc. Annals XIII (1933), 116 et 128. **Syn nov.**

Staminum filamenta 6, aequalia, erecta vel inflexa, ad corollæ faucem in annulum prominentem connata. Flores 3-8 mm. longi, 2 mm. crassi.

#### *Sectio 1*: WURMBIA Furtado **sect. nov.**

Annulus staminalis membranaceus, aut truncatus, apice in filamenta parva, erecta, filiformia productus, aut in filamenta erecta, lobiformia, abrupte subulata divisus. Antheræ haud aristatæ.

Inter divisiones *Licualae* hæc sectio species plurimas includens, qui in regionibus torridis et semi-torridis ex Birmania, Thailandia (Siam) et China meridionale ad Celebesiam et Novam Guineam habitant, maximæ species in regionibus malayanis (viz. in Peninsula Malayana, Sumatra et Borneo).

Species typica: *L. spinosa* Wurmb.

Nomen hujus sectionis in honorem cl. F. VON WURMB, auctoris speciei typicæ.

#### *Sectio 2*: BONIA Furtado **sect. nov.**

Annulus staminalis brevis, crassus. Filamenta erectiuscula, lobiformia, elongata, subbulbosa, apicem in connectivum discoideum antherarum dorso adnatum, expansa. Antheræ haud aristatæ.

Species hujus sectionis adhuc unica (*L. fatua* Becc.) cognita, habitat in Indo-China. Nomen hujus sectionis in honorem Rev. Presb. BON, qui specimen typicum speciei in Tonkinia Occidentale legit.

*Sectio 3: DAMMERA* (Becc.) Furtado **stat. nov.**

*Dammera* Becc. in *Webbia* V (1921), 24 et 38 et in *Calc. Annals* XIII (1933) 116 et 130 (loco subgeneris).

*Dammera* K. Schum. et Laut, *Fl. deutsch Schutzgeb. Sudsee* (1900) 201 t. A-F et 2 (loco generis).

Annulus staminalis elevatus, crassus. Filamenta e basi valida superne attenuata et antherarum dorso proluxe adnata. Antheræ haud aristatæ. Species hujus sectionis duæ tantum cognitæ, ambæ in Nova Guinea habitant.

Species typica: *L. Beccariana* Furtado **nom. nov.**

Basinym: *L. ramosa* (K. Schum. et Laut) Becc. (1921), nec *L. ramosa* Bl.

*Sectio 4: BECCARIA* Furtado **sect. nov.**

Annulus staminalis brevis, crassus, conspicuus. Filamenta lobiformia, perlonga, subulata, apice bis inflexa (i.e. apice introflexa et rursus erecta), antheras apiculato-aristatos ferentia.

Species hujus sectionis adhuc unica (*L. reptans* Becc.) cognita in Borneo habitat.

Nomen hujus sectionis in honorem Cl. O. BECCARI, palmographi magni.

### III. PERICYCLA (Bl) Drude in *Engl. u. Prantl, Pflanzenf.* II, 3 (1887) 35 (Sphalmate *Pericycla*).

*Pericycla* Bl., *Rumphia* II (1844) 47 t. 94 (loco generis).

*Pericycla* (Bl.) Ridl. in *Journ. Roy. Asiat. Soc., Straits Settl.* 41 (1903) 42, *Mat.* II (1907) 159 et *Flora V* (1925) 25—(loco sectionis; sphalmate *Pericyclus*).

Staminum filamenta 6, erecta, valde inæqualia, 3 ad loborum apicum majorum inserta, et 3 in sinibus vel ad loborum apicum minorum sita, ad corollæ faucem in anulum prominentem connata. Antheræ haud aristatæ. Flores inter minores.

Species hujus subgeneris pauçæ, omnes in regionibus oceaniis habitant; unica in Australia, alteræ in insulis

papuanesianis usque ad insulas Solomonenses, maximæ in Nova Guinea.

Species typica: *L. penduliflora* (Bl.) Miq. (= *Pericycla penduliflora* Bl.).

#### 4. Analytical Key to the Species

- A. Flowers about 15 mm. or more long and 5 mm. or more across. Stamens 6, equal, free at the throat of the corolla, the staminal ring being almost obsolete (LIBERICULA). .. *L. peltata* Roxb.
- AA. Flowers about 3–8 mm. long and 2 mm. across. Stamens united at base into a conspicuous ring at the throat of the corolla .. (B).
- B. Staminal ring 3-lobed, lobes emarginate; 1 filament in the notch at the apex of each lobe and 1 in each sinus between the lobes. (PERICYCLA).
- (a) Leaf-blade entire. Partial inflorescences paniculately divided into 8–10 branchlets (spikelets) .. *L. grandis* Wendl. (cultivated).
- (aa) Leaf-blade multipar-tite. Partial inflorescences digi-tately divided into 3–4 branchlets .. *L. Rumphii* Bl. (cultivated).
- BB. Staminal annulus ends in 6 almost equal lobes or filaments (EU-LICUALA) .. (1).
- 1A. Spadix simple, terminated by one or more floriferous spikelets .. (2).
- 1B. Spadix branched into two or more partial inflorescences, each internode sheathed by a separate spathe .. (4).
- 2A. Spadix terminated by one or two spikelets .. (3).



- 2B. Spadix terminated by many floriferous spikelets (sometimes a short liguliform spathe intervening) .. *L. modesta* Becc. (partly).
- 3A. Spadix axis and flower-buds covered with long coarse hairs. Calyx striate, splitting into many longitudinal fibres. Leaf divided into 5-8 segments .. *L. Kingiana* Becc.
- 3B. Spadix axis and flower-buds covered with minute hairs, Calyx membranous, not dissolving into fibres. Leaf segments 12-15 .. *L. Scortechinii* Becc.
- 4A. Partial inflorescences unbranched (*i.e.* consisting of solitary spikelets) .. (5).
- 4B. Partial inflorescences branched .. (14).
- 5A. Flowers distinctly pedicelled. Calyx turbinate or narrowed into a long pedicelliform base .. (6).
- 5B. Flowers not distinctly pedicelled. Calyx cylindrical or campanulate .. (8).
- 6A. Spikelets distinctly hairy. Calyx hairy, or, if deciduously hairy, the corolla is distinctly hairy (7),
- 6B. Spikelets and calyx not hairy, but covered with fugaceous rusty-brown scales. Corolla glabrous .. *L. Moyseyi* Furtado
- 7A. Hairs on spikelets and calyx long, coarse. Calyx nearly as broad as long, membranous, striate, turbinato-campanulate, suddenly ending in a short solid cylindrical base, more or less lobed at apex. Flowers usually solitary .. *L. Kunstleri* Becc.
- 7B. Hairs on spikelets and calyx fine. Calyx coriaceous, not striate, cup-shaped, nar-

- rowed into a long (longer than the cup) pedicelliform base, obscurely denticulate at apex but not lobed or lacerate. Flowers in groups of 2-3 in some parts
- 8A. Calyx cyathiform-campanulate, deeply lobed .. (9). *L. Corneri* Furtado
- 8B. Calyx cylindrical, truncate or lobed at apex .. (11).
- 9A. Calyx covered with long coarse hairs, usually one carpel fertile. The lateral margins of leaflets nearly straight .. .. (10).
- 9B. Calyx covered with fine hairs which later fall off partly. Frequently two or three carpels fertile. Lateral margins of leaflets arched, so that leaflets are arcuately cuneate .. .. *L. kemamanensis* Furtado.
- 10A. Hairs tawny .. .. *L. acutifida* Mart. (partly).
- 10B. Hairs whitish .. .. *L. pusilla* Becc. (partly).
- 11A. Calyx  $\pm 4$  mm. long, densely tomentose, curvately cuneate at base, little lobed at apex .. .. *L. tiomanensis* Furtado.
- 11B. Calyx smaller, puberulous or glabrous, not curvately cuneate at base; truncate or deeply lobed at apex .. (12).
- 12A. Calyx conspicuously striate, glabrous, asymmetrically lobed at apex, truncate, caudiculate at base .. *L. pahangensis* Furtado.
- 12B. Calyx puberulous or glabrous, but neither conspicuously striate nor caudiculate .. (13).
- 13A. Calyx apex almost truncate at first, then irregularly split .. .. *L. Ridleyana* Becc.
- 13B. Calyx deeply lobed .. .. *L. confusa* Furtado.

- 14A. Lower partial inflorescences paniculiform, composed of 10 or more scattered spikelets (=floriferous branchlets) .. .. (15).
- 14B. Lower partial inflorescences composed of 2-5, usually digitate, spikelets .. (17).
- 15A. Spikelets slender, somewhat flexuose. Flowers frequently in groups of 2, spirally, or in terminal parts subalternately, arranged. Calyx 5 mm. long, about twice as long as it is broad .. *L. longicalycata* Furtado.
- 15B. Spikelets stouter, not flexuose. Flowers pluriseriate, usually solitary. Calyx shorter, almost as long as broad .. .. (16).
- 16A. The spathes much inflated. Spadix flexuose. Calyx cylindrical, thick from the very beginning. Ovary villous in the upper part .. *L. longipes* Griff.
- 16B. Spathes not so inflated. Spadix not flexuose. Calyx campanulate, membranous at first. Ovary glabrous .. *L. paludosa* Griff.
- 17A. Calyx glabrous, not split or lobate, but denticulate at apex .. .. (18).
- 17B. Calyx otherwise .. .. (19).
- 18A. Leaf-lamina about 12"-16" in radius, divided into 12 or more, triangular, subequal segments .. .. *L. glabra*
- 18B. Leaf-lamina 8"-12" in radius, divided into 5-8, arcuately cuneate, unequal segments, median segment divided half-way .. .. *L. glabra* var. *selangorensis*.
- 19A. Flowers pedicellate .. *L. mirabilis*.
- 19B. Flowers not pedicellate .. (20).

- 20A. Spathes and spadix densely covered with dark fuscous ferruginous scurf, and the spikelets and calyces densely covered with similarly coloured hairs .. *L. ferruginea.*
- 20B. Scurf and hairs when present not similarly coloured and frequently not so thick .. (21).
- 21A. Calyx cylindric, truncate at first, slightly split later. Spadix and spikelets not covered with a thick coat of deciduous tomentum .. *L. malajana* Becc.
- 21B. Calyx campanulate, lobed, or, if apparently truncate in early phases, the spadix and spikelets covered with a thick coat of deciduous tomentum .. .. (22).
- 22A. Plants stemless, about 12"-18" long, smallest in the genus. Leaves the smallest in the genus, divided into 3-8, rarely more, segments. Spadix about 12"-15" long, with spikelets 1½"-2½" long .. (23).
- 22B. Plants and leaves larger, with more leaf segments. Spadix and spikelets usually longer .. .. (24).
- 23A. Flowers frequently in groups of 2-3, often more than one fertile carpel. Fruit narrow elongate, about 3-4 times as long as it is thick. Ovary glabrous. Median leaf-segment never petiolulate .. .. *L. Kiahii* Furtado.
- 23B. Flowers solitary, with only one fertile carpel. Fruit globose. Ovary hairy. Median segment frequently petiolulate .. .. *L. triphylla* Griff.



- 24A. Lower partial inflorescences usually bifid, the upper ones unbranched. Most of the leaflets nearly linear, about  $\frac{3}{4}$ "-1 $\frac{1}{2}$  inches in width (25).
- 24B. Lower partial inflorescences usually 3-5-branched. Leaflets in most cases broader and conspicuously triangular .. (26).
- 25A. Spikelets and calyces rusty-tomentose. Flowers pluriserial on a cylindrical spikelet .. .. *L. acutifida* Mart. (partly).
- 25B. Spikelets and calyces whitish-tomentose. Flowers arranged spirally on flexuose spikelets .. .. *L. pusilla* Becc. (partly).
- 26A. Spadix, spathes and spikelets covered in early stages with a thick coat of creamish deciduous woolly tomentum. Corolla densely sericeous. Flowers solitary *L. lanuginosa* Ridl.
- 26B. Tomentum, when present on spadix, spathes or spikelets, not thick, and minute. Flowers frequently in groups of 2-3, Corolla glabrous or minutely hairy (27).
- 27A. Leaflets about 12" long. Spadix at the most 2 $\frac{1}{2}$  ft. long. Spikelets usually less than 6" long and the lower spadix branches about 6" or less apart. Fruit elliptic, about 10-13 mm. long, 6-8 mm. through .. *L. modesta* Becc. (partly).
- 27B. Leaflets 20" or more long. Spadix 6 ft. or more long, with lower branches 9-18 inches apart, each spikelet in lower branches being 9-15" long. Fruit globose, 6-8 mm. in diameter .. *L. spinosa* Wurm.

## 5. Systematic Notes

## A. LIBERICULA Furtado.

*Licuala peltata* Roxb., Fl. Ind. II (1824) 179; Griff. in Calc. Journ. Nat. Hist. V (1845) 324, et Palms Brit. Ind. (1850) 120 t. 222; Hook. f., Fl. Brit. Ind. VI (1892) 430; Becc. in Webbia V (1921) 24 et 39, et in Calc. Annals XIII (1933) 131 t. 74.

MALAY PENINSULA: *Lower Siam*, Kantang (Haniff & Nur, 4720).

*Distribution*: In the monsoon forests of North East India, Burma, Andamans and Nicobars.

This species was not recorded previously in the Peninsula, where it occurs only in the northern-most parts which form the southern-most range of the distribution of the species. In cultivation it is grown in many gardens throughout the Peninsula. The species sometimes begins to flower before its leaves have started to divide into segments.

B. EU-LICUALA § *Wurmbia* Furtado.

1. *Licuala acutifida* Mart., Hist. Nat. Palm. III, ed. 1 (1842) 237, t. 135 III et IV; Griff. in Calc. Journ. Nat. Hist. V (1845) 237 et Palms Brit. Ind. (1850) 122 t. 222 A et B; Mart. op. cit. III, ed. 2 (1849) 236 et (1850) 318; Hook. f., Fl. Brit. Ind. VI (1892) 433; Ridl., Mat. II (1907) 163 pp.; Becc. in Webbia V (1921) 30 et 44; Ridl., Flora V (1925) 27 pp.; Becc. in Calc. Annals XIII (1933) 168.

MALAY PENINSULA: *Penang*, Tulloh Bahang (Curtis, 1010); Government Hill (Ridley and Curtis, 7906); Waterfall (Curtis in June 1890); Penang Hill (Ridley in July 1898).

This species is very near to *L. Kunstleri* and so far not known from outside Penang. RIDLEY referred here some specimens of *L. pusilla* Becc. LOBB 280 cited by BECCARI as from Singapore may have come from Penang, for LOBB frequently gave incorrect localities to his plants, and there are reasons to believe that the majority of the Malayan plants collected by LOBB were from Penang (*vide*, BURKILL, in *Gard. Bull. Straits Settl.* IV, 1927 p. 127).

CURTIS notes on his specimen numbered 1010 that this is not the palm that supplies the walking sticks known as the "Penang Lawyer".

2. *Licuala confusa* Furtado sp. nov. Fig. 1.  
? *L. acutifida* Becc. var. *peninsularis* Becc. in Webbia V (1921) 30 et 44, et in Calc. Annals XIII (1933) 169 t. 10-II. *Syn. nov.*?

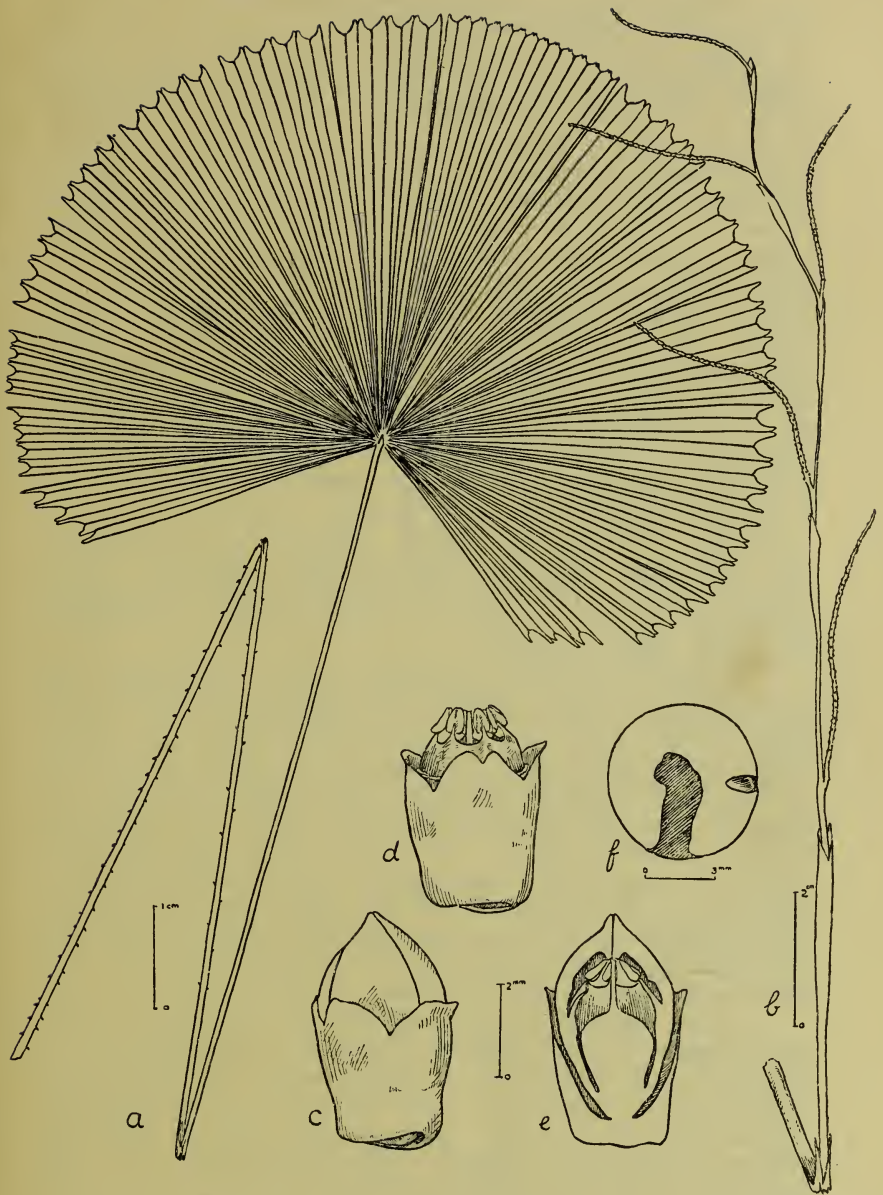


Fig. 1. *Licuala confusa* (Holotypus: FURTADO no. A).

a. Frons. b. Spadix. c. Alabastrum. d. Alabastrum, petala resecta, ut aestivatio staminum appareat. e. Alabastrum verticaliter discissum. f. Semen verticaliter discissum.

A *L. Ridleyana*, cui valde affinis, differt calyce conspicue lobato, apice nonnihil membranaceo.

*Palma* solitaria, acaulescens. *Petiolus* ultra 1 m. longus, interdum minor, ad medium aculeatus. *Segmenta* foliorum circa 17, subaequalia vel inaequalia, 2-4 costata, 34-45 cm. longa; medianum indivisum, interdum alteris multo latius, 6-12 costatum. *Spadix* petiolo brevior, in 4-5 partiales inflorescentias simplices, axi tomentosas divisus. *Flores* pluriseriatim dispositi, solitarii, plerumque super pulvinos prominulos interdum in depressionibus inserti. *Calyx* puberulus, cylindricus, basi truncatus, apice 3-lobatus, lobis rotundatis, saepe in 2 lobulis fassis, parum striatis, nonnihil membranaceis. *Corolla* calyce duplo longior, lobis acutis, puberulis vel non. *Annulus* staminalis in 6 filamenta antherifera abrupte subulata divisus. *Ovarium* glabrum. *Fructus* vivo rubrus, in sicco brunnescens, rugosus, circa 8 mm. in diam.; semen orbiculare 5 mm. in diam., gramineum, fossa integumentale cylindrica, ad centrum seminis cursa, apice parum curvata.

MALAY PENINSULA: *Perak*, Tapah Hill (Furtado sub litt. A, 11 June 1937-Holotypus); Tapah (Ridley, 14112); Bujong Malacca (Curtis in Dec. 1895 et in Aug. 1898). *Dindings*, Lumut (Ridley in Feb. 1892). *Selangor*, Semenyih (Hume, 7962).

RIDLEY 14112 is the haptoholotype of *L. Ridleyana* and in the capsules mounted on the sheet there are a few flowers which agree with the description and figure given by BECCARI for that species. But the vast majority of the flowers in the capsule and the flowers still attached to the spikelets are like the ones described here. Since I have typified *L. Ridleyana* on the characters of the flowers, I could not retain under that species RIDLEY 14112 from the Singapore herbarium. There are some minor variations between RIDLEY 14112 and the holotype of *L. confusa*. The *Dindings* specimens has no flowers and has been cited here because of its general resemblance to this species.

I have reduced here *L. acutifida* var *peninsularis* with some doubt. RIDLEY 9806 is cited as a paratype of the variety, but its duplicate in Singapore is *L. Ridleyana* as typified here. I have not been able to find in the Singapore herbarium any material which agrees exactly with the figures by BECCARI. RIDLEY 10329 from Lumut (the type collection is cited as 10239) bears calyces somewhat similar to the ones figured by BECCARI, but the partial inflorescences are branched in the Singapore specimen and the corolla is hairy. It seems to represent a variety of *L. spinosa*, typical material of which species is also mounted on the same sheet.



*L. confusa* has manifest affinities with *L. Ridleyana* but this has a truncate calyx which later splits irregularly. *L. pahangensis*, also an ally of *L. confusa*, has a glabrous, conspicuously striate calyx which bears a somewhat caudiculate base and less symmetrical lobes at the apex.

3. *Licuala Corneri* Furtado sp. nov. Fig. 2.

*L. Kunstleri proxima, a qua calycibus basin versus pedicelliformiter longe productis truncatis, obscure denticulatis, sat distincta.*

*Palma* solitaria ut videtur, cum caule 0.60–2 m. longo, 2–4 m. alta. *Petiolus* 35–100 cm. longus, prope basin tantum aculeatus, in medio circa 6–8 mm. et apice 4 mm. latus. *Segmenta* frondium subaequalia, circa 12–14, cuneatissima, 2–3, raro 1–4, costata, 25–35 cm. longa, apice 3–4.5 cm. lata; mediana alteris latiora, apice dentibus brevissimis. *Spadices* compositi, 35–80 cm. longi, in dimidia parte basali haud ramosi, cum 2–3 spathis involuti, in altera parte terminali in ramos simplices, florigeros, plerumque 3–4, ad 15 cm. usque longos, dense pubescentes, divisi. *Spathae* basales bicarinatae, alterae tubulares, punctis fugaceo fusco-leprosis tectae, apice marcescentes. *Flores* geminati vel interdum solitarii, pedicellati, in alabastro fusiformes, 5–8 mm. longi. *Calyx* dense pilosus, 4 mm. longus, apice truncatus, obscure 3-denticulatus, in basin pedicelliformen contractus. *Corolla* calyce cupulari duplo longior, glabra. *Annulus* staminalis in filamenta 6 apice abrupte contracta, divisus. *Fructus* immaturus tantum visus, ellipticus, utrinque acutus, circa 6 mm. longus, 4–5 mm. in diam., fossa albuminali indivisa, cylindrica.

MALAY PENINSULA: *Kemaman*, Ulu Bendong in Kajang, alt. 500 ped. (Corner, 30072–Holotypus); Sungai Nipa (Corner, s.n.).

CORNER 30072 was found mixed with some specimens of *L. malajana*. The collector notes: palm is slender solitary; leaflets dark green above, pale beneath, not glaucous; flowers greenish white; fruit fall orange-red when ripe; perianth green; staminal tube white; ovary pale orange; inflorescence hanging”.

Though this species falls into the group having simple partial inflorescences, it has no close ally in the Peninsula except the one described here as *L. Moyseyi*. In the long pedicelliform base of the calyx and its obscurely toothed apex the species may seem to appear very near to *L. Beccariana* of New Guinea but that species has been described to have very much longer flowers borne on simple and shorter spadices and belongs to the section DAMMERA.

4. *Licuala ferruginea* Becc. in Hook. f., Fl. Brit. Ind. VI (1892) 432; Ridl., Mat. II (1907) 162; Becc.

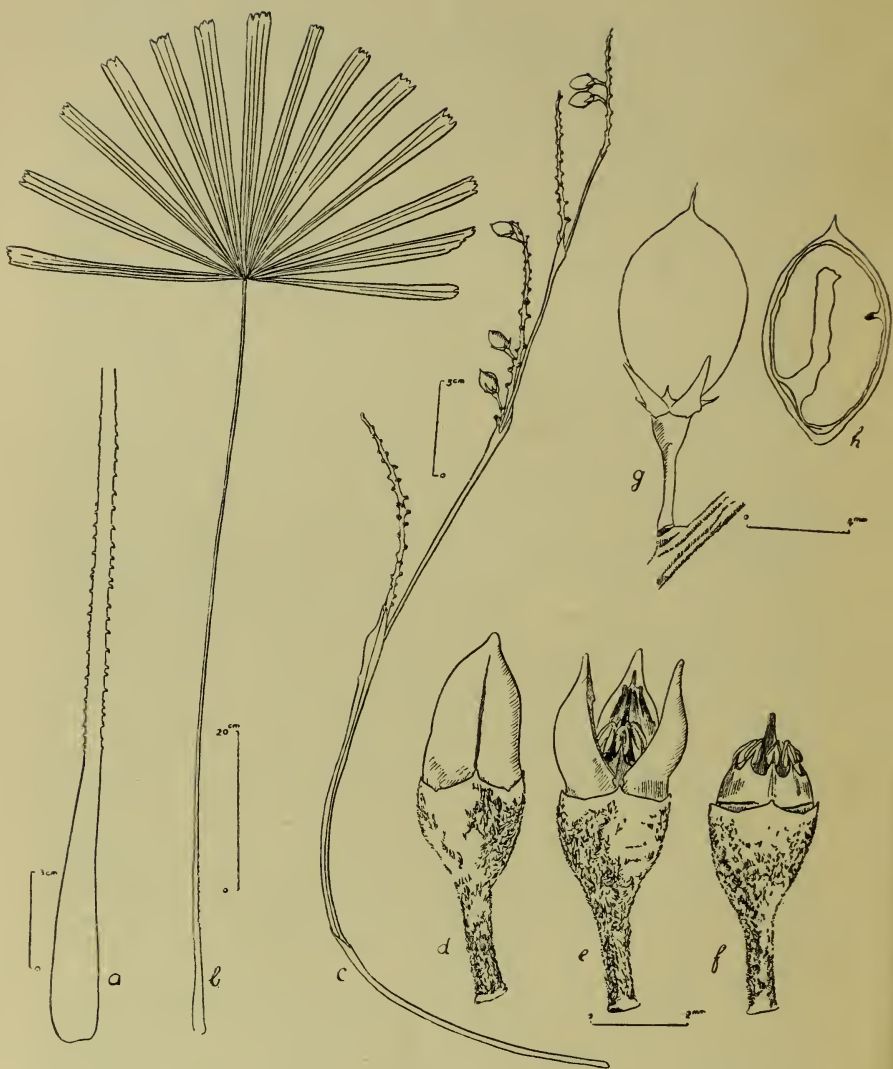


Fig. 2. *Licuala Corneri* (Holotypus: CORNER 30072).

a. Petioli pars inferior. b. Frondis lamina cum petiolo. c. Spadix fructiferus minimus. d. Alabastrum. e. Flos ad anthesin. f. Flos, corolla resecta, ut aestivatio staminum appareat. g. Fructus cum perianthio et filamentis staminum. h. Fructus verticaliter discissus, semen cum substantia integumentale oblique percurrente et embryone dorsale exhibens.

in Webbia V (1921) 32 et 46; Ridl., Flora V (1925) 26; Becc. in Calc. Annals XIII (1933) 180 tt. 9-X, 89 et 89 bis.

MALAY PENINSULA: *Kemaman* Bukit Kajang, alt. 1,000 ft. (Corner, 30398). *Pahang*, Pulau Tawar (Ridley in 1891); Bukit Sagu (Nur, 25167). *Negri Sembilan*, Ayer Kuning near Bahau (Symington, 24380). *Johore*, Sednah (Ridley, 13519); Sungai Kayu Ara (Corner, 28688); Mount Austen (Ridley in Jan. 1904); Kluang (Holttum, 9260); Gunong Belumut (Holttum, 10605); Sungai Endau (Holttum, 24944). *Singapore*, Reservoir Woods (Ridley in 1893); Bukit Timah (Ridley, 3512); Sungai Jurong (Mat in 1894); Ang Mo Kio (Ridley, 6676); Bukit Mandai (Ridley s.n.); Bukit Arang (Goodenough on 16 Nov. 1889); Botanic Gardens' Jungle (Ridley, 3168).

*Distribution*: Sumatra and Riow Archipelago.

From all the peninsular species having branched partial inflorescences this species is easily distinguished by the presence of the ferruginous tomentum on spikelets and calyx and by the sessile flowers. It is distinguished from the Sumatran *L. ferruginoides* (which frequently produces branched partial inflorescences) by longer hairs on the calyx and smaller flowers.

5. *Licuala glabra* Griff. in Calc. Journ. Nat. Hist. V (1845) 329 et Palms Brit. Ind. (1850) 124 t. 233; Hook. f., Fl. Brit. Ind. VI (1892) 432; Ridl., Mat. II (1907) 161; Becc. in Webbia V (1921) 34 et 48; Ridl., Flora V (1925) 26; Becc. in Calc. Annals XIII (1933) 192 tt. 14-I fig. 1-3, et t. 82.

*L. longepedunculata* Ridl. in Journ. Roy. Asiat. Soc. Straits Br. XLI (1903) 42, Mat. II (1907) 161 et Flora V (1925) 26.

MALAY PENINSULA: *Peninsular Siam*, Kampong Bukit (Kiah, 24256). *Kelantan*, Kuala Betis (Henderson, 29725). *Perak*, Gunong Batu Puteh (Wray, 254-Syntype of *L. longepedunculata*). *Pahang*, Karak (Best, 13884); Gunong Tahan (Haniff & Nur, 8111); Fraser Hill (Burkill & Holttum, 7842); Tahan Woods (Ridley, in 1891). *Malacca*, Gunong Ledang (Ridley, 3473); Mount Ophir (Feilding in 1892; Derry, 633; Hullett, 852; Ridley in Dec. 1899). *Selangor*, Bukit Hitam (Kelsall in 1890; Ridley in May 1896); Bukit Kutu (Ridley 7894).

In this species there is a good deal of variation in size and robustness of the leaves, spadices, and flowers, and I agree with BECCARI in reducing *L. longepedunculata* to *L. glabra*, though the former has somewhat larger flowers than

the type of the latter. The specimen from Peninsular Siam has a somewhat pedicelliform base to the calyx, but transitions from this to the typical form are also found.

6. *Licuala glabra* Griff. var. *selangorensis* Becc. in Webbia V (1921) 35 et 48; Ridl., Flora V (1925) 26; Becc. in Calc. Annals XIII (1933) 194 t. 14-I.

MALAY PENINSULA: *Trengganu*, Gunong Padang alt. circ. 2,500 ft. (Moysey & Kiah, 33399). *Pahang*, Fraser Hill, alt. 4,000-4,300 ft. (Burkill & Holttum, 8426). *Selangor*, Semangkok Pass, up to alt. circ. 3,000 ft. (Ridley in Aug. 1904; 15881, et 12117: Haptoholotype); Sempang (Ridley in April 1911). *Johore*, Kluang (Holttum, 10601).

The Trengganu specimen cited above is a more robust form than the others.

7. *Licuala kemamanensis* Furtado sp. nov. Fig. 3.

A L. ferruginoides, cui peraffinis, palma acaulescente, frondibus minoribus, spadicebus haud flexuosis, ramis supra spathae apicem remote orientibus, floribus minoribus, bracteolis inconspicuis recedit. Facie L. Kunstleri similis, sed floribus haud conspicue pedicellati, calyce basin versus haud valde angustato, ovariis pilosis, foliis minoribus dissimilis.

*Palma* humilis, acaulescens. Petiolus circa 30-65 cm. longus in specimina visa, tertia parte basali aculeis remotis brevibus, 1-2.5 mm. longis armatus. Segmenta foliorum circa 14, cuneatissima, 2-6 costata, subaequalia; medianum circa 27 cm. longum, 4 cm. latum, 3-6 costatum, apice obsolete dentatum costis approximatis; intermedia mediano aequilata vel fere, paulo breviora, oblique eroso-dentata, costis 3-4 nonnihil remotis; basilaria minima, 2-3 costata, 12-14 cm. longa, 2.5-3 cm. lata, apice intermediis conformia. Spadix unicus tantum visus, haud flexuosus, 60 cm. longus, in inflorescentias partiales duas simplices, 5-8 cm. longas, ferrugineo tomentosas, supra spathae apicem remoto orientes divisus, basi cum spathis 3 involutus. Spathae fugaceo fusco-furfuraceae, tubulosae, infima bicarinata. Flores pluseriatim dispositi, solitarii, in alabastro globoso-ovati, circa 4 mm. longi; super pulvinum prominentem basi bracteolatum siti. Calyx lato campanulatus, ferrugineo-pilosus, haud striatus, ad medium in lobos 3 rotundatos divisus, basi truncatus. Corolla calyce duplo longior, striata, apice acuta, puberula. Annulus staminalis in filamenta 6 aequalia abrupte subulata divisus. Ovarium loculis saepe 3 fertilibus praeditum, minute pubescens.

MALAY PENINSULA: *Kemaman*, Sungai Nipa (Corner, 30520).



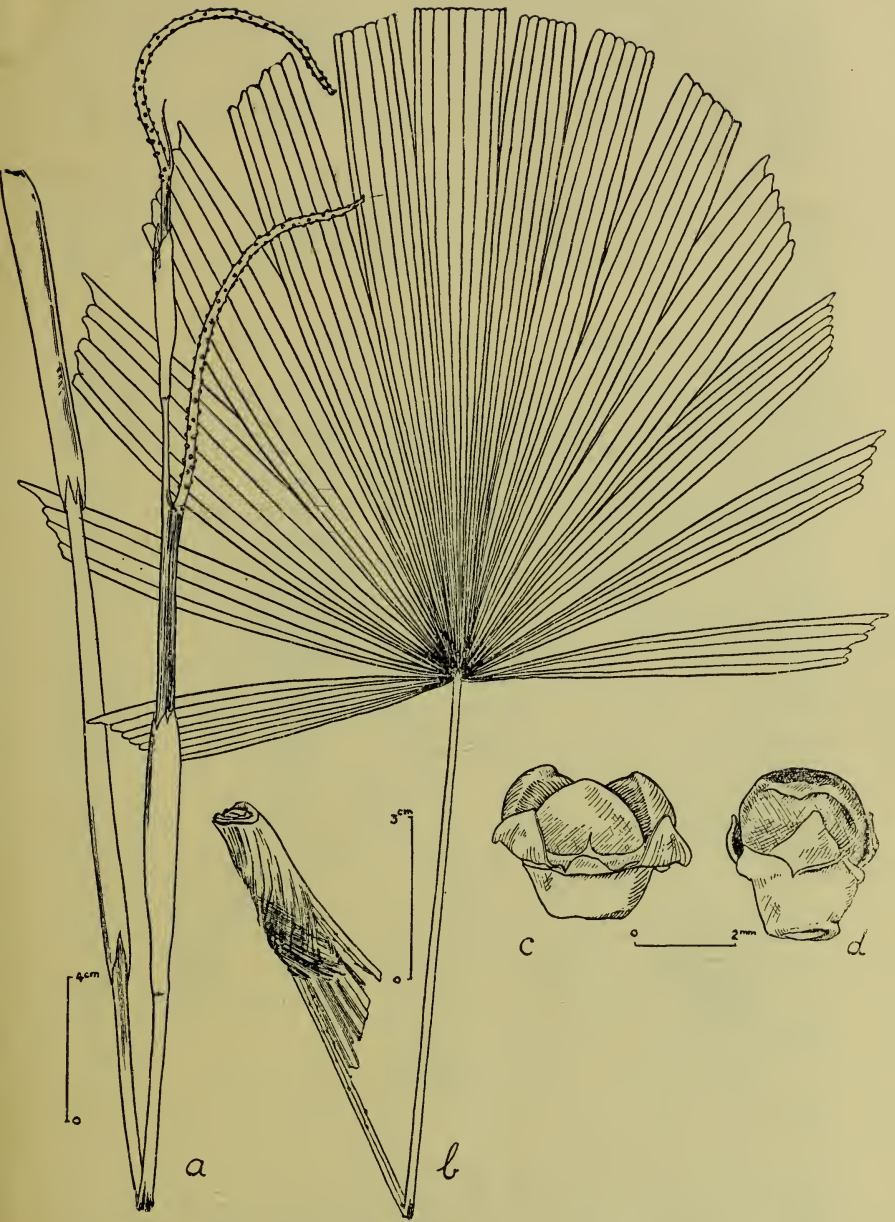


Fig. 3. *Licuala kemamanensis* (Holotypus: CORNER 30520).

a. Spadix. b. Frons. c. Flos tres carpella fertilia et unum filamentum staminale exhibens. d. Flos cum uno carpello fertile.

This species appears to be very near to *L. ferruginoides*, a Sumatran species described to have simple partial inflorescences but known also to bear sometimes two spikelets to each spadix branch. *L. ferruginoides* is however a very tall species having much larger leaves and flowers, a zigzag axis to the spadices, the spikelets arising a little below the apex of the leaves.

The only peninsular species having simple partial inflorescences to simulate *L. kemamanensis* is *L. Kunstleri*, but the latter is readily distinguished from the former by the very long pedicels of its flowers, turbinate calyx, and glabrous ovary.

8. *Licuala Kiahii* Furtado sp. nov. Fig. 4.

*Palma* humilis acaulescens. *Petiolus* 60–70 cm. longus, praesertim ad basin versus rubescens, prope basin tantum spinis reduncis, remotis, 1–2 mm. longis armatus. *Segmenta* foliorum 5, rarissime 6–7, inaequalia; medianum 10–14 costatum, 20–25 cm. longum, apice 8–10 cm. latum, superficialiter obtuseque dentatum, cuneatissimum, sessile; altera 3–5 costata, mediano minora, oblique eroso-truncata, arcuato cuneata. *Spadix* petiolo duplo vel triplo brevior, basi cum pedunculo circa 20 cm. longo fusco-furfuraceo, spathis 3–4 tubulosis induto, suffultus, apice in inflorescencias partiales 2–3, simplices vel bifurcatas, furfuraceas, 3–4.5 cm. longas divisus. *Flores* in glomerulis 1–3, remotis, alterne vel spiraliter dispositi, sessiles, pulvino inconspicuo. *Calyx* furfuraceus, pubescens, in lobos acuminatos profunde partitus. *Corolla* calyce parum longior, pubescens, in lobos altos, acuminatos divisa. *Annulus* staminalis in sex filamenta abrupte subulata divisus. *Ovarium* glabrum; carpellis plerumque 1–2 vel saepius omnia evolutis. *Fructus* elongato-clavatus, saepe parum curvatus, circa 22–23 mm. longus, 3.5–4.5 mm. in diametro; semine conforme, osseo; fossa integumentali embryo dorsali supra basin objecta, apicem versus mox ascedente cylindracea.

MALAY PENINSULA: *Johore*, in collibus apud ripas Sungai Kayu (*Kiah*, 32137, Holotypus); in monte Gunong Pulau (*Haniff*, s.n., 27 Dec. 1925).

This species is very peculiar in the genus in that it has very long fruits borne on a compound spadix. The only other species known to produce such long fruits is *L. mattanensis* Becc. from Borneo, which however is characterised by many-lobed leaves, a simple, unbranched spadix having almost pedicellate flowers, and the integumental process in the seed situated on the same side as the embryo (not opposite the embryo as is the case with *L.*



Fig. 4. *Licuala Kiahii* (Holotypus: KIAH 32127).

a. Spadix. b. Planta cum spadice fructifero. c. Fructus. d. Fructus verticaliter discissus. e. Perianthium fructiferum. f. Filamentum staminale.

*Kiahii*). Otherwise *L. Kiahii* has many characters similar to those of *L. mattanensis*, even in the habit of developing frequently more than one fertile carpel in each ovary.

9. *Licuala Kingiana* Becc. in *Malesia* III (1889) 193; Hook. f., *Fl. Brit. Ind.* VI (1892) 434; Ridl., *Mat.* II (1907) 165; Becc. in *Webbia* V (1921) 38 et 51; Ridl., *Flora* V (1925) 30; Becc. in *Calc. Annals* XIII (1933) 213 t. 11-II.

MALAY PENINSULA: *Perak*, Bukit Kapayang (Ridley in Feb. 1904); Sungai Siput (Haniff & Nur, 6962); Gunong Keledang (Ridley, 9804); Kinta Valley (Ridley s.n.); Bujong Malacca (Curtis, 3162); Keledang Saiong (Symington, Cf. 25724 & 25612—Herb. Kepong).

The Bukit Kapayang specimen collected by RIDLEY has one spadix bifid at the apex.

10. *Licuala Kunstleri* Becc. in Hook. f., *Flor. Brit. Ind.* VI (1892) 433; Ridl., *Mat.* II (1907) 162; Becc. in *Webbia* V (1921) 30 et 44; Ridl., *Flora* V (1925) 27; Becc. in *Calc. Annals* XIII (1933) 167 t. 94.

MALAY PENINSULA: *Perak*, Temango (Ridley, 14709). *Pahang*, Tanjong Antan (Ridley in 1891); Sungai Lepar (Burkill & Haniff, 17460). *Selangor*, Ulu Gombak, alt. 1,500 ft. (Hume, 9437); Bukit Kutu (Casdani in 1899); Kuala Lumpur (Ridley in 1889); Gua Batu (Ridley in Dec. 1896).

Some specimens of this species have been distributed from Singapore under the name of *L. ferruginea*.

11. *Licuala lanuginosa* Ridl. in *Journ. Roy. Asiat. Soc. Straits Br.* 44 (1905) 203, *Mat.* II (1907) 165; Becc. in *Webbia* V (1921) 33 et 46; Ridl., *Flora* V (1925) 30; Becc. in *Calc. Annals* XIII (1933) 181 tt. 9-IV et 50.

*L. longipes* sensu Ridl. op. cit. (1907 and 1925) pro parte.

MALAY PENINSULA: *Johore*, Gunong Panti (Ridley in Dec. 1892; Corner 30739 & 30739A); Gunong Belumut, alt. 2,200 ft. (Holtum, 10792); Gunong Pulai (Mat in 1892; Ridley 12198 partim; Best 7711; Corner in 1937); Bukit Tinjau Laut alt. 1240 ft. (Corner 37068).

12. *Licuala longicalycata* Furtado sp. nov. Fig. 5.

*L. baculariæ affinis ut videtur, sed planta robustiore, foliorum segmentis latioribus, inflorescentiæ ramulis partialis pluribus, floribus majoribus, calyce floris longe piloso, sed fructus interdum laevi, corolla minute pubescente haec species sat distincta. Inter species malayanas L. glabra producit formas aspectu calycale similes L. longicalycatæ,*



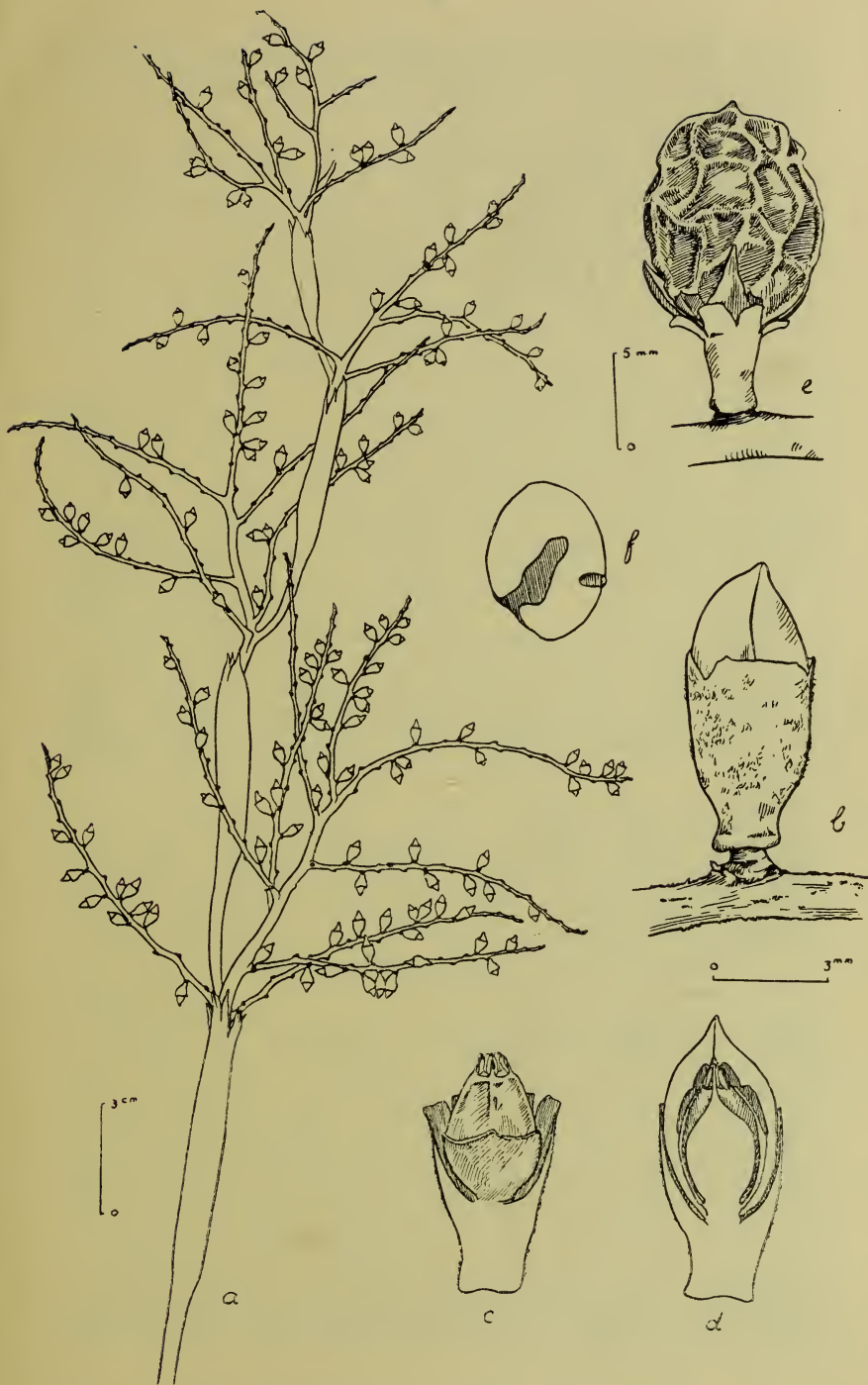


Fig. 5. *Licuala longicalycata* (Holotypus: KIAH 32401).

a. Pars spadiceis flordi. b. Alabastrum. c. Alabastrum verticaliter discissum ut aestivatio staminum appareat. d. Alabastrum verticaliter discissum ut ovarium exhibeat. e. Fructus (e specimine SYMINGTON 47092). f. Semen ejusdem fructus verticaliter discissum.

a qua illa inflorescentiæ ramulis partialis paucioribus, calyce laevi apice arcuato denticulato (haud truncato et irregulariter fissis), pulvinis floriferentibus brevioribus differt.

*Caulis* robustus, ad 3 m. altus. *Petiolus* longus 1–3 m. longus, tertia parte basilari aculeatus, apice circa 8 mm. latus. *Segmenta* foliorum circa 16, inaequalia, cuneatissima; centrale latissimum, pluricostatum, apice obtuse dentatum, ad 9–16 cm. latum, 40–55 cm. longum; altera angustiora, altius dentata, 3–4 costata. *Spadix* circa 70–80 cm. longus, petiolo brevior, in 4–5 inflorescentias partiales, unasquisque 5–10 ramulosas, fugaceo fusco-furfuraceas ad apicem spathæ vel paulo infra orientes, divisus, axi flexuosus. *Flores* 6–8 mm. longi, super pedicellum prominentem 1–2 glomerulati, remoti, spiraliter dispositi; in alabastro fusiformes, striati, dense fugaceo-furfuracei. *Spathæ* tubulares, fugaceo furfuraceæ, parum inflatæ, apice parce marcescentes, basilares conspicue bicarinatæ. *Calyx* 4–5.5 mm. longus, gramineus, pilis longiusculis remotis præditus, cyathiformis, basin versus nonnihil angustatus, utrinque truncatus, apice superficialiter 3 lobatus, interdum in fructu irregulariter fissus. *Corolla* minute puberula, calyce sesqui vel duplo longior, segmentis lanceolatis, acutis, striatis, persistentibus. *Annulus* staminalis 6-fidus, lobis abrupte subulatis. *Ovarium* glabrum, gramineum, rarissime loculis fertilibus 2–3. *Fructus* in sicco oblongus, rugosus, circa 12–14 mm. longus, 10 mm. in diam; semen oblongum, 7 mm. longum, 5 mm. crassum; fossa albuminale indivisa, cylindrica.

MALAY PENINSULA: *Johore*, Sungai Kayu, in locis paludosis (Kiah, 32401, Holotypus); *Kluang* (Holttum, 9252); *Arong* (Symington, 47092–Herbarium Kepong); *Labis* (Symington, 47068–Herbarium Kepong). *Negri Sembilan*, Ayer Kuning, prope Bahau (Symington, 24379).

In BECCARI'S Key *L. longicalycata* would have to be placed near *L. paludosa* and *L. bintulensis*, from both of which it is readily distinguished by the longer calyx and the longer flower-bearing pulvini. The species also appears to be very near to *L. bacularia* which I know only from description, and which is a much smaller species having narrower leaf-segments, and more branches to the partial inflorescences. The only peninsular species which may be confused with *L. longicalycata* is *L. glabra*, especially those forms which have a longer calyx, but in the latter species the calyx is glabrous, arcuately denticulate and unlobed or unsplit, even when in fruit. The form, the colour and the pubescence of the calyx remind one of *L. modesta* and *L. tiomanensis*, both of which bear undivided partial inflorescences to the spadix. I have described the young flowers

from SYMINGTON 47068 where there is a portion of very young inflorescence mounted together with an older one; the veins and the thick furfur that is present on the flowers in bud disappear when the flowers are developed. The fruits are described from SYMINGTON 47092.

13. *Licuala longipes* Griff. in Calc. Journ. Nat. Hist. V (1845) 330 et Palms Brit. Ind. (1850) 125 tt. 234 A & B; Hook. f., Fl. Brit. Ind. VI (1892) 431; Ridl., Mat. II (1907) 162; Becc. in Webbia V (1921) 28 et 42; Ridl., Flora V (1925) 27; Becc. in Calc. Annals XIII (1933) 155 t. 8-V.

MALAY PENINSULA: *Kemaman*, Ulu Bendong, Kajang, alt. 700 ft. (Corner, 30111). *Pahang*, Titi Bungor in Temerloh (Henderson, 10559); Mentakab (Holttum, 24560). *Negri Sembilan*, Gunong Angsi (Nur, 11571; Ridley, 10121); Tampin (Burkill, 1417); Gunong Tampin (Burkill, 1171; Holttum 9557); Beremban along Sungai Bendol (Furtado, 33125). *Malacca*, Ayer Panas (Goodenough, 1406; Ridley & Goodenough, 1577); Bukit Besar Ophir (Ridley, 10120 & 3474); Selandan (Ridley, 10793); Bukit Tampin (Goodenough, 1962).

*Distribution*: recorded from Mergui in Lower Burma.

GRIFFITH cites the syntypes of this species thus: "Malacca, solitary in dense forests, Ayer Punnus (Rhim), Goonoong Miring, and Mount Ophir, but not above an elevation of a thousand feet. Tenasserim coast in forests near Lainer to the south of Mergui."

BECCARI found only one syntype in the Calcutta herbarium with no indication as to its locality, and since he had not seen any specimen definitely coming from the Malay Peninsula, he gave Tenasserim as the probable origin of this GRIFFITH'S specimen. However from the description and the drawings given by BECCARI I think the species is common in the Peninsula, especially in the regions where GRIFFITH saw it.

From the notes given by collectors it appears that this species is very common in Malacca and Negri Sembilan; also that though it is easy to find plants in flower, it is rare to find them in fruit. There are a few specimens which have been collected above a height of 1,000 ft., and in some of these the flower-bearing pulvini are quite prominent (*e.g.* BURKILL 1171 and HOLTUM 9957); but there are transitions between these and the usual forms where the pulvini are nested in depressions.

There is some variation in the dentation of the calyx; some split very early during the development of the flowers and here the lobes are rounded at the apex and are often bifid; in others this lobation is retarded and the calyx looks



almost truncate and later split irregularly as in *L. malajana*, a species which appears to have very close affinities with *L. longipes*.

GRIFFITH records that this species is known to Malays as *Palas Batu*, a name recently recorded also by a Malay collector who notes that the leaves are used for thatching house roofs.

14. *Licuala malajana* Becc., Malesia III (1889) 197; Hook. f., Fl. Brit. Ind. VI (1892) 431; Ridl., Mat. II (1907) 161 pro parte; Becc. in Webbia V (1921) 35 et 55; Ridl., Flora V (1925) 26 pp.; Becc. in Calc. Annals XIII (1933) 196 tt. 14-IV et 87.

MALAY PENINSULA: *Trengganu*, Brang in Tersat, alt. 2,500 ft. (Kiah & Moysey, 33398). *Kemaman*, Kajang at Ulu Bendang, alt. 500 ft. (Corner, 30072 A); *Sungai Nipa* (Corner, 30547).

The following specimens have more hairy calyces, but seem to belong here:

*Kelantan*, Kuala Krai (Haniff & Nur, 10104). *Pahang*, Bukit Senai (Henderson, 19434). *Selangor*, Pahang Track (Ridley in 1897). *Johore*, Gunong Muntahak, alt. 600 ft. (Nur, 19968).

I have not seen any authentic specimens named by BECCARI and so my identification of the species is based entirely on the description and plates given by BECCARI. The specimens doubtfully cited here come very near to some forms of *L. modesta* which however produces very much shorter spadices bearing flowers in groups of two or three on very prominent, almost pedicelliform tubercles. The typical calyx of *L. malajana* has some resemblance to that of *L. Ridleyana*, but the latter species produces unbranched partial inflorescences.

15. *Licuala mirabilis* Furtado sp. nov. Fig. 6.

A *L. Kunstleri*, cui peraffinis, *spathæ limbo pedicellum axillaris spicæ plerumque valde superante, spathis superne inflatis, spicis (=inflorescentiis partialibus) 2-5 ramulosis haec species sat distincta. Secundum clavem Beccarii analyticam prope L. baculariam ponenda, a qua spadibus quam petioli valde brevioribus facile distinguitur.*

*Palma solitaria vel sobolifera, cum caule 1-1.5 m. longo 3-4 m. alta. Petiolus circa 1.5 m. longus, vagina fibrosa mox marcescente decidua præditus, in 2/3 partibus basalibus aculeis reduncis, inferioribus robustis 4 mm. altis, 1-2 mm. crassis, superioribus obscuris armatus. Segmenta frondium 20-27, basin versus valde angustata, fere petiolulata, apice 3.5-7 cm. lata, 5-15 mm. profunde dentata, 2-3, raro 4-6, costata; medianum alteris parum majus 3-6*





Fig. 6. *Licuala mirabilis* (Holotypus: FURTADO 33054).

a. Pars spadiceis floridi. b. Frondis lamina cum parte petioli.  
 c. Fructus. d. Semen verticaliter discissum. e. Alabastrum. f. Pulvinus cum flore dua carpella fertilia exhibente. g. Filamentum staminale.

costatum, minus profunde dentatum. *Spadices* petiolo multo breviores, ad 45 cm. longi. *Spathæ* fugaceo furfuracæ basi tubulosæ superne subito inflatæ, apice acutæ, in uno latere fissæ, partem pedicellarem spicarum axillarium plerumque superantes. *Inflorescentia partialis* in spiculas 2-5 axi pubescentes divisa, pedicello ad 2.5 cm. longo, infra limbum *spathæ* axillantem plerumque oriente, saepe quam limbus *spathæ* minore. *Flores* conspicue pedicellati, geminati vel solitarii. *Calyx* turbinato campanulatus, pubescens, apice membranaceus, lobatus vel partim truncatoides, in basin cylindricam induratum abrupte constrictus. *Corolla* calyce duplo longior, dense sericea. *Annulus* staminalis in filamenta 6, aequalia superne abrupte subulata. *Ovarium* glabrum. *Fructus* globosus, utrinque acutus, 10-12 mm. longus, 6-8 mm. crassus; albumine carneo, albescenti, fossa integumentale cylindrica, vertice paulo dilatata, interdum biapicali.

MALAY PENINSULA: *Kedah*, Ayer Tërjang Valley in Baling (Furtado, 33054-Holotypus); Yan (Ridley in June 1893). *Province Wellesley*, Permatang Bertam? (Ridley in 1895); Bukit Mertajam, alt. circa 450 m. (Burkill, 9021). *Perak*, Bukit Merbau Balong in Kroh (Furtado, 33037).

This species is closely allied to *L. Kunstleri*, but the branching of the partial inflorescences distinguishes them at once, *L. Kunstleri* having always simple branches to the spadices. From *L. ferruginea*, with which *L. mirabilis* has been confused, it is distinguished by the non-marcescent apex of the spathes, the pedicelled flowers and the membranous calyx having an attenuate and constricted base.

16. *Licuala modesta* Becc., Malesia III (1889) 195; Hook. f., Fl. Brit. Ind. VI (1892) 433; Ridl., Mat. II (1907) 163; Becc. in Webbia V (1921) 35 et 48; Ridl., Flora V (1925) 28; Becc. in Calc. Annals XIII (1933) 198 tt. 14-VI et 88.

*L. Wrayi* Becc. ex Ridl. in Journ. Roy. Asiat. Soc. Straits Br. 82 (1920) 201; Becc. in Webbia V (1921) 37 & 50; Ridl., Flora V (1925) 28; Becc. in Calc. Annals XIII (1933) 210 tt. 13-I et 46. **Syn. nov.**

MALAY PENINSULA: *Perak*, Taiping Hills (Hervey, in 1889; Ridley, 14721, in Dec. 1902 and in Feb. 1904; Furtado, 37103); Kuala Kangsar (Ridley, 3167); Gunong Hijau (Fox sub Curtis no. 3529; Burkill & Haniff, 12873 & 12589; Anderson, 164 & 171); Tea Gardens (Ridley, 11406 and in Feb. 1891); Maxwell's Hill (Burkill & Haniff, 12948, & 12551; Ridley in June 1893 & Feb. 1892; Curtis, 2077 partim, ex altera parte=*Calamus* sp.); Gunong Pondok, alt. 1,000 ft. (Henderson, 23804); Box Hill, alt. 4,200 ft. (Fox, 163); Larut Hill (Anderson, 177).

I am unable to detect any appreciable differences between the forms described by BECCARI and RIDLEY as *L. Wrayi* and *L. modesta*. The species produces very short inflorescences; in some there may be a few partial inflorescences separated by more or less elongated tubular spathes; in others the number of branches and the size of the spathes are reduced, so that the entire spadix may appear to bear directly the spikelets on its axis, though one or two liguliform spathes about 3–6 cm. in length will indicate the reduction that has taken place in the spathes; and in still others the ligule may be further reduced into small, inconspicuous bracteoles. If the definition of LICUACELLA were accepted, the specimens bearing these small bracteoles could not be kept in the subgenus that includes *L. modesta*, a reason why BECCARI was obliged to erect *L. Wrayi*.

Some of the specimens cited above were referred by RIDLEY (1907 and 1925) to *L. malajana* and to *L. pusilla*.

**17. Licuala Moyseyi Furtado sp. nov. Fig. 7.**

A *L. Corneri*, cui valde affinis, recedit haec species: petiolo inermi; segmentis frondium inaequalibus, mediano latissimo; ramulis floriferis furfuraceis, haud pubescentibus; pedicellis fere tuberculiformibus; floribus in spicis inferioribus plerumque 2–3 glomeratis; calyce fugaceo furfuraceo, haud piloso, minore, apice conspicue 3-lobato.

*Petiolus* gracilis, inermis, 75–90 cm. longus, ad basin circa 4 mm. latus, apice paulo angustior. *Segmenta* foliorum 8–10 dentibus 5–10 mm. altis; medianum latissimum, 10–14 costatum, 22–25 cm. longum, apice 10–15 cm. latum; altera angustiora, minora, 3–4, raro 2–5 costata; basilaria minima, apice oblique erosa. *Spadices* 60–75 cm. longi; in parte basilari haud ramosa, 35–40 cm. longa, spathis 2–3 involuti; in altera parte in ramos floriferos 3–4, simplices, fusco furfuraceos divisi. *Spathæ* tubulares, fugaceo fusco furfuraceæ, superiores obscure biangulatæ, haud inflatæ, ad 6 mm. crassæ, apice oblique truncatæ; infima latior conspicue biangulata. *Flores* in tuberculis prominentibus insidentes, 1–3 glomerati, 3–4 mm. longi, clavati. *Calyx* fugaceo fusco furfuraceus, conspicue 3-lobatus, in alabastro apice globosus, basin versus pedicelliformiter contractus. *Corolla* juvenilis tantum visa, haud pubescens. *Annulus* staminalis in filamenta aequalia abrupte subulata divisus. *Ovarium* glabrum.

MALAY PENINSULA: *Trengganu*, Gunong Padang, alt. circa 1300 m. (Kiah et Moysey, 31840).

This species may easily be confused with *L. Corneri*, for both have simple, unbranched partial inflorescences and they are the only species in the peninsula having a long pedicelliform base to the calyx. However *L. Moyseyi* can



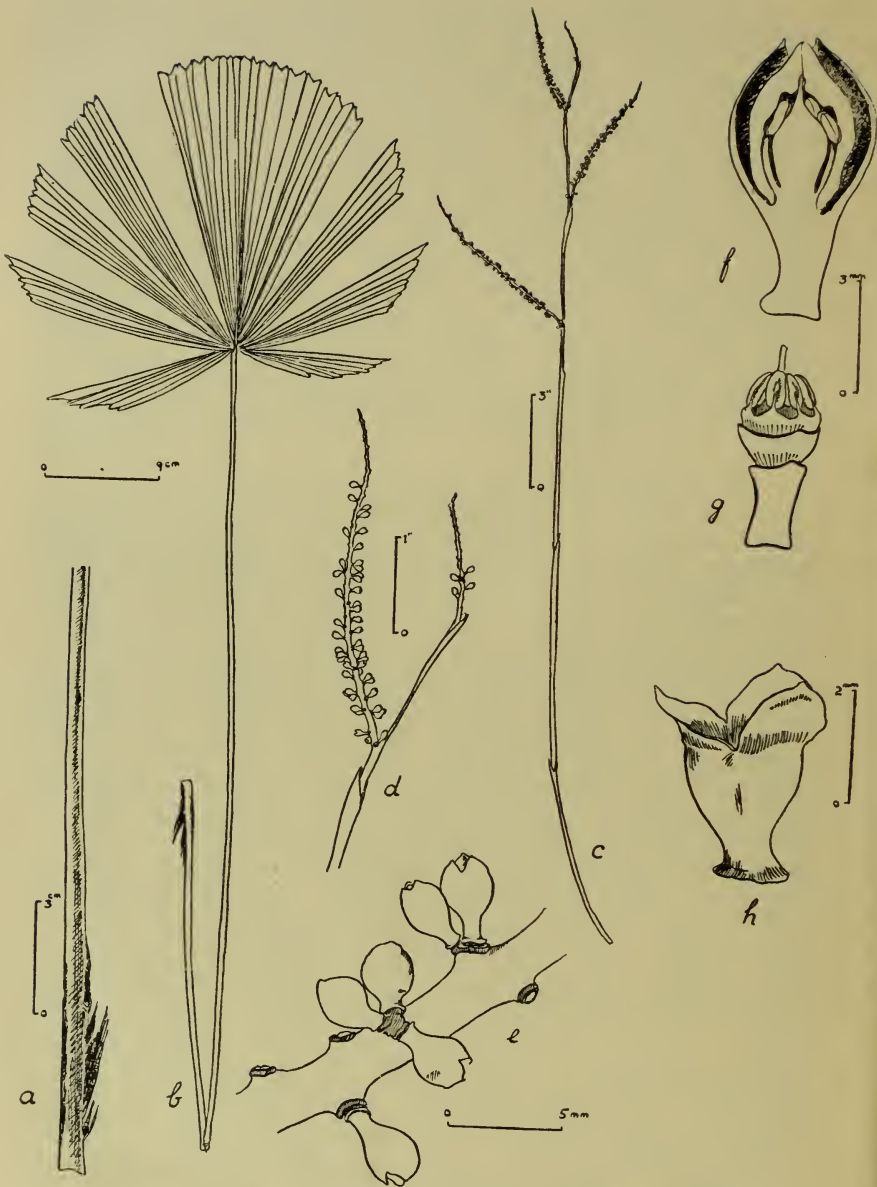


Fig. 7. *Licuala Moyseyi* (Holotypus: KIAH & MOYSEY 31840).

a. Petioli pars inferior. b. Frondis lamina cum petiolo. c. Spadix. d. Pars ejusdem apicalis. e. Pars spicae ut dispositio florum appareat. f. Alabastrum verticaliter discissum. g. Alabastrum sine perianthio ut aestivatio staminum appareat. h. Calyx fructiferus.



be distinguished from *L. Corneri* by its thornless petiole; unequal leaf-segments, the median being 2–3 times broader than the others; furfuraceous, not hairy spikelets; smaller, almost tubercular flower-pedicels; flower-glomerules consisting frequently of 3 flowers; smaller, not hairy, and distinctly 3-lobes calyx.

The flowers present in the specimen are not fully developed, the reason why the description of the petals is so meagre. One fully developed calyx was found on a spadix from which all fruits had fallen off; this calyx is represented in the drawing to show the depth of the calyx lobes.

18. *Licuala pahangensis* Furtado sp. nov. Fig. 8.

*L. malajana* sensu Ridl., Mat. II (1907) 161 et Flora V (1925) 26 p.p.

*L. spinosa* sensu Ridl. in Trans. Linn. Soc. Lond. III (1893) 391 p.p.

*Inter species sapdice composito ramulis floriferis simplicibus ponenda; L. Ridleyanae et L. peninsulari valde affinis, sed calycibus striatis, glabris, apice alto lobatis, basi truncatis vertice basali caudiculatis; petalis glabris; sat distincta.*

*Petiolus* 50–100 cm. longus, tertia parte basali aculeatus. *Segmenta* frondium subaequalia; centralia 4–6 costata, 3.5–5 cm. lata, circa 45 cm. longa, paulo latiora et minus profunde dentata alteris 2–3 costatis paulo brevioribus. *Spadices* petiolis fere aequilongi, vel eis paulo breviores, ramis simplicibus, ad 15–20 cm. longis, supra spathæ apicem remoto orientibus. *Spathæ* tubulosæ, fugaceo furfuraceæ. *Flores* solitarii, pluseriatim dispositi, circa 4–5 mm. longi. *Calyx* membranaceus, valde striatus, glaber, apice in 3 lobos asymmetros divisus interdum irregulariter fissus, basi truncatus vertice caudiculatus. *Corolla* glaber, calyce duplo longior. *Annulus* staminalis in filamenta versus apicem arcuatim angustata divisus. *Ovarium* glabrum, loculis saepe duobus vel tribus fertilibus. *Fructus* maturus ignotus.

MALAY PENINSULA: *Pahang*, ad radicem montis Gunong Senyum (Henderson, 22305–Holotypus); Titi Bungor, Temerloh (Henderson, 10623); Tanjong Antan (Ridley in 1891); Pulau Chengai (Ridley in 1891).

From the species bearing simple spadix-branches *L. pahangensis* is readily distinguished by the striate, glabrous calyx which is deeply lobed at the apex and truncate at the base, where it has a small tail-like projection. Otherwise this species may be easily confused with *L. peninsularis* and *L. Ridleyana*.

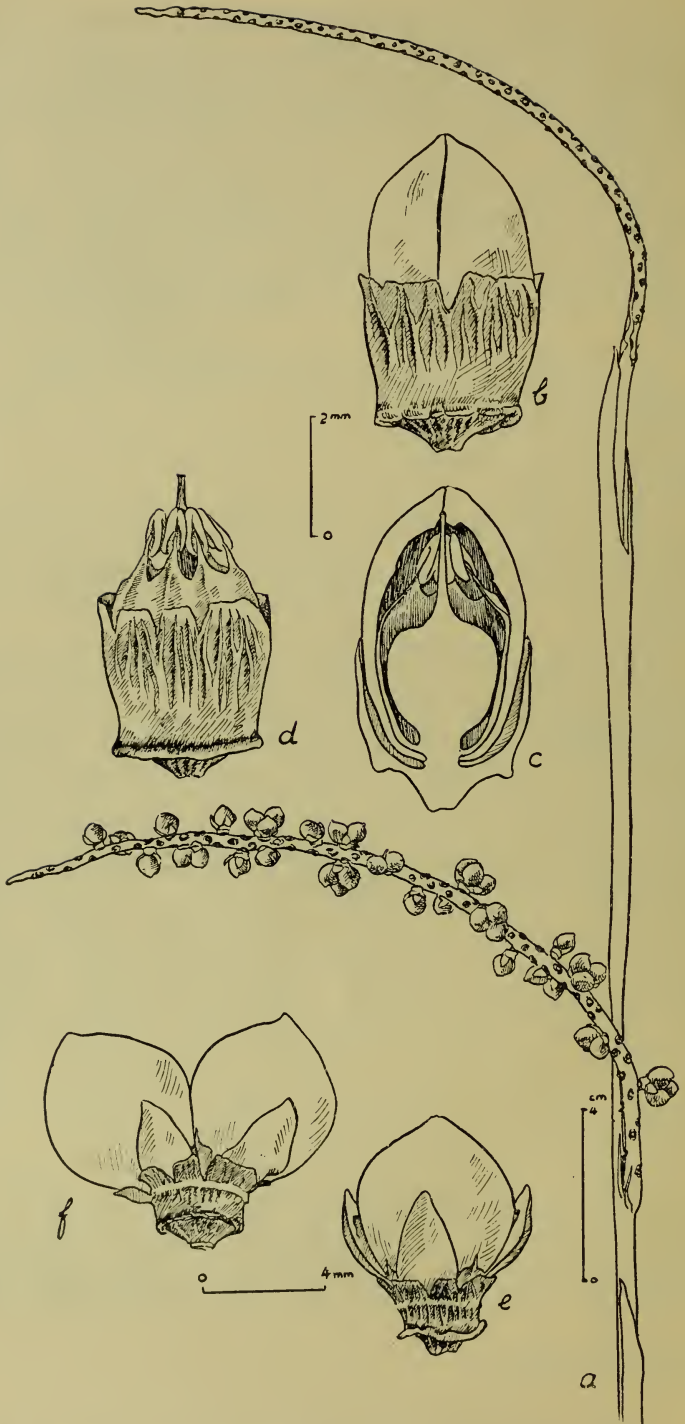


Fig. 8. *Licuala pahangensis* (Holotypus: HENDERSON 22305).

a. Pars spadicis. b. Alabastrum. c. Alabastrum verticaliter discissum. d. Alabastrum, petala resecta, ut aestivatio staminalis apparet. e. Fructus immaturus monospermus. f. Fructus immaturus

19. *Licuala paludosa* Griff. in Calc. Journ. Nat. Hist. V (1843) 233 et Palms Brit. Ind. (1850) 118 tt. 221 A, B, et C; Hook. f., Fl. Brit. Ind. VI (1892) 430; Ridl., Mat. II (1907) 160 p.p.; Becc. in Webbia V (1921) 24 et 43; Ridl., Flora V (1925) 25 p.p.; Becc. in Calc. Annals XIII (1933) 159 tt. 8–XI, et 98.

*L. paniculata* Ridl. in Journ. Roy. Asiat. Soc. Straits Br. XLI (1903) 42, et Mat. II (1907) 163; Becc. in Webbia V (1921) 29 et 43; Ridl., Flora V (1925) 30; Becc. in Calc. Annals XIII (1933) 161 tt. 10–I et 46. **Syn. nov.**

*L. patens* Ridl. in Journ. Roy. Asiat. Soc. Straits Br. LXXXII (1920) 202 et Flora V (1925) 25. **Syn. nov.**

*L. spinosa* sensu Ridl. in Kew Bull. (1926) 91.

MALAY PENINSULA: *Perak*, Hermitage Hill (Ridley in 1892, Holotype of *L. paniculata*); Sungai Krian Estate, alt. sea level (Spare, 33288); Gunong Bubu alt. 4,000 ft. (Wray, 3928, Haptosyntype of *L. patens*). *Selangor*, Sungai Tinggi, near Kuala Selangor (Nur, 34076). *Johore*, Hadji Senawi (Ridley, 11212).

SUMATRA, Siberut in Mentawi Islands (Boden-Kloss, 14614).

*Distribution:* Borneo and Indo-China.

RIDLEY has referred to this species many specimens of *L. spinosa*. Perhaps he had these specimens in mind when he erected *L. patens*.

*L. paludosa* is easily distinguished from *L. spinosa* by its calyx being minutely puberulous or almost glabrous outside and irregularly and shortly lobed at the apex. I do not find any important difference between the specimens collected in the lowlands and those collected in the mountains, and so I have reduced *L. patens* to a synonym of *L. paludosa*. There are some small differences noticeable between the types of *L. paniculata* and *L. paludosa*, but there are transitions; but even without these transitions the differences are so trivial that I have no hesitation in reducing *L. paniculata* to *L. paludosa*. (These differences have been noticed by BECCARI in Calcutta Annals *l.c.*).

In erecting *L. paniculata* (1903) RIDLEY remarked that it and *L. penduliflora* from New Guinea were the only species known to him to have a "panicked" inflorescence, which, according to him, characterise the section PERICYCLA. Since he did not include in this section *L. paludosa*, *L. longipes* and *L. patens*, even in his most recent work (1925), it is not easy to understand RIDLEY's conception of the section PERICYCLA (sometimes spelt by RIDLEY as *Pericyclus*).



BECCARI has reduced *L. amplifrons* Miq. to *L. paludosa*, but the specimens growing under that name in the Botanic Gardens, Buitenzorg, Java, appear to be different, though BECCARI quoted material from these plants under *L. paludosa*. In 1936 I collected herbarium material from these plants in Buitenzorg and distributed it under the Singapore Field no. 31102 and 31129. The plants can be distinguished from the typical *L. paludosa* in being solitary, bearing shorter petioles, fewer branches to partial inflorescences, longer flower-bearing pulvini, and sometimes the flowers borne in pairs on each pulvinus. The material looks so different that a further inquiry into the status of *L. amplifrons* Miq. seems to be necessary.

20. *Licuala pusilla* Becc., Malesia III (1889) 194; Hook. f., Fl. Brit. Ind. VI (1892) 433; Ridl., Mat. II (1907) 164; Becc. in Webbia V (1921) 31 et 45; Ridl., Flora V (1925) 28; Becc. in Calc. Annals XIII (1933) 174 t. 85.

*L. acutifida* sensu Ridl. op. cit. (1907) 163 et (1925) 27. p. parte.

MALAY PENINSULA: *Kelantan*, Gua Ninek (Henderson, 19686). *Selangor*, Rantau Panjang (Hume 7619; Ridley in Aug. 1909); Kanching (Foxworthy and Burkill on 30 Nov. 1921). *Negri Sembilan*, Gunong Angsi (Ridley in Feb. 1904). *Malacca*, Sungai Udang (Goodenough, 1360 as Palas Padi).

Of this species I have not seen any specimens named by BECCARI, and so my identification of it is based entirely on BECCARI's description and plate. The young floriferous branches are covered with whitish tomentum.

This species appears to be very near to *L. triphylla* some forms of which bear many, narrow almost linear segments to the leaves, the median lobe being sessile. Further investigation in the field may prove *L. pusilla* to be only a form or variety of *L. triphylla*.

21. *Licuala Ridleyana* Becc. in Webbia V (1921) 31 et 44 et in Calc. Annals XIII (1933) 170 tt. 10-III et 34.

*L. malajana* sensu Ridl., Mat. II (1907) 161 et Flora V (1925) 26 p.p.

MALAY PENINSULA: *Perak*, Bujong Malacca (Ridley, 9805, et 9806, Haptoparatype of *L. acutifida* var. *peninsularis*).

From the description and drawings given by BECCARI and from the Singapore duplicates of the specimens cited by BECCARI, the flowers of the specimens cited under *L. Ridleyana* and *L. acutifida* var. *peninsularis* (see *L. confusa*) appear to have been interchanged either by RIDLEY at the



time of distributing his collections or by BECCARI at the time of drafting his description. In the Singapore herbarium spadices of RIDLEY 9806 (cited by BECCARI under *L. acutifida* var. *peninsularis*) and RIDLEY 14112 (Haptoholotype of *L. Ridleyana*) still bear flowers; but RIDLEY 9806 has flowers depicted for *L. Ridleyana* and RIDLEY 14112 has flowers depicted for *L. acutifida* var. *peninsularis*. As I have typified the species on the characters of flowers, which are more stable and of better diagnostic value than the characters of leaves, spathes, etc., investigators should note these points in case discrepancies be noticed in the original specimens of these two taxonomic units.

As described by BECCARI, *L. Ridleyana* approaches very near to *L. malajana* which has however branched partial inflorescences. (see also observations under *L. confusa*).

22. *Licuala Scortechinii* Becc., Malesia III (1889) 192; Hook. f., Fl. Brit. Ind. VI (1892) 434; Ridl., Mat. II (1907) 164; Becc. in Webbia V (1921) 37 et 49; Ridl., Flora V (1925) 30; Becc. in Calc. Annals XIII (1933) 208 tt. 13-IV, 59 et 59 bis.

MALAY PENINSULA: *Kedah*, Gunong Jerai =Kedah Peak (Haniff in May 1904; Ridley, 5201; Robinson and Kloss, 6016).

This species was based on a specimen collected by SCORTECHINI in Perak where it has not been found again.

23. *Licuala spinosa* Wurm in Verh. Bat. Genootsch. II (1780) 469; Bl., Rumphia II (1844 ?) 39 tt 82 et 88; Hook. f., Fl. Brit. Ind. VI (1892) 431; Ridl., Mat. II (1907) 160; Becc. in Webbia V (1921) 34 et 47; Ridl., Flora V (1925) 25; Becc. in Calc. Annals XIII (1933) 186 t. 84.

MALAY PENINSULA: *Perlis*, Mata Ayer (Henderson, 23061). *Kelantan*, Sungai Keteh (Nur, 12077). *Lankawi*, common (Curtis, 2129); Coah (Curtis, 3419). *Pahang*, Pekan (Ridley on Aug. 20, 1889); Tasek Bera (Henderson, 24433); Pulau Tioman (Nur, 18901; Burkill in June 1915). *Perak*, Dindings (Ridley, 3170); Matang Jambu (Wray, 2527). *Malacca*, Bukit Bruang (Hassan, 25). *Johore*, Sungai Segal in Muar (Fox, 11303); Sungai Rhu (Corner, 28485); Sungai Sedili in Mawai (Holttum & Corner, on 16 May 1932); Pulau Tinggi (Feilding in 1892). *Singapore*, Pulau Ubin (Ridley, 5121 et 3166; Hullett on 9 Nov. 1884); Pulau Battam (Ridley in 1890 and in 1891); Pulau Brani (Ridley in 1900); Changi (Ridley in April 1889).

*Distribution:* Lower Burma, Siam, Indo-China, Andamans, Sumatra, Java, Borneo, and the Philippines.

24. *Licuala tiomanensis* Furtado sp. nov. Fig. 9.

*Inter species inflorescentias partiales simplices gerentes calyce majore superficialiter lobato dense adpresse piloso sat distincta. Facie florum L. modestæ similis, sed spadibus longioribus, inflorescentiis partialibus remotioribus simplicibus dissimilis.*

*Palma humilis. Petiolus unicus tantum visus, 22 cm. longus, infra medium aculeatus. Segmenta foliorum multa, inaequalia, cuneata; medianum maximum, circa 28 cm. longum, 9 cm. latum, pluricostatum; basilaria 2—costata, minima, 15—17 cm. longa, circa 2 cm. lata; intermedia 3—4 costata. Spadix circa 80 cm. longus, in ramos 2—3, pilosos, simplices, infra spathæ apicem orientes divisus. Spathæ tubulosæ, fugaceo-furfuraceæ. Flores immaturi lanceolati, 6—8 mm. longi, super pulvinos prominulos plerumque geminati. Calyx 4 mm. longus, dense pilosus, apice truncatus, breviter lobatus vel in 3 lobos obscure fissus. Corolla ante anthesin calyce 1/3 longior, puberula, lobis acutis. Annulus staminalis conspicuus, in 6 filamenta abrupte subulata divisus. Ovarium glabrum.*

MALAY PENINSULA: *Pahang*, Bukit Kajang in insula Tioman, alt. 3,300 ped. (Nur, 18611).

This species resembles *L. Ridleyana*, *L. peninsularis*, etc. in having simple branches to the spadix, but in the characters of the flowers it is easily confused with *L. modesta*. Unfortunately *L. tiomanensis* is known only from a single specimen containing only one leaf which may not be typical of the species. Fruits are not known.

NUR, 18910 collected also on Gunong Kajang in Pulau Tioman at an alt. 2,500 ft. seems to belong here, but no flowers are present in the Singapore herbarium, though from the collector's notes it appears that the flowers were present in the collection. The petiole is very much longer in this specimen and may have been over 3½ feet long; the partial inflorescences arise very high above the apex of the spathes. The collector notes that the plant which supplied this specimen is 15—20 feet in height.

25. *Licuala triphylla* Griff. in Calc. Journ. Nat. Hist. V (1845) 332 et Palms Brit. Ind. (1850) 126 t 225; Hook. f., Fl. Brit. Ind. VI (1892) 432; Ridl., Mat. II (1907) 163; Becc. in Webbia V (1921) 33 et 46; Ridl., Flora V (1925) 28 t. 211; Becc. in Calc. Annals XIII (1933) 182 tt. 9—V et 96.

*L. pygmaea* Merr. in Univ. Calif. Publ. Bot. XV (1929) 20. Syn. nov.

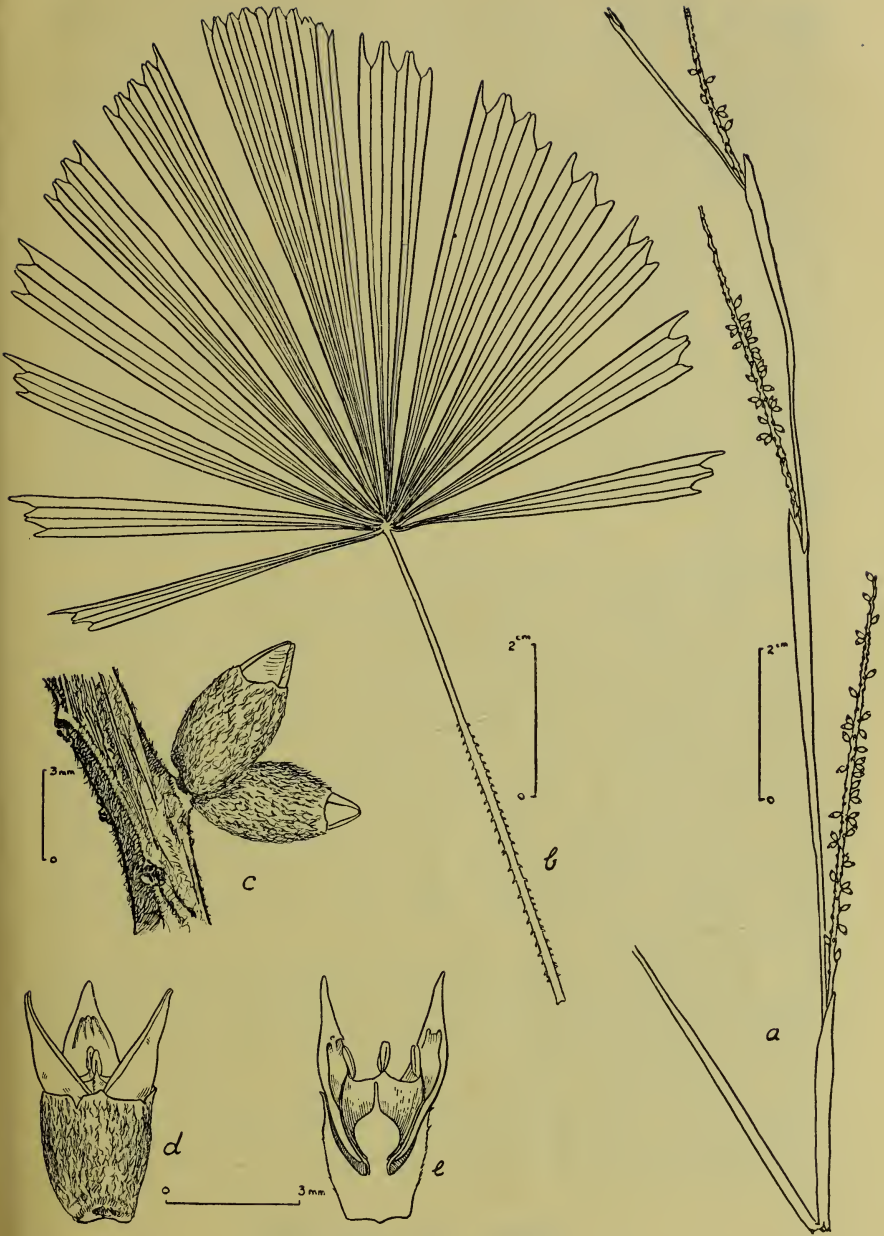


Fig. 9. *Licuala tiomanensis* (Holotypus: NUR 18611).

a. Pars spadicis. b. Frondis lamina cum parte petioli. c. Pars spicae cum alabastris. d. Flos ad anthesin. e. Flos verticaliter discissus ut filamenta staminum et ovarium appareant.



*L. triphylla* var. *integrifolia* Ridl., Mat. II (1907) 164; Becc. in Webbia V (1921) 33 et 46; Ridl., Flora V (1925) 28; Becc. in Calc. Annals XIII (1933) 184. **Syn. nov.**

**MALAY PENINSULA:** *Kedah*, Bukit Seblak at Weng (Furtado, 33069). *Pahang*, Gunong Senyum (Henderson, 22356); Batu Talam near Raub (Burkill & Haniff, 16959); Lubo Pellang (Ridley in 1891, the holotype of the var. *integrifolia*); Pulau Tijou (Ridley in 1891); Dong near Raub (Burkill & Haniff, 16911). *Perak*, Kroh (Furtado, 33041); Bujong Malacca (Curtis in Aug. 1898); Gunong Tungul in Dindings (Ridley in May, 1896 and July 1898). *Negri Sembilan*, Tampin (Burkill, 3212; Nur 1308). *Malacca*, Chabau (Alvins, 2306 as Palas Revang); Ayer Panas (Ridley & Goodenough, 1628); Malacca Town (Alvins, 655, as Gurcheng or Palas Tikus); Bukit Bruang (Curtis, in May 1901). *Johore*, Sungai Tebrau (Ridley, 13234); Bukit Keara in Muar (Fox, 11301; Ridley in 1902); Sungai Buloh Kasap (Corner on 5 Jan. 1936); Bukit Tinjau Laut (Corner, 37079). *Singapore*, Changi (Ridley in 1891 & 1894).

**BRITISH NORTH BORNEO:** Tawao (Elmer, 21635, Haptosyntype of *L. pygmaea*).

*Distribution:* Bangka (?) *vide* Beccari.

*L. triphylla* is a very variable species as regards the number of the leaf segments and the size of the petiolule of the median segment, some median segments being quite sessile. Owing to these variations field studies are necessary to see whether *L. pusilla* is a special form of this species. *L. triphylla* flowers when the plants are very small, so that leaves showing no divisions or leaves partially divided into 2 or 3 lobes may be found. In the holotype of *L. triphylla* var. *integrifolia* some leaves have very narrow segments at the base; these have been ignored by RIDLEY in describing the variety. Transitions from this to many-segmented leaves are many.

Many leaves bear sessile median segments, so that this cannot be taken as an invariable character of the species. GRIFFITH'S plate depicts leaves with sessile median lobes and so also RIDLEY'S figure which appears to have been based mainly on GRIFFITH'S plate.

I cannot separate *L. pygmaea* from *L. triphylla* on any characters. The median segment in the duplicate specimen in Singapore shows a distinct tendency to petiolulation.

## 6. Summary and Conclusions

This paper contains the results of a study of the *Licuala* species indigenous in the Malay Peninsula.



Though *Licualas* present little difficulty for collecting herbarium specimens, yet they are not well represented in the herbarium. The principal reason for this is that some experience is required before the collector is able to distinguish between the different species he meets with in the field, and so very often rare species, being mistaken for the common ones, are omitted in the collection. Hence some hints are given in this paper to enable the collector to distinguish readily between the species of a given area.

An inquiry into the affinities of the Malayan species revealed the necessity of revising the subdivisions of the genus. The previous subdivisions were mostly based on the branching of the spadices, a character very variable and therefore unsatisfactory for the purpose. It has been found also that all *Licuala* species produce a dorsal embryo in the fruit so that the definition that PERICYCLA includes species with basal embryo is untenable. The only stable character which can be employed to place allied species into large groups is found in the andrœcium, and in the nature of its divisions.

As revised here, the genus *Licuala* consists of three subgenera: LIBERICULA (new), EU-LICUALA and PERICYCLA, the second subgenus being again subdivided into four sections: WURMBIA (new), BONIA (new), BECCARIA (new) and DAMMERA (new state). The subgenus LIBERICULA and the sections BONIA and BECCARIA are monospecific, containing respectively: *L. peltata* (in monsoon forests in North-East India, Assam, Burma, Andamans and Thailand (Siam)), *L. fatua* (Indo-China) and *L. reptans* (Borneo). Of the section DAMMERA only two species are known, both from New Guinea. The subgenus PERICYCLA has been re-defined to include all the species which are allied to *L. penduliflora* (Bl.) Miq., the type of the subgenus; these inhabit the tropical and sub-tropical regions in Oceania, one occurring in Australia, a few in the small islands west of the Solomon Islands, and the rest in New Guinea. The section WURMBIA includes the great majority of the *Licuala* species, the greatest number of these being limited to the Malay Peninsula, Sumatra and Borneo, though some also occur outside this region in Burma, Indo-China, South China, Java, Philippines, Celebes and New Guinea. Usually the distribution of the individual species of this section is very limited; *L. spinosa*, the type of the section, is the most widespread, being also of a frequent occurrence throughout the Malay Peninsula.

There are in all twenty-five species indigenous in the Malay Peninsula. Of these *L. peltata* is the only species that is not a member of WURMBIA. Besides *L. peltata* and

*L. spinosa*, four peninsular species are known or reported to occur wild outside the Malay Peninsula, namely *L. ferruginea*, *L. longipes*, *L. paludosa* and *L. triphylla*; they are also fairly widespread within the Peninsula itself. The other nineteen are all endemic, most of them being apparently restricted to small regions in the Peninsula. Much of this endemism may be more apparent than real, because, owing to the difficulty of distinguishing *Licualas* in the field, the species are not well represented in the collections. Furthermore, recent collections from Sumatra, Borneo, and Siam have not yet been worked out.

The new name *L. Beccariana* has been proposed for the New Guinea species, previously known as *L. racemosa* Becc. (DAMMERA), non *L. racemosa* Bl. (WURMBIA). In addition nine new species have been described from the Malay Peninsula: *L. confusa*, *L. Corneri*, *L. kemamanensis*, *L. Kiahii*, *L. longicalycata*, *L. mirabilis*, *L. Moyseyi*, *L. pahangensis*, and *L. tiomanensis*.

The following names have been reduced in the synonymy: *L. acutifida* var. *peninsularis* (*L. confusa*, doubtful), *L. longepedunculata* (*L. glabra*), *L. paniculata* and *L. patens* (*L. paludosa*), *L. pygmaea* (*L. triphylla*), *L. racemosa* Becc., non Bl. (*L. Beccariana*), *L. triphylla* var. *integrifolia* (*L. triphylla*) and *L. Wrayi* (*L. modesta*).

It has been shown that *L. ferruginoides* produces at times branched partial inflorescences (vide observ. sub. *L. ferruginea*) and that a further inquiry is needed before Beccari's reduction of *L. amplifrons* to *L. paludosa* can be accepted as final.

## 7. Index to the Collector's Numbers

**Alvins:** 655 & 2306(25). **Anderson:** 164(16); 171 & 177(16). **Best:** 7711(11); 13884(5). **Boden-Kloss:** 14614(19). **Burkill:** 1171 & 1417(13); 3212(25); 9021(15). **Burkill & Haniff:** 12551 & 12589(16); 12873 & 12948(16); 16911 & 16959(25); 17460(10). **Burkill & Holtum:** 7842(5); 8426(6). **Corner:** 28485(23); 28688(4); 30072(3); 30072A(14); 30111(13); 30398(4); 30520(7); 30547(14); 30739(11); 37068(11); 37079(25). **Curtis:** 1010(1); 2077(16); 2129(23); 3162(9); 3419(23). **Derry:** 633(5). **Elmer:** 21635(25). **Fox:** 163(16); 3529(16); 11301(25); 11303(23). **Furtado:** 33037 & 33054(15); 33069(25); 33125(13); 37103(16). **Goodenough:** 1360(20); 1406(13); 1962(13). **Haniff & Nur:** 4720(A); 6962(9); 8111(5); 10104(14). **Hassan:** 25(23). **Henderson:** 10559(13); 10623(18); 19434(14); 19686(20); 22305(18). 22356(25); 23061(23); 23804(16); 24433(23);

29725(5); 33041(25). **Holttum**: 9252(12); 9260(4); 9557(13); 10601(16); 10605(4); 10792(11); 24560(13); 24944(4). **Hullett**: 852(5). **Hume**: 7619(20); 7962(2); 9437(10). **Kiah**: 24256(5); 32137(8); 32401(12). **Kiah & Moysey**: 31840(17); 33398(14); 33399(6). **Kloss**: see **Boden-Kloss**. **Lobb**: 280(1). **Moysey**: see **Kiah & Moysey**. **Nur**: 1308(25); 11571(13); 12077(23); 18611(24); 18901(23); 18910(24 obs.); 19968(14); 25167(4); 34076(19). **Ridley**: 3166(23); 3167(16); 3168(4); 3170(23); 3473(5); 3474(13); 3512(4); 5121(23); 5201(22); 6676(4); 7894(5); 9804(9); 9805(21); 9806(21) 10120(13); 10121(13); 10239(2 obs.); 10329(2 obs.); 10793(13); 11212(19); 11406(16); 12117(6); 12198(11); 13234(25); 13519(4); 14112(2); 14709(10); 14721(16); 15881(6). **Ridley & Goodenough**: 1577(13); 1628(25). **Robinson & Kloss**: 6016(22). **Spare**: 33288(19). **Symington**: 24379(12); 24380(4); 25612(9); 25724(9); 47068(12); 47092(12).

## 8. Index to the Botanical Names

Sectional and Subgeneric names in small CAPITALS. New names in bold faced type. Synonyms in *italics*.

### BECCARIA

#### BONIA

**DAMMERA** tr. nov.

*DAMMERA* subg.

#### **EU-LICUALA**

#### LIBERICULA

#### LICUACELLA

#### Licuala:

acutifida

acutifida var. *peninsularis*  
(obs.)

amplifrons (obs.)

**Beccariana** nom. nov. (gen.)

**confusa** sp. nov.

**Corneri** sp. nov.

ferruginea

ferruginoides (obs.)

glabra

glabra var. *selangorensis*

**grandis** (gen.)

**kemamanensis** sp. nov.

**Kiahii** sp.n.

Kingiana

Kunstleri

lanuginosa

*longepedunculata*

**longicalycata** sp.n.

malajana

#### Licuala:

*mirabilis* sp.n.

*modesta*

**Moyseyi** sp.n.

**pahangensis** sp.n.

*paludosa*

*paniculata*

*patens*

*peltata*

*pusilla*

*pygmaea*

*racemosa* (gen.)

*Ridleyana* (obs.)

**Rumphii** (gen.)

**Scortechinii**

*spinosa*

**tiomanensis** sp.n.

*triphylla*

*triphylla* var. *integrifolia*

*Wrayi*

#### LICUALINA

#### LICUALOPSIS

*Pericycla* emend. (obs.)

#### PERICYCLA

#### WURMBIA



THE FERN GENUS DIPLAZIUM IN THE  
MALAY PENINSULA

by R. E. HOLTUM

## General

The ferns of the genus *Diplazium* occurring in the Malay Peninsula are all, with the exception of *D. esculentum* and *D. polypodioides*, found on the ground in shady forest, many of them only in moist places near streams. They are especially characteristic of the valleys at medium elevations in the mountains, though a few species are common in the more open parts of the forest. There are no epiphytes and no climbing species among them. Nearly all have short erect rootstocks (sometimes developing a short trunk) and tufted fronds, sterile and fertile fronds being almost alike.

There is comparatively little difference of external form among the species of the same degree of division (*i.e.*, among pinnate and among bipinnate species), and there is of course a certain amount of variation according to age and influences of habitat, so that the clear distinction of species is at first sight difficult, and there has in fact been much confusion in the past. I have found, however, that the characters of the scales are most useful in distinguishing species of similar habit, and I believe that I have arrived at a clear distinction of our local species, with the possible exception of *D. Prescottianum*.

I have been unable to identify four of our species with any described from places outside the Peninsula, and so have described them as new. There are undoubtedly a very large number of species within the Malayan region, but I think that a good many have been described more than once. The descriptions are, however, inadequate as a basis for comparison, and much herbarium material is incomplete (part only of a leaf, or lacking in scales, or representing an immature stage). A study of much material over a wide area is necessary before a proper account of the genus in the Malayan region can be given.

*Diplazium cordifolium* provides a remarkable case of polymorphism leading to confusion of names. Young plants develop rather large simple fronds which are often fertile, and this stage may persist indefinitely, especially in the lowlands. Mature plants, however, often bear pinnate fronds with several pairs of pinnæ. The two stages have been separately named; and the fact that other superficially similar simply pinnate species have sometimes a few veins anastomosing has also led to confusion between these and the mature form of *D. cordifolium*. The young



stages of species may be characteristic, and so useful diagnostically, in this genus as in other fern genera, but they have been little studied. I have noted especially the early stages of *D. bantamense* and *D. riparium*.

In the following account of the species found in the Malay Peninsula, I have not attempted to give full lists of synonyms. There has been so much confusion in the application of names that such lists of synonyms would be difficult to compile accurately. I believe that the names used are all correctly applicable to our species; but I differ in some cases from the usage of the recent book by Backer and Posthumus on the ferns of Java. In such cases, the synonymy is briefly discussed.

As regards citation of specimens, this is done only where I believe there has been confusion in the past, or in the case of new species; in cases of well characterized species such as *D. accedens* and *D. cordifolium* there seems no need for the publication of lists of specimens. Specimens collected in our Singapore Field Number series (started by Burkill in 1912) are cited as S.F.N. Duplicates of many of these will be found in other herbaria, in some cases under other names than those now given. A list of numbers at the end of this paper may therefore prove helpful. It should be noted that the earlier distribution labels did not bear the words "Singapore Field Number".

A fairly full description is given for each species. To aid in the identification of specimens, the most distinctive characters in each description are italicised.

### Distribution

Until a full investigation is made, it is impossible to give a complete picture of the distribution of the species of *Diplazium* found in the Malay Peninsula. There are certainly cases in which one name is used in different countries to cover different species, and conversely the same species sometimes goes by different names in different countries. From the material at my disposal in the Singapore herbarium, it is, however, possible to make a few generalizations.

A few Malayan species certainly have a wide distribution, notably the two that grow in open places, *D. polypodioides* and *D. esculentum*. These both appear to extend from N. India and S. China right through the Malayan region to N. Guinea or beyond. *D. polypodioides* has various synonyms, and it appears that specimens from India and China need checking against the Java type.

*D. accedens* may have an even wider distribution if it should be found indistinguishable from *D. proliferum*, of which the type comes from the Mascarene Islands. A

similar case is that of *D. silvaticum* (type from Mauritius), but this is a less well characterized species, and its true Asiatic distribution is in doubt.

*D. sorzogonense* is another interesting case of a widely distributed species. This has undoubtedly been confused with *D. speciosum* and probably also with other species, but I have seen quite typical specimens from the Philippines and New Guinea. It is perhaps significant that this species is found in lowlands and mountains alike in Malaya, and is not confined to the most moist and shady places. *D. speciosum*, on the other hand, is certainly more restricted in distribution, and in Malaya is only found in the mountains, the typical form only (hitherto) on G. Tahan on the east side of the Peninsula.

*D. montanum* is a case of more restricted distribution. Our ferns which I now so name were formerly called *D. pallidum*. The latter species, however, as found on the mountains of Java and Sumatra, is clearly distinct, and I find that our ferns agree with the type of *D. montanum* from Sumatra. *D. montanum* appears to occur at lower altitudes in east and south Sumatra; i.e., those parts adjacent to Malaya.

*D. heterophlebium* is our only case in this genus of a species finding the southern limit of its distribution in Malaya.

So far as our present knowledge goes, the following species appear to be confined to the Malay Peninsula: *D. insigne*, *D. subintegrum*, *D. velutinum*, *D. procumbens*, *D. Kunstleri*, *D. simplicivenium*. All these are ferns of the moist, shady mountain valleys.

*D. insigne* is a remarkable fern of the alliance of *D. accedens* but very large. *D. subintegrum* is allied to *D. pallidum* but in my opinion quite distinct. *D. velutinum* is probably the most local of all, a derivative of *D. tomentosum*. *D. procumbens*, *D. Kunstleri* and *D. simplicivenium* are distinct members of the very large bipinnate group, the Peninsular species of which have been mostly hitherto lumped under the names *D. dilatatum* or *D. latifolium*.

### Characters of the Genus

There has been much discussion on the status of the genus *Diplazium* and on its relationship to *Athyrium*. I do not feel that I can offer any new evidence, more especially as the typical species of *Athyrium* (in the stricter sense) occur outside Malaya. In view of Christensen's remarks in this Bulletin, Vol. 7, p. 268, and in view of the fact that in Malaya *Diplazium* and *Athyrium* are quite distinct, I here maintain the genus *Diplazium*, as in Christensen's *Index Filicum*.

The principal characters of the genus may be summarized as follows:—

Stock usually short, erect, sometimes forming a short trunk, in a few cases creeping, but (in Malayan species) the fronds always tufted; roots rather coarse, black, sometimes forming a very close mat on the surface of the ground. Scales on young fronds orbicular to linear, edges entire or toothed, the cells usually elongated, walls of rather uniform thickness, colour throughout medium to dark brown (never clathrate), the teeth where present always formed of two adjacent cells, the ends of which may separate; edges of scales also provided sometimes with short glandular hairs. Stipes relatively stout, sometimes bearing papillae or spines near the base or throughout, these prominences being the bases of fallen scales. Rachises glabrescent, minutely scaly or in a few species hairy on the rounded lower side, papillate in the grooved upper side. Midribs of pinnae and pinnules grooved above, the edges of the groove often strongly winged, the wing often interrupted and/or extended at the junction of the midrib of a pinnule or the main vein of a lobe. Lamina simple, pinnate or bipinnate, texture mostly thin, pinnae and pinnules of bipinnate fronds with subequal base, the venation never anadromous. Veins in most species free, in a few species adjacent vein-groups anastomosing more or less freely. Sori elongated along the veins, with lateral indusium; the lowest acroscopic sorus in any group usually double (diplozoid), and occasionally other sori double also; double sori usually with two quite separate indusia, never grading into a horse-shoe shape with indusium continuous all round.

As compared with the above description, most species of *Athyrium* have an anadromous venation and division,

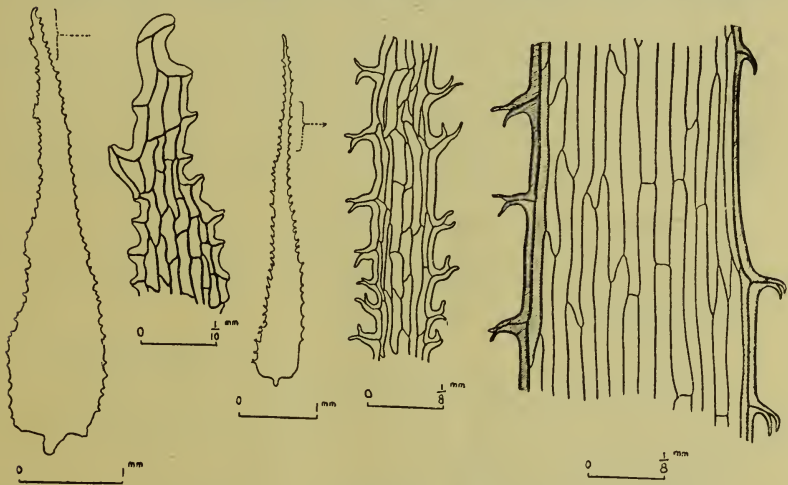


Fig. 1. Scales from base of stipe. On left, *D. crenatoserratum*, outline of single scale and apex enlarged. Centre, *D. silvaticum*, same, showing forked teeth. On right, *D. accedens*, middle part of scale; shaded cells at edges are black.



the pinnules often with very unequal bases, the scales are always relatively broad and entire, usually rather pale and thin, and the sori are always short and broad, the diplazioid ones often of a horse-shoe shape, the two sides of the sorus being connected.

In the character of grooved upper surface of costæ and costules and the winged margins of the groove, both *Diplazium* and *Athyrium* agree with *Eu-Dryopteris* and *Polystichum* rather than with *Thelypteris*; and the teeth on the scales on certain species of *Diplazium* are similar in structure to the teeth of *Dryopteris* and *Polystichum*. No scales in *Athyrium* or *Diplazium* (so far as I have observed) have hairs on the margin as found in many species of *Thelypteris* and *Cyclosorus*.

The markedly anadromous leaf-architecture found in many species of *Athyrium* is matched in the group of species formerly called *Polystichum* but now separated by Ching as *Rumohra*. Such leaf-architecture does not occur in *Thelypteris*.

It appears therefore that *Athyrium* and *Diplazium* are more nearly related to *Eu-Dryopteris* than to *Thelypteris*.

Though the leaf-architecture in many species of *Athyrium* is anadromous, there are clearly catadromous species (e.g. *A. silvaticum*) commonly referred to that genus. It seems possible that the type of leaf-architecture may afford a useful character in subdividing the genus.

The true *Athyriums* in the Malayan region are all species of rather high mountains (which is probably the reason why they are little represented in Malaya, which has much less high land than the great Sunda Islands), whereas species of *Diplazium*, as noted above, are characteristic of lowlands and medium elevations in the mountains.

### Key to the Species of *Diplazium* of Malaya

*N.B.*—This Key applies only to full-grown plants.  
Fronds simple.

Fronds to 4 cm. wide, narrow at base .. .. *D. subserratum*

Fronds more than 4 cm. wide, broadly cordate at base .. *D. cordifolium*

Fronds simply pinnate.

Scales entire, not toothed

Veins anastomosing copiously

veins anastomosing near costa *D. heterophlebium*

veins anastomosing only in marginal third of lamina .. *D. cordifolium*



- Veins free or only slightly anastomosing  
fronds to about 15 cm. wide,  
costæ hairy beneath .. *D. tomentosum*  
fronds usually wider, costæ not  
hairy beneath  
pinnæ cut half way or  
more to costa  
sori impressed, rachis  
fibrillose, veinlets to  
10 pairs .. *D. sorzogonense*  
sori not impressed,  
rachis not fibrillose,  
veinlets to 7 pairs .. *D. malaccense*  
pinnæ cut less than half  
way to costa  
pinnæ to 5 cm. or  
more wide  
veins at 45° to  
costa, pinnæ to 12  
pairs .. *D. xiphophyllum*  
veins at more than  
60° to costa, pin-  
næ to 5 pairs .. *D. riparium*  
pinnæ under 5 cm.  
wide  
lower veinlet of  
group simple or  
once forked .. *D. montanum*  
lower veinlet more  
copiously branch-  
ed  
2 veins of each  
group sori-  
ferous .. *D. subintegrum*  
4-6 veins of  
each group  
soriferous .. *D. Prescottianum*
- Scales toothed  
Veins much anastomosing .. *D. accedens*  
Veins free or only occasionally  
joining near margin  
pinnæ subentire, more than  
2 cm. wide .. *D. bantamense*  
pinnæ lobed, or if entire, less  
than 2 cm. wide  
pinnæ lobed  $\frac{3}{4}$  or more  
towards costa .. *D. speciosum*

pinnæ lobed less than  $\frac{3}{4}$   
towards costa

pinnæ thin in texture, not auriculate below, scales strongly toothed .. *D. silvaticum*

pinnæ thicker in texture, often auriculate below, scales irregularly and shortly toothed .. *D. crenatoserratum*

Fronds bipinnate.

Veins anastomosing

stipes smooth, pinnules usually less than 2 cm. wide, lobed about  $\frac{1}{4}$  to costa .. .. *D. esculentum*

stipes spiny, pinnules always more than 2 cm. wide, toothed only .. .. *D. insigne*

Veins free

scales  $\pm$  round, peltate, entire sori very short, basal on veins .. *D. latisquamatum*

sori longer, medial on veins .. *D. Kunstleri*

scales much longer than broad frond to about 30 cm. long .. *D. velutinum*

frond much longer

lobes of pinnules 3-4 mm. wide, cut more than  $\frac{3}{4}$  to midrib .. *D. polypodioides*

lobes of pinnules 7 mm. or more wide, cut less than  $\frac{3}{4}$  to midrib

rhizome procumbent, fronds to 80 cm. long .. *D. procumbens*

rhizome erect, fronds to more than 100 cm. long

lower pinnules sessile, to c. 2 cm. wide, veins to 5 pairs, all simple .. *D. simplicivenium*

lower pinnules on stalks to 5 mm. long, to more than 2 cm. wide, veins 5-8 pairs, some forking .. *D. dilatatum*

1. *Diplazium accedens* Bl. Enum. 192. 1828.

Stock stout erect, sometimes a short trunk. *Stipes* stout, green, covered with soft green protuberances near base, to c. 60 cm. long; when young covered with narrow scales, each on the end of a protuberance, the scales to 1.5 mm. wide at base, dull brown, thick in texture, with narrow black toothed edge (see fig. 1). *Lamina* simply pinnate, to 120 cm. or more long and 50 cm. wide, pinnæ about 15-jugate; apex of frond like the lateral pinnæ or with 1 or 2 deep lobes at the base; rachises and costæ glabrescent, smooth, buds common in the axils of the pinnæ. Lower pinnæ on stalks to 8 mm. long, upper sessile, gradually smaller. Largest pinnæ to  $40 \times 8$  cm., base truncate or very broadly cuneate, sides parallel for  $2/3$  or more of the length of the pinnæ, then tapering to acute apex, edges entire or very shallowly lobed, the lobes slightly toothed. Main lateral veins in the pinnæ about 8–12 mm. apart on the costa, at about  $60^\circ$  to the costa, each bearing up to 10 pairs of lateral veinlets, the lateral veinlets of adjacent groups anastomosing when they meet and so producing a series of parallelogram-shaped areolæ; anastomosis of small veins near edge of lamina irregular. Sori on some or all the veinlets, often throughout their length.

A fern of shady mountain stream-sides found in Malaya only on the Main Range and Taiping Hills. Sometimes in very large fronds there are extra areoles between the normal groups adjacent to the main lateral veins; a specimen having this character formed the basis of *Athyrium Ridleyi* Copeland, which I include in the present species.

This species is closely related to *D. proliferum* (Lam.) Thouars, and the two should perhaps be united; if so, the species in this broader sense would extend from the Mascarene Islands to the Pacific. A study based on material from all parts of this wide range is required to decide on the status of *D. accedens* and *D. proliferum*.

As regards the name *D. accedens*, the situation is a little complicated. It appears that the three names *D. accedens*, *D. repandum* and *D. Swartzii*, all published in the same book by Blume, are to be regarded as synonymous. Later authors have in many cases regarded all as synonyms of Lamarck's earlier name, or of *Asplenium decussatum* Sw.; the names *Swartzii* and *accedens* have been taken up and used in the genera *Callipteris*, *Asplenium* and *Athyrium*, but the name *D. repandum* appears to have been almost or entirely ignored. Backer and Posthumus (1939), however, have revived the name *D. repandum*, apparently on grounds of page priority (though they do not state this) which is not admitted by the Rules. In their synonymy, however,

they include *Diplazium proliferum* Thouars, an older name; their use of the name *D. repandum* is therefore contrary to the rules.

It appears to me that, if the Malaysian fern is to be regarded as specifically distinct from that of the Mascarene Islands, the name *Diplazium accedens* Bl. is the appropriate one to use, as this name has already been used by Christensen in the 3rd Supplement to his *Index Filicum* (1934), and had previously been used in a varietal sense for Java ferns by van Alderwerelt van Rosenburgh.

## 2. *Diplazium bantamense* Bl. Enum. 191. 1828.

Stock short suberect. Stipes to 60 cm. long, glabrescent, clothed at the base with *brown scales about 1 cm. long and 1.5 mm. wide at base, edges finely toothed. Frond simply pinnate, to about 60 cm. long and 25 cm. wide, pinnæ up to about 8 pairs, terminal pinnæ similar to the others or occasionally with a large lobe at the base; a bud often present on the rachis at the base of one of the upper pinnæ.* Basal pinnæ on stalks 3 mm. long, base slightly unequal, on the lower side rounded and on the upper side cuneate at 45° and decurrent; bases of the upper pinnæ more equally rounded. *Sub-basal pinnæ largest, up to about 20 by 7 cm., commonly about 12 by 4.5 cm., widest a little above the base, then narrowed gradually to the acuminate apex; edges entire or toothed only near the apex, texture firm; veins usually distinct on both surfaces but sometimes obscure, at rather more than 45° to the costa, forked at or near the costa, the upper branch simple and often soriferous almost throughout its length (diplazioid sorus), the lower branch forked again 1-3 times, 1-3 of the branches often bearing short simple sori towards the margin; occasionally a slight anastomosis of veins towards the margin; indusia narrow, persistent.*

Young plants have fronds with simple lamina to about 15 by 5 cm., deeply cordate or almost sagittate at the base, later fronds having one or more pairs of lateral pinnæ below the terminal lamina. This behaviour is closely similar to that of *D. cordifolium*; but *D. cordifolium* develops a much larger simple lamina, which usually becomes fertile, before producing fronds with free lateral pinnæ.

The name *D. bantamense* has in the past been given to all Peninsular specimens of *Diplazium* with free veins and rather broad subentire pinnæ. These I now separate into *D. bantamense* with toothed scales, *D. xiphophyllum* and *D. riparium* with entire scales. I find that *D. bantamense* as above described agrees well with Java specimens, and hence, though I have not seen the type, I feel confident that I have selected the correct Peninsula



fern to bear this name. It is a fern of moist shady forest, chiefly in the hills, sometimes near streams in lowland forest. In the shape of its pinnæ, it most nearly resembles the pinnate form of *D. cordifolium*, but the much anastomosing veins of the latter distinguish it.

Specimens in Singapore Herbarium:—

TRENGGANU. Kuala Berang, on streambank, Holttum s.n., 14.5.1925.

PAHANG. Fraser's Hill, 4,000 ft., S.F.N. 10018 (Holttum & Burkill); S.F.N. 11473 (Holttum); S.F.N. 36505 (Holttum). Cameron Highlands, Robinson Falls, 4500 ft., S.F.N. 17978 (Henderson); 4,800 ft., S.F.N., 23340 (Holttum). Sungei Teku, 500 ft., S.F.N. 20554 (Holttum).

PERAK. Waterloo, Curtis 1361 p.p. (narrow toothed pinnæ, and apical pinna lobed; a doubtful specimen). Ulu Temango, Ridley 14229. Taiping, 300–500 ft., King's Collector 8388. Upper Perak, 300 ft., Wray 3616.

NEGRI SEMBILAN. Ulu Bendul, S.F.N. 9876 (Holttum).

SELANGOR, near the Gap, 2,700 ft., S.F.N. 37159 (Addison).

PENANG, near Tiger Hill, 2,500 ft., S.F.N. 19346 (Holttum).

### 3. *D. cordifolium* Bl. Enum. 190. 1828.

Stock short erect. Stipes to 50 cm. or more long, clothed at the base with brown scales about 1.0 cm. long and 1.5 mm. wide at base, *edges of scales entire. Fronds of two kinds, either simple with cordate base, or pinnate with ovate entire pinnæ*; transition forms also occur, but fully-grown plants may bear simple fronds. *Lamina of simple fronds to 35 cm. long and 12 cm. wide, the base cordate* (often with a bud on the costa close to the base) the apex more or less acuminate, the margin entire; texture thin but firm, veins clearly visible on both surfaces; veins at more than 60° to the midrib, forked close to the midrib, the lower branch forked again, lateral members of the groups so formed anastomosing about half-way towards the margin, *the outer part of the lamina containing a series of narrow areoles about 1 mm. wide and 1 cm. or more long.* Sori on the outer veins of each group and also on some of the inner veins, anastomosing with the veins, and reaching almost to the edge of the lamina; indusia narrow, persistent. *Pinnate fronds with 1–8 pairs of pinnæ below the terminal lamina, which is smaller as the number of lateral pinnæ increases.* Lateral pinnæ sessile or the lowest very shortly stalked, varying much in size, the basal pinnæ largest, upper ones

gradually smaller; base of pinnæ subequally rounded, *margins quite entire*, apex shortly acuminate; largest pinnæ usually 12–16 cm. long and from 2.5 to 6.5 cm. wide; *veins as in the simple lamina above-described*, but more oblique to the midrib of the pinnæ (at about 45°).

This species is frequent in both lowland and mountain forest in Malaya but is never found in the open. In the lowlands it rarely (if ever) develops beyond the stage of simple fronds, and in the mountains it appears that some plants remain for a considerable time at this stage, which is usually fully fertile. It is common, however, in mountain forest to find plants which have one or more pairs of lateral pinnæ below the cordate terminal lamina, and all stages of transition can be found up to fronds with 7 or 8 pairs of lateral pinnæ. Specimens of the latter have usually been named *D. fraxinifolium* Pr. or *D. lineolatum* Bl., simple fronds being called *D. cordifolium*.

Backer and Posthumus (*Varenflora voor Java*, p. 123), recognizing that both simple and pinnate forms belong to one species, use the name *D. fraxinifolium* Presl. Presl's name was published prior to *D. cordifolium*, but the description is very inadequate (anastomosis of veins is not even mentioned) and I think it better to use Blume's name, which is well established. Owing to the polymorphism of this species, and to the superficial resemblance of pinnate forms to *D. bantamense* Bl., there has been much confusion of names.

The parallel between *D. bantamense* and *D. cordifolium* is a close one. Both ferns have at first simple fronds, and later one or more pairs of lateral pinnæ which are broad and sub-entire. There are, however, several clear differences. The scales are toothed in *D. bantamense* and entire in *D. cordifolium*; the veins are almost always quite free in *D. bantamense* but copiously anastomosing in *D. cordifolium*; and the initial stage of simple lamina is much more developed in *D. cordifolium*, being often fertile, whereas the simple lamina of *D. bantamense* is only found in young plants and is rarely fertile.

I think it unnecessary to cite the many specimens of this species which have been obtained in all parts of Malaya.

4. ***D. crenatoserratum*** (Bl.) Moore, Index 121. 1859.  
Asplenium Bl. Enum. 177. 1828.

Stock short, erect. Scales on young fronds and bases of stipes to about 4 by 1.5 mm., acuminate, edges irregularly and shortly toothed, teeth not forked (see fig. 1). Stipes to about 30 cm. long. Fronds simply pinnate, commonly about 30 cm. by 15 cm., sometimes larger, pinnæ numerous, close, the upper adnate, grading into the lobed deltoid apical

lamina, the lower longest, on stalks to 5 mm. long, commonly about 15 by 2 cm., sometimes larger, texture firm. *Pinnæ of fronds on young plants with bluntly rounded apex*, edges almost entire, base truncate and slightly auricled above. *Pinnæ on large plants acuminate, edges lobed  $\frac{1}{4}$ – $\frac{1}{2}$  way towards costa, base strongly auricled above and less so below; lobes close, usually irregular in length; veins pinnate in the lobes, to about 4 pairs, often all fertile, the sori from the costa almost to the edges, the sorus on the lowest acroscopic vein diplazioid, the others not.*

This is a very common fern of lowland forest, varying much in size and in the degree of lobing of its pinnæ. Young (or small) plants with blunt entire pinnæ may be fertile. The largest plants approach *D. silvaticum*, but differ in the points mentioned under that species. It approaches also *D. tomentosum*, some specimens having many short hairs, like those of *D. tomentosum*, on the base of pinna-stalks beneath, and to much less extent on the main rachis; but *D. crenatoserratum* is never so tomentose as typical *D. tomentosum*. Typical specimens of the two species are very different, but some are almost intermediate; distinguishing characters are given under *D. tomentosum*.

##### 5. *Diplazium dilatatum* Bl. Enum. 194. 1828.

*A very large fern, with stout erect stock. Stipes 8 mm. or more in thickness near base, slightly rough with raised bases of fallen scales; scales to about 1.5 cm. long, hardly 1 mm. wide at base, brown with black toothed edges. Lamina bipinnate-tripinnatifid, pinnæ to 75 cm. long and 27 cm. wide, pinnules to about 12–jugate below deltoid lobed apex of pinna. Rachis glabrescent, costæ with scattered very narrow brown scales, especially near base and on stalks of pinnules. Largest pinnules to 18 by 4 cm. (commonly narrower) on stalks 5 mm. long, base truncate-subcordate, apex acuminate, cut half-way to costa or a little more, segments 8–10 mm. wide at base, slightly oblique, edges slightly toothed, apex rounded; smaller distal pinnules sessile, lobed less deeply; texture thin but firm, colour when dry dark. Veins in each lobe pinnate with 5–8 pairs of veinlets, lowest acroscopic veinlet often simple, the rest usually forked (sometimes simple in fronds of small or young plants), sori from near base along  $\frac{1}{2}$ – $\frac{2}{3}$  length of the veinlets; sorus on basal acroscopic veinlet usually diplozioid, rest not.*

This very fine species has only been found in Malaya at Cameron Highlands. The Highlands specimens closely match a fern from Java (G. Ardjœnœ, 1800 m. Posthumus 3939) and also the Sumatran specimens quoted below. I



think they are quite distinct from the more numerous specimens, mostly from lower elevations, referred in this paper to *D. simplicivenium*.

Specimens in Singapore Herbarium:

PAHANG. Cameron Highlands, 4,600 ft., S.F.N. 23620 (Henderson); S. Terla, 3,900 ft., S.F.N. 31334 (Holttum), young plant.

SIAM. Doi Chiang Dao, Eryl Smith 1198.

SUMATRA. Brastagi, 5,000 ft. S.F.N. 15403 (Holttum). Dolok Singgalang, N. v. h. Tobameer 1650 m., Lorzing 8864.

Copeland Pterid. Philip. Exsicc. 178 (Mt. Matutum, April 1917) seems to me closely similar to the above specimens and I would refer it to the same species.

6. *Diplazium esculentum* (Retz.) Sw. Schrad. Journ. 1801, 2: 312. 1803. *Hemionitis esculenta* Retz. Obs. Bot. 38. 1791.

Stock erect. Stipes to 50 cm. or more long, glabrescent except for a few brown scales at base; scales about 1 cm. long and 1 mm. wide, the edges finely toothed. *Lamina bipinnate, large*, often 1 m. or more long and about half as wide. Pinnæ to 50 cm. or more long, bearing numerous pinnules which are often rather distant from each other. *Pinnules varying much in size and cutting, usually less than 2 cm. wide*, the lowest stalked 2 mm., the rest sessile, *truncate or broadly cuneate and usually more or less auricled on one or both sides at the base, edges crenate or lobed up to about 1/4 distance to costa*, the lobes or crenations slightly toothed. Veins in pinnate groups in the lobes, about 8–10 pairs of side veins, *the lower 2–3 pairs of adjacent groups anastomosing*, forming an irregular intermediate excurrent vein leading towards a sinus between adjacent lobes. Texture thin; rachises and costæ glabrescent, or occasionally pubescent beneath with numerous pale brown hairs with dark cross-walls, and scattered or abundant small ovate toothed scales on costæ. Sori occupying almost the whole length of the veins, often also on part of the joint excurrent vein, often more than one diplazioid sorus in each group.

This is a common fern of wet ground in open places in the lowlands of Malaya, and is well known as an edible plant. It never occurs in shady forest. It is a straggling and untidy species, lacking the beauty of most of the larger species of this genus.

The excurrent vein formed by union of the lateral veins of adjacent groups does not run to the sinus, stopping there in a thickened single unit, as in *Cyclosorus* (*Dryopteris* p.p.), but divides just below the sinus, part running close



to the edge of the lamina on either side above the sinus. Thus, though the venation of *D. esculentum* is superficially similar to that of species of *Cyclosorus*, it is not identical and doubtless had a quite separate origin.

7. **Diplazium heterophlebium** (Mett.) Diels Nat. Pfl. 1, 4: 228. 1899. *Asplenium heterophlebium* Mett.; Baker, Syn. Fil. 243. 1867.

Stock short erect. Stipes slender, to 30 cm. long, glabrescent, when young clothed at the base with *thin entire brown scales* to about 1 cm. long and 1.5 mm. wide at the base. *Lamina to at least 35 cm. long and 25 cm. wide, the apical part (in young plants the whole lamina) deeply lobed, and below this a few pairs of adnate or sessile pinnæ.* Lobes of apical lamina falcate acuminate entire, to about 15 cm. long and 4 cm. wide; pinnæ to about the same size, their edges entire or more or less deeply undulate. Main lateral veins in the pinnæ pinnate, *the veinlets of adjacent groups anastomosing rather irregularly from about 1/4 distance from costa to margin,* the areolæ smaller towards the margin, with free short veins with thickened ends just within the margin. Sori of small fronds few, often one to each vein-group, on the basal acroscopic vein, often all simple but sometimes diplazioid; on larger fronds often several sori to each vein-group, some of them anastomosing with the veins. Texture thin, rachis and costæ glabrous or slightly scaly beneath with small narrow entire scales.

In Malaya, this species has only been found in the valley of the Bertam River, below Cameron Highlands, at 3,000–3,500 ft. altitude. The specimens there gathered differ from Himalayan specimens in having broader fewer pinnæ, all (or almost all) adnate to the rachis, with ampler venation and more irregular anastomosis. It is possible that fully grown plants have not yet been noticed. Further collecting in the valleys in the north of the main range will no doubt reveal more localities for this and other ferns of northern distribution which find their southern limit in Malaya. The thin pale entire scales show that this species is not closely related to *D. accedens*, though the anastomosing venation might lead one to think them allied.

8. **Diplazium insigne** Holttum, Gard. Bull., S.S., 9: 123. 1937.

Stock stout, short, erect. Stipes stout, c. 1 m. long, spiny towards the base, the spines 2 mm. long, each at first bearing a scale; scales dull brown 1.5 cm. long by 1.5 cm. wide at the base, with a narrow black toothed edge, deciduous. *Lamina to 1.5 m. long, bipinnate.* Lowest pinnæ about 28 cm. long and 6.5 cm. wide, narrowed and

stalked at the base, the margins lobed half-way to the costa, the apex acuminate. *Middle pinnæ largest, to 60 cm. long and 16 cm. wide, pinnate; pinnules slightly oblique, adnate to the rachis* (the lowest ones narrowly, the upper fully adnate and grading into the lobed apical lamina of the pinna), to 9 cm. long and 2.3 cm. wide, cuneate at the base at an angle of about 45° on each side, narrowed gradually from the base and then suddenly at 1.5–2 cm. from the apex, margins slightly serrate; texture firmly herbaceous; *veins anastomosing as in D. accedens*. Sori few or copious, the lowest acroscopic sorus in each vein-group usually diplazioid, and occasionally a few others also.

This species is evidently closely allied to *D. accedens*, and the apex of a frond might pass for that species, but its copious bipinnate form marks it as a quite distinct species. It is evidently similar to *D. Smithianum* from Ceylon, but appears to be much larger; probably both *D. Smithianum* and *D. insigne* are local derivatives of *D. accedens* (or *D. proliferum*).

Since the original description of *D. insigne* was published, I have discovered a collection made by Curtis on Taiping Hills at 2,000 ft. (No. 1352), labelled *D. Smithianum*, which is clearly *D. insigne*. Otherwise no new locality has yet been found for *D. insigne* except the type locality in a valley below Fraser's Hill (Pahang side).

### 9. *Diplazium Kunstleri* Holttum sp. nov. Fig. 2.

Rhizoma repens? Stipites ad 1 m. longi vel ultra, in sicco olivaceo-straminei, non muricati, basin versus squamis rotundatis peltatis deciduis muniti. Rachides læves, pallidæ, plerumque ad basin pinnarum superiorum proliferæ. Lamina bipinnata, ad 120 cm. longa et 80 cm. lata vel ultra; pinnæ fere 12–jugatæ, infimæ leviter reductæ, superiores in lobos apicis laminæ sensim mutatæ. Pinnæ maximæ c. 65 cm. longæ, c. 25 cm. latæ, in stipitibus 9 cm. longis stantes (stipites pinnarum superiorum sensim breviores). Pinnulæ infimæ inter se 5 cm. distantes; pinnulæ maximæ 16 cm. longæ et 3.5 cm. latæ, stipitatae 3 mm. vel ultra (ad 8 mm.), basi late cuneatæ vel truncatæ, apici acuminatæ dentatæ, cetera margine lobatæ 2/3 costam versus; lobi leviter obliqui, 5–7 mm. lati, basi dilatati, margine leviter serrati, apice rotundati; costulæ falcatæ, squamis parvis latis peltatis paucis munitæ; venulæ in uno lobo 7–9–jugatæ, obliquæ, plerumque furcatæ (vel in pinnulis parvis simplicibus), utrinque distinctæ sed haud prominentes; lamina textura quam species affines crassior. Sori medium venularum solum occupantes; indusia angusta, in soris maturis haud evidentia.

TYPUS: Ginting Simpah, Selangor, 2,500 ft. alt., S.F.N. 31194, leg. Holttum.

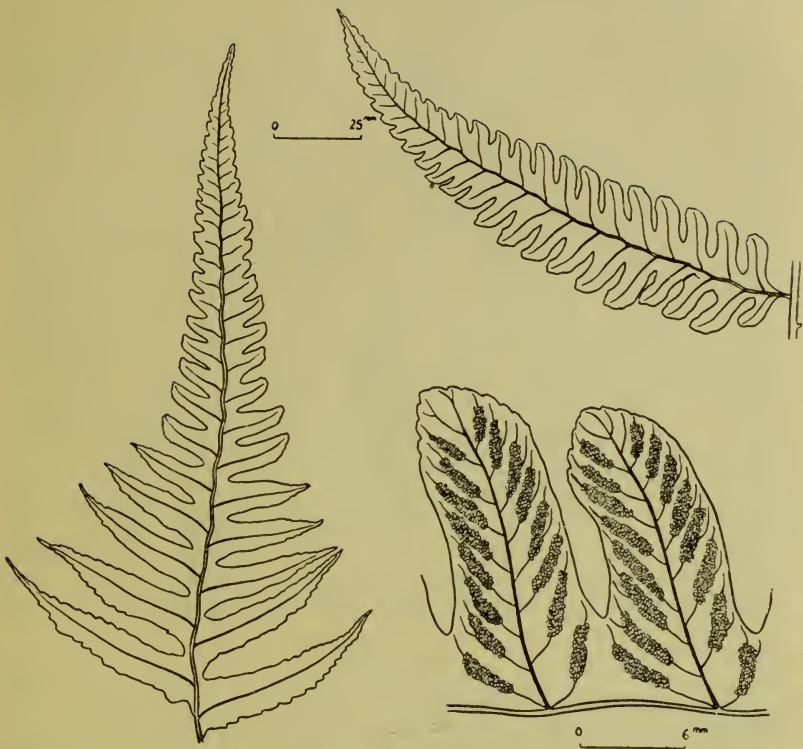


Fig. 2. *Diplazium kunstleri*, type. On left, apex of frond; on right, above, single pinnule from middle pinna; below, two fertile lobes.

*D. Kunstleri* is very distinct among the Malayan bipinnate species of *Diplazium* in the combination of the following characters: round peltate scales (otherwise found only in *D. latisquamatum*); pinnules cut more than half-way to the costa, with broad lobes; medial sori which never reach base or apex of the veins; and proliferous rachis. I found the type growing in a rocky streambed in shady forest.

The species is named after Hermann Kunstler ("King's Collector" of herbarium labels), who collected many interesting Malayan plants for the first time. He collected *D. Kunstleri* "near little stream, dense jungle", near Ulu Kerling, under No. 8797. Other collections in the Singapore herbarium are: 15th mile, Pahang Track, Ridley 8652; Rawang, Ridley 7843, 7852. Thus all specimens have been found on the Main Range in Selangor, at medium altitudes.



10. *Diplazium latisquamatum* Holtt. Gard. Bull., S.S., 9: 124. 1937. Fig. 3.

Stock short erect. *Stipes* to 90 cm. long, throughout or towards base only papillate with rather soft green papillæ, which in young fronds bear round or ovate, peltate, entire, nearly black scales, to about 5 mm. long and 3 mm. wide; old stipes and rachises bearing scattered small rounded scales only. *Lamina* to about 1.5 m. long and 1 m. wide, bipinnate-tripinnatifid. Largest pinnæ to about 60 cm. long and 23 cm. wide, shortly stalked, the basal pinnules slightly reduced, smaller on the acroscopic than on the basiscopic side. *Pinnules* sessile (or the basal ones on stalks to 2 mm. long), the largest about  $12 \times 2.5$  cm. (commonly about  $9 \times 1.5$  cm.), base broadly cuneate or subtruncate, gradually narrowed to acuminate toothed apex, margins lobed to within 2–3 mm. of the costa, lobes slightly oblique, mostly about 4 mm. wide, apex truncate, margins entire or slightly toothed near apex, texture thin but firm, costæ bearing scattered small ovate or rounded scales; veins pinnate in the lobes, the veinlets 5–6-jugate, simple or forked. *Sori* occupying only the lower half or less of the veins, the basal acroscopic sorus usually diplazioid, the others simple, the indusia thin, broad, persistent.

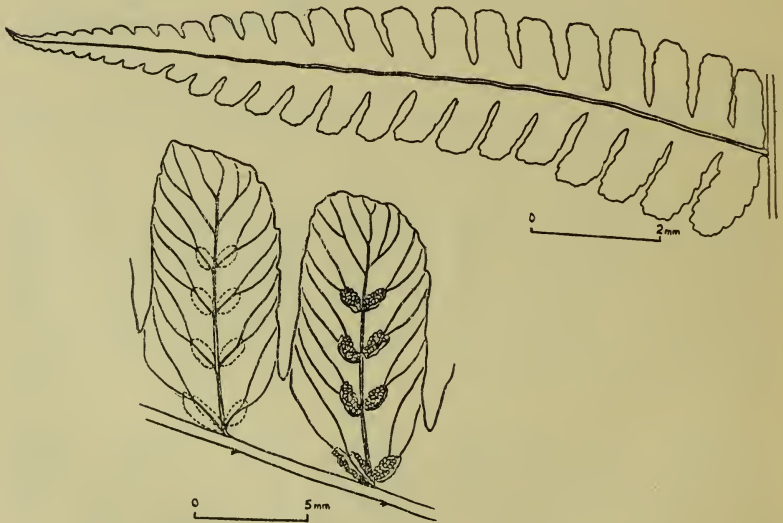


Fig. 3. *Diplazium latisquamatum*. Above, single pinnule from middle pinna. Below, two fertile lobes; the dotted outlines on the left hand lobe show the position of sori removed.



This species is very clearly distinguished from all others in Malaya by its almost round peltate entire scales and very short sori confined to the basal half of the veins. In general appearance, it resembles *D. procumbens*, but the scales of the latter, and its prostrate stem, distinguish it, even in sterile plants.

*D. latisquamatum* has been found in Malaya in shady forest by streams in the valleys of the Main Range at 4,000–5,000 ft. at Cameron Highlands and Fraser's Hill only. I have collected closely similar specimens in Sumatra, at 6,000–7,000 ft. altitude on Korinchi Peak. I am, however, in some doubt whether the Kinabalu (British North Borneo) specimens cited with the original description of the species should be regarded as identical; some have decidedly longer and more pointed scales, and pinnæ and pinnules broader.

The additional specimens from Malaya and Sumatra to be added to the list published in 1937 are:—

PAHANG. Fraser's Hill, 4,000 ft. S.F.N. 11007 (Md. Nur); S.F.N. 36504 (Holttum).

SUMATRA. Korinchi Peak 6,000–7,000 ft., Holttum s.n. 13/2/1933.

#### 11. *Diplazium malaccense* Presl. Epim. Bot.: 86, 1849

Stock short erect. *Stipes* to c. 50 cm. long, clothed at base with entire brown scales which are 10–15 mm. long and 1.5–2 mm. wide at base, rest of stipe and rachis glabrescent, not fibrillose. *Lamina* pinnate, to about 60 by 30 cm. Pinnæ to about 20–jugate, below lobed apex of the lamina. Lower pinnæ on stalks 5 mm. long, bases very unequal, lower base often much cut away, upper truncate; upper pinnæ with base subequally truncate or broadly cuneate. Pinnæ thin in texture, drying rather light green, commonly to 16 cm. long and 2 cm. wide, apex acuminate, lobed not more than 2/3 way to the costa, lobes about 6 mm. wide at the base, a little more oblique than in *D. sorzogonense*, ends rounded to subtruncate and slightly toothed; veins up to 7 pairs in each lobe, all simple; sori from near base of veins to near margin of lamina, the acroscopic basal sorus usually but not always diplazioid. Surface not depressed below sori; indusium medium brown, thin but firm, usually turned back but not rolled as in *D. sorzogonense*.

A species of lowland and midmountain forest, found throughout Malaya, differing from *D. sorzogonense* (which grows in similar localities) in glabrescent stipe and rachis, less deeply lobed pinnæ, and sori not at all impressed. Specimens have been distributed under the names *D. silvaticum* and *D. speciosum*, both of which differ in having toothed scales.

A very large, perhaps monstrous, specimen was gathered by Mohamed Nur on Gunong Angsi (S.F.N. 11563). The apical part of the frond is quite like normal *D. malaccense*, but the middle and lower pinnæ are very large (to 8 cm. wide) and deeply lobed (almost to the costa), the lobes being falcate and acutely pointed, with forked lateral veinlets up to about 20 pairs. The bases of these pinnæ have 3 or 4 pairs of normal segments below the larger pointed segments.

12. *Diplazium montanum* v.A.v.R. Bull. Buitenz. II Ser., 28: 19. 1918.

Stock short erect. Scales on bases of stipes narrow, black, entire, to about 10 by 1 mm. Stipes black at the base, to about 60 cm. long. Frond simply pinnate. Pinnæ to about 20—jugate, to about 18 by 2 cm., the lower ones on stalks to 4 mm. long, upper sessile, the apical pinna like the others (occasionally with one or two  $\pm$  separate round lobes at the base); upper pinnæ unequally cuneate at the base; lower pinnæ with upper base narrowly rounded, lower base narrowly cuneate; edges of pinnæ toothed, apex acuminate toothed, texture thin; veins forked at or near base, the acroscopic branch soriferous, simple, the lower branch simple or sometimes forked, occasionally bearing a short sorus. Sori on the acroscopic veinlet mostly simple, but occasionally diplazioid, reaching from the costa almost to the edge of the lamina.

This species differs from *D. pallidum* Bl. in having the apical pinna like the others (in *D. pallidum* the apical lamina of the frond is deltoid and deeply lobed), and in having the lower pinnæ with much narrower bases (in *D. pallidum* the lower pinnæ have a broadly truncate upper base). It appears also that *D. pallidum* has fertile fronds from a young stage of development, whereas *D. montanum* does not produce fertile fronds until the plants are full grown.

*D. pallidum* occurs in Sumatra on the higher parts of the mountains, matching Java specimens exactly; *D. montanum* appears to occur at lower levels in Sumatra, thus falsifying its name. In the Peninsula *D. pallidum* does not occur. *D. montanum* occurs in forest at low and medium elevations.

Specimens in Singapore Herbarium:—

PAHANG. Tahan River, Ridley 2167. Tembeling, S.F.N. 24703 (Holtum). Buloh Telang, P. Tioman, 800 ft., S.F.N. 18583 (Henderson).

PERAK. 2,000–2,500 ft., King's Collector 10959. Sungei Siput, Haniff 4047. Ulu Temango, Ridley 14209.

SUNGEI UJONG. Hullett s.n. Aug. 1880.

SELANGOR. Batu Caves, Ridley 8139.

SUMATRA (East Coast). Region of Marban, Bilah, near Bilah Pertama, Rahmat si Toroes 145,221 (distr. Univ. of Michigan).

SIAM. Patani, 210–350 m., on rock in stream, Eryl Smith 1948.

13. *Diplazium polypodioides* Bl. Enum. 194. 1828.

*D. asperum* Bl. Enum. 195. 1828.

Stock stout, erect, often subarborescent; stipes stout, to 1 m. long, clothed thickly at the base with narrow scales of thick texture, dull brown with narrow black toothed edges, to about 4 cm. long and 2 mm. wide at base, usually not more than 1 mm. wide over the greater part of their length; the scales attached to protuberances on the stipe which remain as more or less short prickles up to 1 mm. or rather more in height. Lamina bipinnate, deeply tripinnatifid, commonly about 100 cm. long and 60 cm. wide, sometimes much larger, largest pinnae to about 85 by 30 cm., commonly less, shortly stalked, with 20–30 pairs of pinnules below the deltoid lobed apex of the pinna. Largest pinnules to 16 by 3.5 cm., commonly about 9 by 2 cm. or sometimes less, sessile or the lowest shortly stalked, base truncate or very broadly cuneate, apex acuminate, edges cut into lobes  $\frac{3}{4}$  or more towards the costa; lobes slightly oblique, subtruncate or bluntly pointed, their margins sharply toothed throughout, 2–5 mm. wide, veins 7–12 pairs in each lobe, usually simple, forked in the largest lobes; texture thin to firm. Rachises and costae usually glabrescent, the costae sometimes with small narrow scales; rachises, like the stipes, often slightly prickly with the bases of fallen scales. Costae above distinctly winged, the wing interrupted and sometimes dilated at the base of each costule. Sori usually present on almost all veins, from the base half-way or more to the edge, the indusia thin but persistent; on short narrow lobes with close veins the sori may be almost confluent.

The long narrow black-edged toothed scales, the usually prickly stipes, and the deeply cut narrow toothed lobes are characteristic of this species.

SELANGOR. Klang Gates, F.D. 14602 (Ingram).

Ginting Simpah, 1,500 ft., Hume 8551B (Herb.

F.M.S. Mus.), S.F.N. 9982 (Burkill).

NEGRI SEMBILAN. G. Angsi 950 ft. S.F.N. 11515

(Md. Nur). Senaling Inas F.R., in small clearing, S.F.N. 9770 (Holttum).

PENANG. N. of Western Hill, 2,000 ft., S.F.N. 19776

(Holttum). Penara Bukit, 2,000 ft., S.F.N.



19342 (Holttum). No loc., abundant, C. Curtis 10135.

PERAK. Ulu Temango, Ridley 14206. Ulu Bubong, King's Collector 10849.

PAHANG. Raub, S.F.N. 14103 (Best). Telom, Ridley 13975. Kuala Tahan, Ridley 2,400. S. Sat, S.F.N. 22089 (Henderson). Robinson Falls, 4,000 ft., S.F.N. 23262 (Holttum). Boh Plantations, 4,000 ft., S.F.N. 32937 (Md. Nur). C. Highlands, 5,000 ft., S.F.N. 23518 (Holttum) S.F.N. 31295 (Holttum) ; 4,800 ft., S.F.N. 23361 (Holttum).

In Malaya, this species is common by the edge of forest in moist ground, especially by streams, never in the heavy shade of high forest. It is especially characteristic of the mountains between 2,000 ft. and 4,000 ft., occurring abundantly by roadsides, but occurs also in low country and at higher elevations. In very moist slightly shaded situations in mountain valleys it sometimes attains a very large size, with broader and thinner leaflets than commonly, but I cannot see any clear specific distinction between these and the smaller leaves of firmer texture. The upper parts of larger fronds are much like the smaller fronds.

I have not examined any Indian specimens, and I do not know how far the specimens described by Beddome as *D. polypodioides* and *D. asperum* would agree with Malayan plants. *D. polypodioides*, as I understand it, is certainly a very widely distributed species. I have seen specimens which I would so name from N. Siam, Hainan, the Philippines and New Guinea.

As regards the identity of Blume's two species, *D. asperum* and *D. polypodioides*, I follow both Raciborski and the recent work of Backer and Posthumus in uniting them, using the name *polypodioides*, though I think it is a pity that the more appropriate name *asperum* was not chosen. Van Alderwerelt van Rosenburgh suggested various differences between Blume's two species, but I do not find that these differences are constantly associated in Peninsula specimens. As above noted, habitat appears to have a considerable influence on size and other characters.

14. *Diplazium Prescottianum* (Wall.) Moore, Index 156. 1859. *Aspidium Prescottianum* Wallich, Catalogue No. 235 (nomen) ; Hooker, Spec. Fil. 3: 251. 1860.

The type of this species was collected in Singapore, and agrees with the other Singapore specimens quoted below. These may be described as follows. *Scales* on bases of stipes brown, entire, about 1.5 mm. wide at base. Pinnæ to about



14-jugate below the lobed deltoid apex of the lamina, texture firm. *Lowest pinnæ on stalks to 6 mm. long*, upper sessile or adnate. Lower pinnæ to 24 cm. long and 1.8 cm. wide, base unequal, rounded above, rounded or cuneate below; upper pinnæ with broadly cuneate auricled upper base, and narrowly cuneate lower base. *Edges of pinnæ crenate or slightly lobed, lobes slightly toothed or entire, the auricle at the base of the upper pinnæ more or less separated by a sinus from the rest of the pinna* (in the type with a few similar lobes following it, cut nearly to the costa). *Veins of largest pinnæ in pinnate groups, 3-4 veinlets on each side of the main vein, 4-6 veins in each group soriferous*, sorus on basal acroscopic vein diplazioid, others not; sori from near base of vein to near margin.

The other specimens differ in the width of the pinnæ, which are up to 3.3 cm. wide, and some of them in the entire lack of an auricle on the upper base of the upper pinnæ. All agree in the character of the scales, the stalks of lower pinnæ, the slight lobing or crenation of the edges of the pinnæ, and the number of veins and sori in each group. The species appears to be related to *D. montanum* v.A.v.R. (and *D. pallidum* Bl.), but differs in larger brown scales, more lobed edges to pinnæ, and many more soriferous veins in each group. From *D. subintegrum* it differs in shorter pinna-stalks, more lobed edges, more veins and sori in each group.

Specimens in Singapore Herbarium:—

SINGAPORE. Between Bukit Panjang and Woodlands, Matthew; Toas, Ridley s.n. 1892.

SELANGOR. Ginting Simpah, Hume, F.M.S. Mus. 9665, 9347, 8997, 9677.

PERAK. Kinta, 1,500-2,000 ft., Kunstler 7146. Larut, 2,000-3,000 ft., Kunstler 2391. Kinta, Curtis 3369.

SIAM. Patani, 540-700 m., Eryl Smith 1930; 260 m., Eryl Smith 1927. Koh Chang, Marcan 1268.

#### 15. *Diplazium procumbens* Holttum sp. nov. Fig. 4.

Rhizoma procumbens, c. 1 cm. diametro. Stipites ad 80 cm. longi, in sicco sordides vel straminei, glabrescentes, basibus squamarum deciduarum leviter asperuli, in juventute squamis parvis lineari-lanceolatis, fuscis, margine leviter dentatis (non nigris) vestiti. Lamina deltoidea, bipinnata, ad c. 80 cm. longa et c. 80 cm. lata; pinnæ maximæ 50 cm. longæ et 20 cm. latæ. Pinnulæ sessiles vel infimis stitipatæ (stipites 3 mm. longi), maximæ 2.5 cm. latæ, basi truncatæ, apice acuminatæ,  $\frac{3}{4}$  ad costam lobatæ; lobi maximi basi 7 mm. lati, oblongi, cum costa angulum fere rectum formantes, apice rotundati, margine apicem

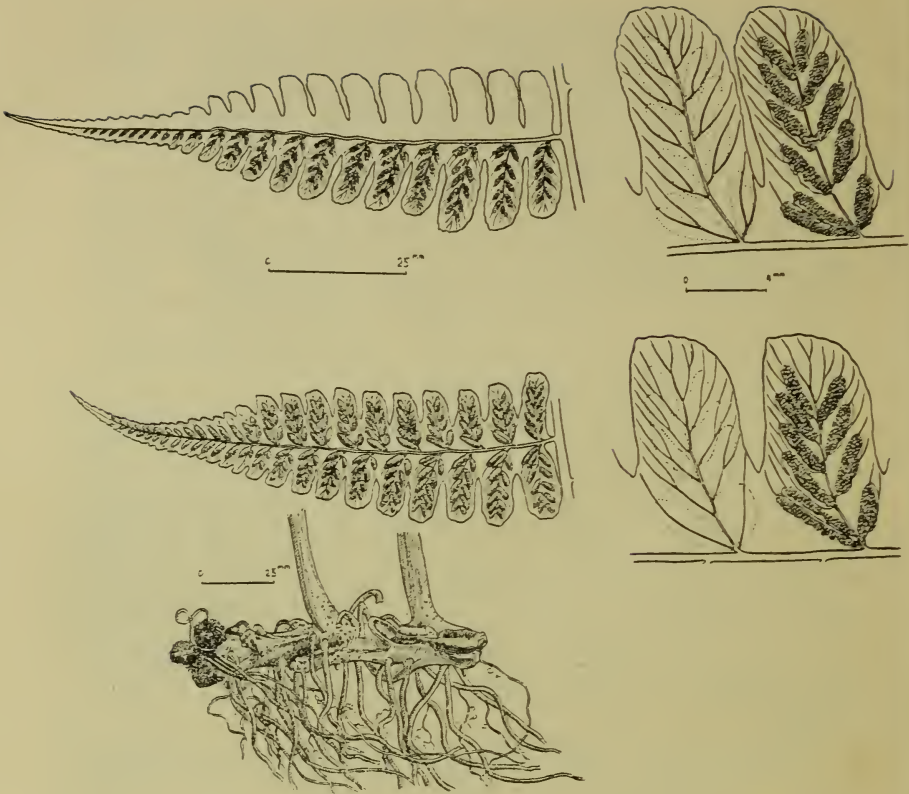


Fig. 4. *Diplazium procumbens*. On left, pinnules from different fronds, and on right enlarged portions of each to show veins and sori. Below, the procumbent rhizome.

versus leviter dentati. Venulæ ad 7-jugatæ, in lobi maximi omnes furcatæ, in lobi parvi plerumque simplices, costæ squamulis paucis parvis lanceolatis brunneis dentatis munitæ. Sori e costa in  $1\frac{1}{2}$ - $2\frac{1}{3}$  longitudine venularum sedentes, sorus infimus acroscopicus plerumque diplazioideus; indusia tenuia membranacea.

TYPUS: Fraser's Hill, 4,000 ft., S.F.N. 36503 (Holtum).

This species resembles *D. latisquamatum* in appearance, but differs in its narrow slightly toothed scales (round and entire in *D. latisquamatum*), procumbent rhizome, hardly muricate stipes, usually broader, more acuminate pinnæ, more copiously forked veins and longer sori with very thin indusia. It is abundant in the moist shady valleys, near streams, on the Pahang side of the divide at Fraser's Hill, and has not yet been found elsewhere.

Specimens in Singapore Herbarium:—

Fraser's Hill, 4,000 ft., S.F.N. 8844 (Burkill & Holttum), S.F.N. 11478 (Holttum), S.F.N. 21645 (Holttum), S.F.N. 37201 (Addison), s.n. Corner 12.8.37.

16. *Diplazium riparium* Holttum sp. nov. Fig. 5.

Rhizoma breve erectum. Stipites ad 50 cm. longi, in vivo virides, in sicco brunnei fusci, basi squamis lanceolatis, fere nigris, integris, 4-5 mm. longis, 1.5 mm. latis, vestiti, cetera nudi. Lamina pinnata, pinnæ laterales ad 5-jugatæ (superiores nonnunquam leviter adnatæ), pinna terminalis

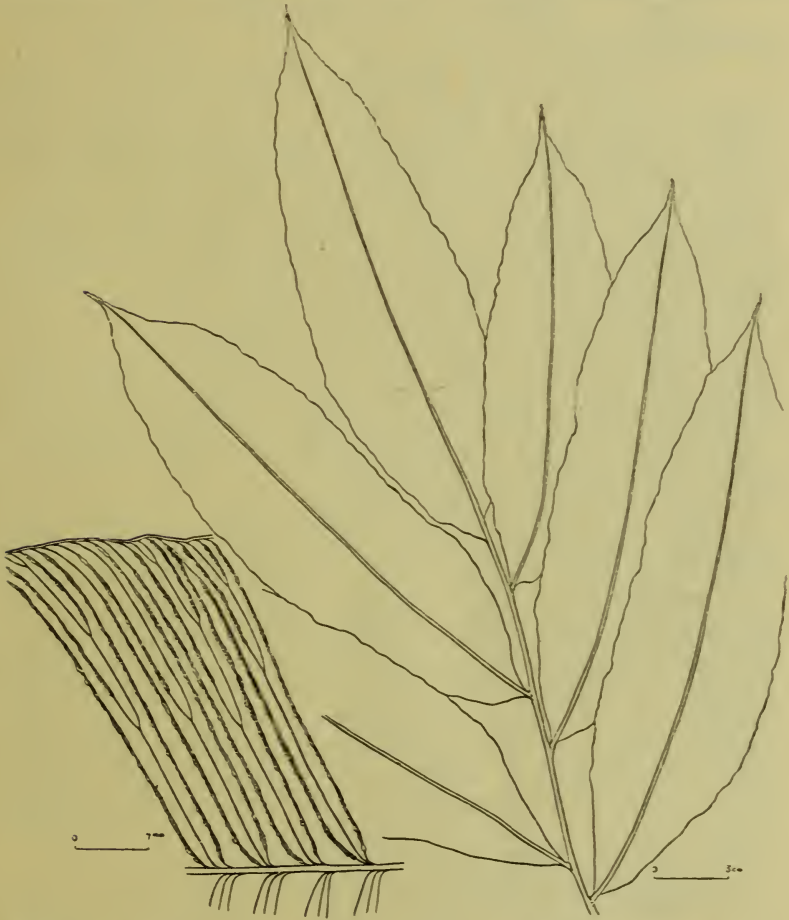


Fig. 5. *Diplazium riparium*, type; outline of frond. On left, below, detail of venation and sori, enlarged.



ceteris similis, rachis non prolifera. Pinnæ maximæ ad 29 cm. longæ et 7 cm. latæ, brevissime stipitatæ vel sessiles, basi subæqualiter cuneatæ, margine fere integræ, apicem versus subito angustatæ et plus minusve caudatæ, cauda ad 2 cm. longa; costa subtus rotundata, in sicco brunnea vel fusca, nuda, supra in sicco canaliculata; venæ angulum plus quam  $60^\circ$  cum costa formantes, rarissime anastomosantes, in fasciculis parvis glomeratæ; fasciculus ex venis tribus constatus, vena medialis furcata (sæpe bis furcata); sori 3-4 pro fasciculo, sori venarum lateralium e costa fere ad marginem extensi, ceteri breviores, omnes prope marginem terminati.

TYPUS: Selangor, Semenyih, Hume 8186 (Herb. F.M.S. Mus.).

This species agrees with *D. xiphophyllum*, as I understand it, in Malaya, in its entire scales and rather large subentire pinnæ. It differs from *D. xiphophyllum* in the following characters: stipe and rachis darker when dry (stramineous in *D. xiphophyllum*); scales shorter, darker; fronds much shorter; pinnæ to about 5 pairs only, shorter and broader, almost or quite entire on old plants; anastomosis of veins rare, veins at more than  $60^\circ$  to midrib in mature plants, the ends of the veins uniting with a cartilaginous margin; rachis not gemmiparous.

Young plants have the first fronds simple, later fronds with one or more pairs of lateral pinnæ, which have distinctly toothed margins, especially towards apex, fertile from an early stage (on pinnæ from  $9 \times 2$  cm.), the lateral veins often making a smaller angle to the midrib than in the larger pinnæ of mature plants.

This is a fern of the lowlands only, in forest near streams, usually in wet places and often on stream banks. It has also been found in the low country of E. Sumatra and Sarawak. It has usually been referred to *D. bantamense*, from which it differs in its entire scales and lack of buds on the rachis, also in young plants not having hastate or cordate fronds. It also resembles *D. Donianum*, but this also (so far as specimens available indicate) has toothed scales. It may be very near *D. alternifolium* from Java, but appears to differ in more entire pinnæ and in fewer veins in each group (*D. alternifolium* has usually 3 pairs of lateral veins in each group, often all soriferous); I have not seen scales of *D. alternifolium*.

Specimens in Singapore Herbarium:—

PERAK. Upper Perak, 300 ft., L. Wray Jr. 3590 (young), 3650. B.P.D. 300-500 ft., King's Collector 7894.



PAHANG. Near K. Teku, 500 ft. (young plant), S.F.N. 20792 (Holttum); S. Cheka, young plant, S.F.N. 24780 (Holttum); Mentakab, West, S.F.N. 24558 (Holttum).

KELANTAN. Ulu S. Ketch, Md. Nur, s.n. 14.2.24.

TRENGGANU. K. Brang, S.F.N. 15323 (Holttum).

SELANGOR. Semenyih, Hume, F.M.S. Mus. No. 8186 (Type).

MALACCA. Ayer Keroh, Ridley s.n. Dec. 1899. Ayer Panas, Ridley 1587.

SUNGEI UJONG. No loc., Alvins 3282.

JOHORE. Ulu Sedili, Holttum, s.n., May 1932; foot of G. Panti, 200 ft., S.F.N. 18301 (Holttum).

SINGAPORE. Hullett s.n. Jan. 1881.

SUMATRA. East Coast, general region of Marbau, Rahmat si Toroes 222.

SARAWAK. No loc., Bishop Hose s.n., 1890.

17. *Diplazium silvaticum* (Bory) Sw. Syn. Fil. 92. 1806.

*Callipteris silvatica* Bory, Voy. 1: 282. 1804.

Stock short, erect. Scales on young fronds and bases of stipes very dark, to about 10 mm. long and 1.5 mm. wide, closely and distinctly toothed, teeth often forked (see fig. 1). Stipes to about 40 cm. long. Frond simply pinnate, to about 50 by 20 cm., pinnæ numerous, lower stalked to about 5 mm., upper sessile; lowest pinnæ with upper base subtruncate, lower base cuneate; upper pinnæ with base broadly cuneate to truncate, more or less auricled above but not below; pinnæ to about 12 cm. long and 3 cm. wide (commonly less), apex acuminate, edges lobed to about  $\frac{1}{4}$  distance to costa, texture thin; lobes oblique, about 5 mm. wide, veins in pinnate groups with 3-4 pairs of lateral veins; sori from near base of veins  $\frac{3}{4}$  or more towards edge, sorus on acroscopic basal vein diplazioid, sometimes sorus on next acroscopic vein also, other sori simple.

This species, which I believe I have correctly identified, occurs throughout Malaya, but is not always easy to distinguish from *D. crenatoserratum*. It differs from *D. crenatoserratum* in having broader pinnæ of thinner texture, not auriculate on the lower base, and by the larger and closely and distinctly toothed scales, the teeth often forked. Some specimens approach *D. malaccanum* in appearance; they are distinguished by their toothed scales (scales of *D. malaccanum* are entire).

*D. silvaticum* was originally described from Mauritius. Malayan specimens, according to Christensen (Dansk Bot. Ark. 7: 82. 1930), are very close to the type. This must be reckoned one of the most widely distributed species of the genus. Ceylon specimens in the Singapore herbarium

have scales like Peninsula plants, but have more ample fronds than any Malayan specimens. How far eastwards the species extends, I do not know. A Java specimen in the Singapore herbarium (quoted below) agrees quite well with Peninsula specimens.

Specimens in Singapore Herbarium:—

SINGAPORE. Hullett s.n. (2 sheets).

PAHANG. Tahan River, Ridley 5818. S. Cheka, Holttum s.n., 26.4.31. Tembeling, S.F.N. 24704 (Holttum). Base K. Glanggi, S.F.N. 22422 (Henderson).

SELANGOR. Woods Batu Caves, Ridley s.n., Dec. 1891 (?). Klang Gates, F.M.S. Mus., Hume 7117.

PERAK. Upper Perak, 300 ft. Wray 3626, 3594. Gapis Pass, Curtis 1360.

KELANTAN. Gua Panjang, Gua Ninik, S.F.N. 19498 (Henderson).

KEDAH. Langkawi, G. Raya, Curtis s.n., Sept. 1890. 48 mile Jeniang Road, S.F.N. 35995 (Kiah).

JAVA. Djember, inter G. Boto et Tjuramamis, 600 m., Backer & Posthumus s.n. 11.3.29.

SIAM. Chawng ( $7^{\circ} 35'$ ), S.F.N. 24382 (Kiah, doubtful). Betong, Patani, 440 m., Eryl Smith 1929.

**18. *Diplazium simplicivenium* Holttum sp. nov. Fig. 6.**

Rhizoma breve erectum. Stipites 1 m. longi vel ultra, basin versus basibus squamarum deciduarum asperuli; squamæ 2 cm. longæ vel ultra, prope basin 1–2 mm. latæ, fuscæ, marginæ dentatæ, dentes simplices. Lamina 1.5 m. longa et 1 m. lata vel ultra, bipinnata. Pinnæ adjacentes c. 15 cm. inter se distantes, obliquæ; pinnæ maximæ 65 cm. longæ et 20 cm. latæ; pinnulæ liberæ ad 20–jugatæ, sub apicem lobatum laminæ; pinnulæ maximæ 12 cm. longæ, 2 cm. latæ, fere sessiles, basi truncatæ (non auriculatæ), apicem versus acuminatæ, e margine  $\frac{1}{4}$  costam versus lobatæ; lobi truncati, c. 7 mm. lati, leviter obliqui; venæ c. 5–jugatæ, omnes simplices; sori e basi venarum  $\frac{3}{4}$  vel ultra marginem versus extensi; textura laminæ tenuis, venæ utrinque distinctissimæ; costæ subtus (plerumque basin versus) squamis parvis paucis brunneis, margine fere nigris, munitæ.

TYPUS: Fraser's Hill, 4,000 ft. alt. S.F.N. 36507, leg. Holttum.

This species differs from *D. dilatatum* in the following characters: wider and longer scales of coarser texture; veins all simple (some may be forked on transition pinnæ near apex of frond, but none on the typical larger pinnæ, even

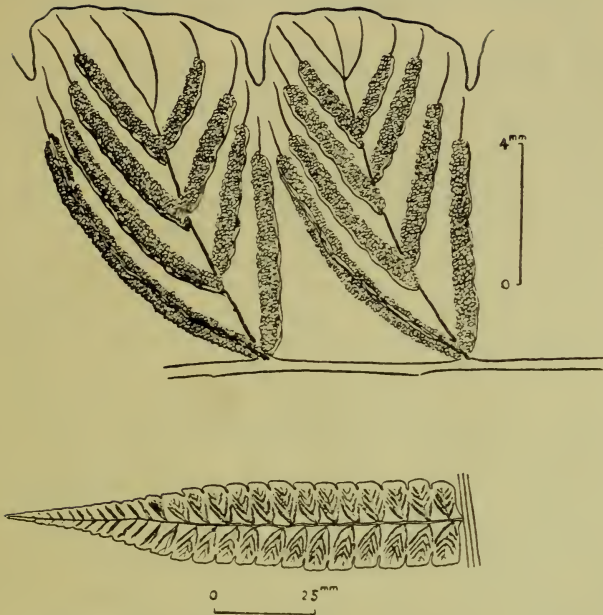


Fig. 6. *Diplazium simplicivenium*. Below, single pinnule from large pinna. Above, two lobes enlarged to show venation and sori.

of very large fronds); usually not more than 5 pairs of veins; sori occupying  $\frac{3}{4}$  or more of the length of the veins.

*D. simplicivenium* occurs in moist shady valleys near streams; it has been found on the Main Range, the Taiping Hills, and on G. Senyum in Pahang, also in Lower Siam. Some specimens from Borneo agree in having simple veins, but they have much wider pinnules than Peninsular specimens and I doubt their identity with this species.

Specimens in Singapore Herbarium:—

PERAK. No loc. Hullett s.n., 1881. Larut, 1,000–1,500 ft., King's Collector 2346; 1,500–2,000 ft. King's Collector 2214. Temango, Ridley 14211. G. Bubu, 600–800 ft., King's Collector 8420.

PAHANG. Tras Valley, 3,800 ft., S.F.N. 21636 (Holttum). Base of G. Senyum, S.F.N. 22388 (Carr).

SELANGOR. Ginting Simpah, Hume 9110 (F.M.S. Mus. Herb.).

LOWER SIAM. Khaw Poh Hill, Khsum, 1,200 ft., S.F.N. 3829 (Haniff & Nur).



19. *Diplazium sorzogonense* Presl, Tent. Pterid.: 114. 1836  
*Asplenium sorzogonense* Presl, Rel. Hænk. 1: 45.  
 1825.

Stock short erect. Stipes to c. 60 cm. long, scaly at base with long narrow entire scales, scales dark brown, sometimes with black edges, to about 1.5 cm. by 1.5 mm.; rest of stipe and rachis scaly with very narrow dark hair-like scales. Lamina simply pinnate, to about 80 by 40 cm., pinnæ to c. 20-jugate below pinnatifid apex of frond; lower pinnæ very shortly stalked, upper sessile, bases truncate or subtruncate, apices acuminate, margins lobed  $\frac{3}{4}$  or more to costa in lower pinnæ, less deeply in upper ones; lobes almost at right angles to costa, oblong, ends rounded and slightly toothed, 4-6 mm. wide above base; texture firm, drying rather dark; largest pinna to 25 × 5 cm., commonly less, veins in the lobes to about 10 pairs, all simple, basal  $\frac{1}{4}$  usually free of sori; sori reaching almost to margin, the lamina below the sorus depressed, the depression with a distinct margin on the dried frond. Sori usually all simple near the base of a pinna, the acroscopic basal sorus of each lobe diplazioid towards apex of pinna. Indusia firm, persistent, rolled back when sorus is mature.

This species is found throughout Malaya, in lowland and mountain forest to 4,500 ft. altitude. It is a very widely distributed species, and though somewhat variable is always recognizable by the fibrillose stipe and rachis and the peculiar impressed sori, which I have not found in any other *Diplazium* of this region (except slightly in *D. subserratum*).

*D. sorzogonense* differs from *D. speciosum* in having entire scales, fibrillose rachis, and in the impressed sori. I think that the two species have sometimes been confused.

Specimens in Singapore Herbarium:—

SINGAPORE. Stagmount, Ridley s.n., 1907; Ridley 11271. Bukit Timah, Ridley s.n. 1897. Mandai Road, Corner s.n., 20.10.29.

PERAK. Kinta, 1,500-2,000 ft., King's Collector 7151. Taiping, Scortechini, March 1884. Tapah, Ridley 14023.

SELANGOR. Kwang, Ridley 13432.

PAHANG. Fraser's Hill, 4,000 ft., S.F.N. 11198 (Md. Nur); s.n., Holttum 20.3.29; s.n., Holttum 31.12.39. Cameron Highlands, 4,500 ft., s.n., Holttum 21.5.36. G. Rokam, P. Tioman, 2,000 ft., S.F.N. 18612 (Henderson).

PENANG HILL s.n. Dec. 1831, Hullett. S.F.N. 19302 (Holttum).

KEDAH. G. Lang 2,000 ft., S.F.N. 35012 (Kiah).



20. *Diplazium speciosum* Bl. Enum. 193. 1828.

Stock short erect. Stipes to 60 cm. long, clothed at the base with *shining brown scales with toothed but not blackened edges, about 1.5 cm. long and 1.5 mm. wide at base; rest of stipe and rachis glabrescent.* Lamina pinnate, to about 70 × 25 cm., pinnæ to about 20-jugate, to 20 cm. long and 3.5 cm. wide, lower pinnæ on stalks to 4 mm. long, upper sessile, base truncate (on lower pinnæ sometimes narrow), apex acuminate, *margins lobed more than  $\frac{3}{4}$  way to costa in lower pinnæ; lobes 4-5 mm. wide above base, slightly oblique, oblong, ends rounded, edges shortly toothed, texture firm, drying rather dark brown; veins to 10 pairs in each lobe, simple, sori from base of veins over  $\frac{2}{3}$  their length, not impressed, often all simple, the indusia thin but firm, not rolled back when sorus is ripe.*

In Malaya this species has only been found on G. Tahan, specimens from which differ from Kinabalu specimens in wider lobes of the pinnæ; Peninsula specimens agree however with that from Mt. Dulit, Sarawak, quoted below.

*D. speciosum* has much the general appearance of *D. sorzogonense*, but lacks the fibrillose scales on stipe and rachis, has toothed scales at the bases of the stipes, and has sori not impressed. The lobes of the pinnæ are also rather more deeply cut and more strongly toothed.

Specimens in Singapore Herbarium:—

PAHANG. Gunong Tahan, Ridley 15991; 5,000 ft., Haniff & Nur. S.F.N. 7953; 4,500 ft., S.F.N. 20747 (Holttum).

BORNEO. Dulit, C. Hose, Herb. Bishop Hose. Kinabalu, 5,000 ft., S.F.N. 25444 (Holttum).

Var. *major* (Bedd.) Holttum stat. nov.

*D. sorzogonense* v. *major* Bedd. Suppl. 40. 1892.

Differs from the typical form of the species in having fronds to 1.50 m. long, pinnæ to 6.8 cm. wide, the lobes more acute and more strongly toothed, veins to 13 pairs, mostly forked.

PERAK. G. Bubu, 5,000 ft., King's Collector 7403 (type of variety); G. Bubu, 5,000 ft., Wray 3862.

PAHANG. Pine Tree Hill, 4,500 ft., S.F.N. 36508 (Holttum).

SUMATRA. G. Sibayak, 5,000 ft., S.F.N. 15457 (Holttum).

The type of Beddome's variety clearly belongs to this species and not to *D. sorzogonense*. It is a very fine fern and might perhaps rank as a species.

21. *Diplazium subintegrum* Holttum, Gard. Bull. S.S. 9: 125. 1937.

Stock short erect. *Scales on stipes brown, entire, to about 1.5 cm. by 2 mm. Stipes to 80 cm. long, pale when dry. Frond simply pinnate, to about 70 cm. long; pinnæ to about 16 pairs, the apical lamina narrowly deltoid, lobed at the base. Pinnæ to 24 by 2.5 cm., lowest stalked to 1.5 cm., upper 2 or 3 pinnæ only sessile; bases almost equal, of lower pinnæ narrower, cuneate; edges toothed, apices acuminate. Veins forked near the costa, the upper branch always simple, the lower branch forked 1-4 times; sori on upper branch from base  $\frac{2}{3}$ - $\frac{3}{4}$  of way towards margin, diplazioid, usually also on one branch only of the lower vein, simple.*

A mountain species, related to *D. montanum* and *D. pallidum*, differing from the latter in larger brown scales, longer stalks and narrower bases of pinnæ, more branched veins and normally diplazioid sori; differing from *D. montanum* also in the narrowly deltoid lobed apex of the lamina. This species appears to be confined to the Main Range of the Malay Peninsula and the Taiping Hills, at 3,000-5,000 ft. The specimens in the Singapore Herbarium were cited with the original description quoted above; no more have since been acquired.

22. *Diplazium subserratum* (Bl.) Moore, Index 338. 1862.  
*Asplenium subserratum* Bl. Enum. 174. 1828.

Stock slender, erect or decumbent. *Stipes slender, clustered, 10-20 cm. long, glabrescent, clothed when very young with small very dark scales, 2-3 mm. long and less than 1 mm. wide, the edges very shortly toothed. Lamina simple, to about 50 cm. long and 4 cm. wide, narrowed gradually to the base which is suddenly contracted from a width of a few millimetres, and very gradually to the acuminate apex; margins entire or irregularly undulate, toothed towards apex; texture very firm. Midrib grooved above, prominent beneath and bearing scattered dark brown ovate-lanceolate scales 1 mm. long or less; scales also on some of the lateral veins beneath. Veins in small groups at an angle of about 60° to the midrib, the groups about 5 mm. apart. Each vein-group formed by forking at the midrib, the acroscopic branch being simple and the lower forked 2-4 times again; the simple acroscopic branch usually sori-ferous and often one, more rarely two, branches of the basiscopic vein also. Sori on acroscopic vein diplazioid, varying in length, often from the base almost to the edge of the lamina; other sori simple and shorter; indusia firm,*

persistent, when old rolled back as in *D. sorzogonense*, and leaving a faint mark on the lamina to show their size and position when young.

This species in Malaya is confined to moist shady mountain valleys, near streams. It is the only Malayan species with narrow simple fronds, and so is easy to recognize. Young plants have fronds which are dissected to the midrib, indicating a probable origin from a pinnate ancestor. The resemblance of the indusia to *D. sorzogonense* is interesting.

*D. subserratum* is probably allied to *D. lanceum* of India and China, but is larger, and has a shorter rootstock which is more or less erect with tufted fronds; the scales also appear to be smaller.

### 23. *Diplazium tomentosum* Bl. Enum. 192. 1828.

Stock short, erect. Scales on stipes to about 4 mm. long and  $\frac{1}{2}$  mm. wide, acuminate, dark to medium brown, the edges irregular but hardly toothed. Stipes to c. 40 cm. long, frond to about 35 by 15 cm., pinnæ many, lowest shortly stalked (to 3 mm.), upper sessile or adnate; lowest pinnæ largest, somewhat deflexed and curved, widest  $\frac{1}{3}$  from base, base narrow, apex acuminate, to 3 cm. wide; middle and upper pinnæ narrower, with parallel sides, almost at right angles to rachis, slightly curved, base truncate, auricled above, broadly cuneate below. All pinnæ of large fronds deeply lobed (half way or almost to the costa), lobes c. 3 mm. wide above the base, at an angle of less than  $60^\circ$  to the costa, their edges slightly toothed at the tip. Veins pinnate in the lobes, the veinlets usually forked, up to 7 pairs or more, often all or almost all veins soriferous, the lowest acroscopic vein with sorus directed towards the main costa or diplazioid. Texture firm, drying very dark; rachis and costæ beneath densely covered with short multicellular hairs with pale cells and dark brown cross-walls.

Young plants have almost entire pinnæ; these approach *D. crenatoserratum* in appearance but are distinguished by their more hairy rachis and costæ beneath, usually narrower more pointed pinnæ, more deflexed, shorter-stalked lowest pinnæ which are broadest near the middle, and darker colour on drying. Fully developed plants, with their deeply lobed pinnæ and deflexed almost elliptical lowest pinnæ are quite distinct.

*D. tomentosum* is closely related to *D. velutinum*, a mountain plant with more deeply dissected, though hardly larger fronds. The tomentum of both is of the same character.



*D. tomentosum* is a common species in lowland and mid-mountain forest throughout Malaya; it seems unnecessary to enumerate all the many specimens.

24. **Diplazium velutinum** Holttum Gard. Bull. S.S. 9: 126. 1937.

Caudex short erect. *Stipes* to 40 cm. long (commonly about 20 cm.), *clothed throughout with scattered multicellular brown hairs*, and towards the base with narrow almost black entire scales, scales to about 1 cm. long and barely 1 mm. wide at the base. *Lamina bipinnate, to about 25 cm. long and 15 cm. wide, the rachises and costæ beneath densely clothed with brown hairs* like those on the stipe, with a few small narrow scales. Free pinnæ 12–15 pairs, the sub-basal largest, the upper ones gradually reduced and grading into the lobed apical lamina. *Largest pinnæ c. 8 cm. long and 3 cm. wide* (commonly about 6 by 2 cm.), subsessile, narrowed from truncate base to acute or acuminate apex, *pinnate towards the base only*, for the rest lobed almost to the costa, the pinnules or segments at right angles to the pinna-rachis at the base, gradually more oblique towards the apex. Free pinnules few, the rest more or less broadly adnate to the pinna-rachis; *largest pinnules about 12 mm. long and 4 mm. wide, base unequally cuneate, margins serrate or lobed* as much as half-way to the costule, apex rounded, texture very firm. Veins in pinnules or pinna-lobes 7–10–jugate, mostly forked; sori on basal  $\frac{1}{2}$ – $\frac{2}{3}$  of veinlets; in the largest pinnules several diplazioid sori, in smaller pinnules only one such sorus; indusia thin, broad, persistent.

This species, closely related to *D. tomentosum* but much more deeply dissected, has hitherto only been found in the moist shady valleys at Cameron Highlands, 4,800–5,000 ft. above sea level. No further collections have been made since my paper above quoted.

25. **Diplazium xiphophyllum** (Baker) C. Chr., Ind. Fil. 241. 1905.

*Asplenium xiphophyllum* Baker, J. Bot. 1879: 40.

Stock short, erect. *Stipes* to 70 cm. long, *drying pale*, clothed at the base with *dull brown entire scales to 1.5 cm. long and 2 mm. or more wide* at the base. Lamina simply pinnate; *pinnæ in adult plants to 12 pairs*, terminal pinna like the rest, *texture thin, colour light green when fresh, light brownish when dry*; lower pinnæ on very short stalks (2 mm. long), uppermost slightly adnate to rachis, *with buds sometimes in their axils*. *Largest pinnæ to about 35 by 6 cm.*, elliptical, narrowed gradually to the slightly unequal base and more abruptly to the acuminate-caudate



apex; *edges slightly and irregularly toothed throughout*; midrib pale, prominent and glabrous beneath, *lateral veins in small groups, at 45° to the midrib*, commonly of one basal pair and one central vein which is forked, one or both of its branches also forked; *veins occasionally anastomosing near margin but never copiously anastomosing, ending distinctly within the margin* and not united to it. Sori on basal pair of veins in each group, from near midrib to near margin, on other veins shorter, commonly 3–4 sori on each vein-group, the sorus on the anterior basal vein only diplazioid.

The above description applies to ferns found in the Malay Peninsula. The type of the species *D. xiphophyllum* is from Borneo (Labuan, coll. Burbidge, at Kew), and shows a frond of a young plant with narrow pinnæ, and detached pinnæ from a mature plant, these being 30 by 3 cm. There is therefore some doubt whether the Peninsula plant (matched also by the Kinabalu specimens quoted below) is really this species, more especially as young plants from Malaya have quite broad pinnæ. I do not, however, know any other species to which our fern could be referred.

*D. xiphophyllum*, as here interpreted, is a fern of lowland and mid-mountain valleys, the highest altitude recorded in Malaya being 3,000 ft. It is fairly constant in character, differing from *D. riparium* in its much larger size and in other points mentioned under that species. There is one aberrant collection, that of Burkill from Ulu Chineras, which has long narrow pinnæ (to 3.8 cm. wide), long acuminate with edges more deeply toothed than normally, the vein-groups less branched and without anastomosis, and fewer sori in each group.

Specimens in the Singapore Herbarium:—

SIAM. Patani, 160–350 m., Eryl Smith 1922; Khao Rum, Eryl Smith 618.

PERAK. No loc., Herb. Mus. Perak 234; Jor Camp, Henderson F.M.S. Mus. 10833; Waterloo, Curtis 1361 p.p.; Larut, 3,000 ft., King's Collector 2698; Temango, Ridley 14227.

PAHANG. Ulu Chineras, K. Lipis, S.F.N. 15692 (Burkill).

SELANGOR. Ginting Peras, Ridley 7833; Ginting Simpah, 2,000 ft., S.F.N. 34310 (Md. Nur), 1,500 ft., Hume 8782, 8777, 8542; Kajang, Symington 24200 (F.D.).

BORNEO. Kinabalu, 5,000 ft., Clemens 29406; 3,500 ft., S.F.N. 25258 (Holtum).

## LIST OF COLLECTORS' NUMBERS CITED

(The figures in brackets refer to the numbers given to the species in this paper)

S.F.N.	25444(20)	10849(13)
3829(18)	31194(9)	10959(12)
7953(20)	31295(13)	Hume (Herb.
8844(15)	31334(5)	F.M.S. Mus.)
9770(13)	32937(13)	8551B(13)
9876(2)	34310(25)	7117(17)
9982(13)	35012(19)	8186(16)
10018(2)	35995(17)	8542(25)
11007(10)	36503(15)	8777(25)
11198(19)	36504(10)	8782(25)
11473(2)	36505(2)	8997(14)
11478(15)	36507(18)	9110(18)
11515(13)	36508(20 var.)	9347(14)
11563(11)	37159(2)	9665(14)
14103(13)	37201(15)	9677(14)
15323(16)	Ridley	Curtis
15403(5)	1587(16)	1352(8)
15457(20 var.)	2167(12)	1360(17)
15692(25)	2400(13)	1361 p.p. (2)
17978(2)	5818(17)	1361 p.p. (25)
18301(16)	7833(25)	3369(14)
18583(12)	7843(9)	10135(13)
18612(19)	7852(9)	Eryl Smith
19302(19)	8139(12)	618(25)
19342(13)	8652(9)	1198(5)
19346(2)	11271(19)	1922(25)
19498(17)	13432(19)	1927(14)
19776(13)	13975(13)	1929(17)
20554(2)	14023(19)	1930(14)
20747(20)	14206(13)	1948(12)
20792(16)	14209(12)	Forest
21636(18)	14211(18)	Department
21645(15)	14227(25)	14602(13)
22089(13)	14229(2)	24200(25)
22388(18)	15991(20)	Herb. F.M.S.
22422(17)	King's Collector	Mus.
23262(13)	(Kunstler)	10833(25)
23340(2)	2214(18)	Wray
23361(13)	2346(18)	3590(16)
23518(13)	2391(14)	3594(17)
23620(5)	2698(25)	3616(2)
24382(17)	7146(14)	3626(17)
24558(16)	7151(19)	3862(20 var.)
24703(12)	7403(20 var.)	Haniff
24704(17)	7894(16)	4047(12)
24780(16)	8420(18)	Alvins
25258(25)	8797(9)	3282(16)

## CARPET GRASS, AXONOPUS SPP.

By R. B. JAGOE

Botanist, Department of Agriculture, S.S. &amp; F.M.S.

## INTRODUCTION

For many years the apparent difference between broad-leaved and narrow-leaved forms of *Axonopus compressus*, or Carpet grass, has not been generally regarded as of specific rank, although the names *Paspalum platycaule* Poir. for the broad-leaved form, and *Paspalum compressum*, for the narrow-leaved form, have been used by some persons. The original *Paspalum compressum*, Swartz., is however, undoubtedly the broad-leaved grass.

These two Carpet grasses have now been recognised as distinct species, the broad-leaved form retaining the present name (*Axonopus compressus* Beauv.), while Miss Agnes Chase, an American authority, has defined the narrow-leaved grass as a new species, and named it *Axonopus affinis*, as follows:—

*Axonopus affinis*, sp. novo.

Ab Axonopo compresso differt: Culmis et stolonibus gracilioribus, laminis augustioribus; spiculis brevioribus, 2 mm. longis, obtusis vel subacutis. (Culms and stolons more slender, leaf-blades narrower; spikelets shorter, 2 mm. long, obtuse or sub-acute).

"The plants are more tufted than in *A. compressus*, sometimes forming dense mats with short rhizomes, and the flowering culms in such colonies are relatively few.

Stolons slender, the internodes short, and the leaf-blades (usually) not conspicuously shorter than those of the culms, as in *A. compressus*.

Culms erect or geniculate ascending, slender, nodes glabrous (?) sheaths compressed, on the average narrower than those of *A. compressus*, leaf-blades flat or folded, 2 to 6 mm. wide.

Peduncles very slender 1 to 3 within uppermost sheath of flowering culm, finally elongate; racemes 2 to 4; 2 to 10 cm. long, spikelets oblong-elliptic rather more plump than in *A. compressus*, 2 mm. long, 0.8 to 0.9 mm. wide, blunt or abruptly acute. The glume and sterile lemma equal, covering the fruit or slightly pointed beyond it, 4 nerved, mid-nerves suppressed, sparsely silky-pilose at base and summit, and sometimes along the nerves. Fruit pale, 1.7 to 1.8 mm. long, blunt." (Agnes Chase).

## HISTORY

*Axonopus compressus*, Beauv., is a native of the West Indies and tropical America, and has spread to Florida and Louisiana in the United States. It was introduced to Singapore about 1895 to 1900, for Ridley refers to *Paspalum*

*platycaule* in 1903 as "lately established in Singapore", since when it has spread to all parts of Malaya, thriving under light or medium shade.

*Axonopus affinis*, Chase, is a native of the southern United States, and is common in the southern States from Carolina to Texas. This species was introduced as "Carpet grass" to the Central Experiment Station, Serdang, in 1921, seed being sent to the Department of Agriculture by the late Professor C. V. Piper of the Agronomy Section of the United States Department of Agriculture. It has been distributed to many parts of the peninsula, but has not yet spread widely.

#### DESCRIPTIONS

The two grasses are readily distinguished, although the broad-leaved species, *A. compressus*, in some circumstances, such as dry, shady conditions, produces long comparatively narrow leaves, little different superficially from those of *A. affinis*.

The distinguishing characters of the two species as found in Malaya differ slightly from those given by Miss Chase and detailed descriptions will be given below.

As stated above, the plants of *A. affinis* Chase, are more densely tufted than those of *A. compressus* Beauv. The former species is normally more free flowering, and the inflorescence peduncles are usually more elongated or extended.

**Leaves.**—Growing in the same conditions, the leaves of *A. compressus* are larger than those of *A. affinis*, the blades being much broader, though shorter.

Further distinguishing features are as follows:—

Leaf-blades of *A. compressus* are wavy-edged and bright green, with conspicuous hairy fringes along the edges of the lower three-quarters of the blades. The edges of the sheaths and the ventral surfaces of the blades are hairy, with a few hairs also on the backs of the blades. The blades taper more at the ends and have less blunt-pointed tips.

The leaf-blades of *A. affinis* are longer and stiffer, and are slightly duller green in colour. They are very much less hairy, sometimes hairless, but usually with comparatively few, though long, hairs along the edges of the blades and sheaths, and seldom any on the surfaces of the blades. The edges of the blades are nearly parallel and the tips are blunt. The ends of the leaf-blades in both species are minutely hairy.

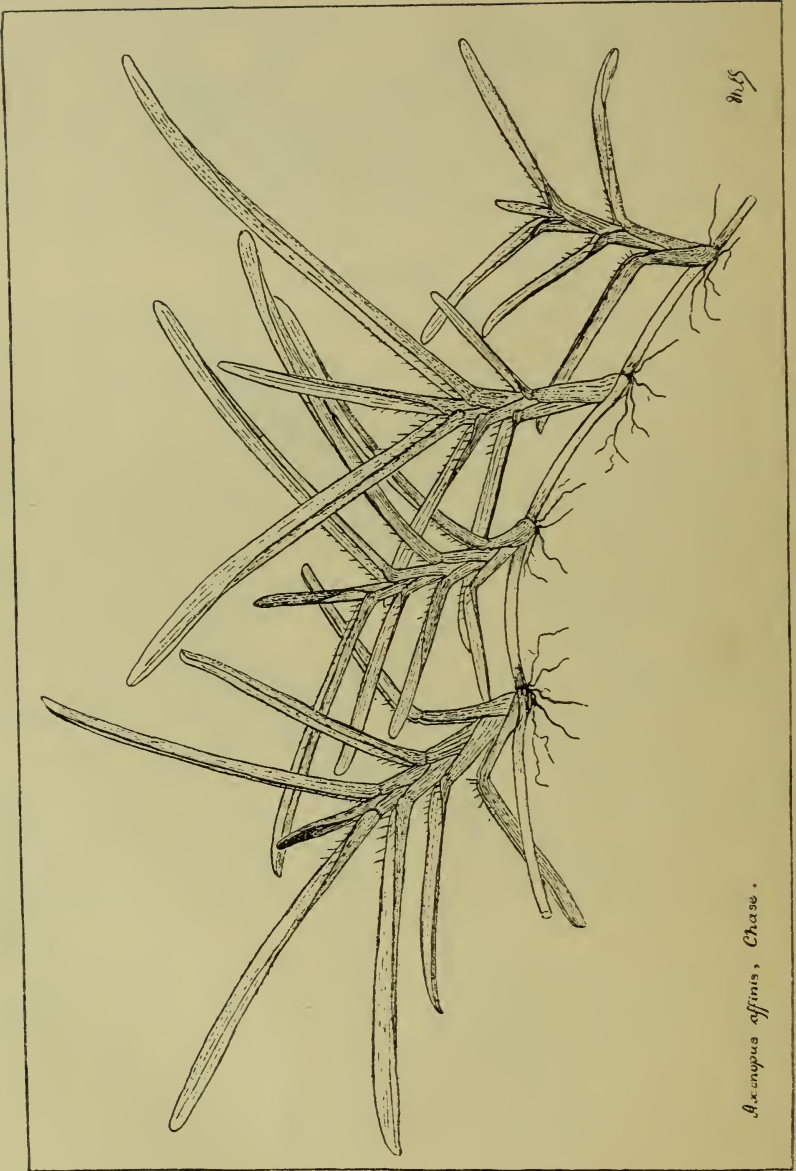
The backs of the blades of *A. affinis* are much more prominently keeled, and tend to fold in two, especially when withered or dry.





M.S.

*Aeluropus compressus*, Beauv.



A further point of difference between the two species is that a red coloration in the leaves of *A. compressus* is very common especially in dry exposed situations, but it is extremely rare in those of *A. affinis*.

**Stolons.**—Both species are freely stoloniferous; stolons vary from fairly slender to comparatively stout, and there is little if any difference between the species in this respect. Stolons are branching; inter-nodes are short, shorter on the average in *A. affinis*; nodes are free-rooting.

In *A. compressus* the stolon nodes are very white-hairy, but in *A. affinis* they are only sparsely hairy.

In *A. compressus* the leaf-blades of the stolon growth stages are often conspicuously shorter than those of flowering culms, while in *A. affinis* this is not so notable.

*A. compressus* is now fairly common under rubber trees, and there grows most often in tufted fashion, conditions presumably being not very favourable for normal stoloniferous growth.

**Flowering Culms.**—Every stolon node bears a potential flowering shoot and when circumstances demand or are suitable, shoots from the nodes form flowering culms. At times, small or large leafy colonies of flowering culms are produced on branching rhizomes from the stolon nodes.

The flowering culms proper have only one inter-node, though at times they appear to have two or three. These extra internodes are the result of stoloniferous internodes being formed and assuming a more or less erect attitude, due to the urge to form floral organs coinciding with good conditions for vegetative growth.

The flowering culms develop with the elongation of the basal internode, from the upper node of which and within the final leaf-sheath is a conic "disc" bearing 4 to 6 long bracts each subtending an inflorescence peduncle.

The blade of the uppermost leaf is short, especially so in *A. affinis*.

The nodes of the flowering culm are, in *A. compressus*, most usually densely white-hairy, though not always all the way round, while in *A. affinis* only the edges of the compressed nodes are (usually) hairy, but sometimes quite glabrous.

The full details of the morphological differences of the flowering culms are however, more conveniently described by taking each species separately.

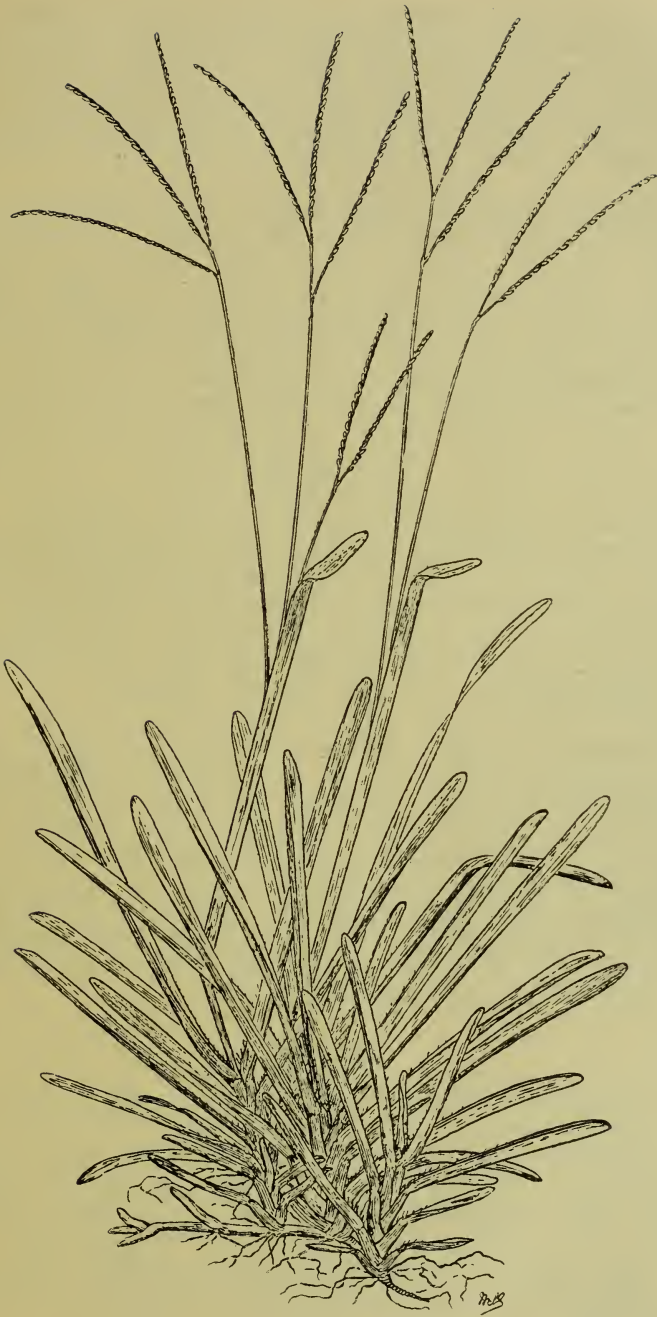
*Axonopus compressus* Beauv. Flowering culms fairly slender, compressed. Nodes more or less silky hairy, leaf-blades 5 to 14 mm. wide, 6 to 28 cm. long; uppermost blade usually short but from 3 to 19 cm. long. From the cone on upper node of culm, 4 to 6 slender peduncles (1 to 4 conspicuous) 10 to 30 cm. long. Very frequently in *A.*



*Axonopus compressus*. Beauv

*Gardens Bulletin, S.S.*





*Axonopus affinis*. Chase

*compressus*, these inflorescence peduncles remain short, and are not elongated beyond the mouth of the leaf-sheath. Each peduncle bears 2 or 3, rarely 4 to 6 slender racemes, the first two of which are at the apex of the peduncle, one terminal, the second subterminal, with others, when present, alternately at short intervals below. Racemes 4 to 10 cm. long.

Spikelets usually silky hairy, not closely spaced, alternating in two rows on a slender flattened or triangular rachis. Spikelets 2.0 to 2.8 mm. long, 0.8 to 1.0 mm. broad. Glumes II and III membranous, pale green with darker veins, hairy, conspicuously pointed, and extending beyond the fruit. Glume II often reddish coloured. Glume IV and palea chitinous. Stamens three, anthers yellow (when full of pollen) with narrow purple outer edges. Stigmas white.

*Axonopus affinis* Chase. Usually more free flowering than *A. compressus*. Flowering culms slender, compressed. Nodes more or less glabrous. Leaf-blades 4 to 8 mm. wide, 6 to 30 cm. long, uppermost blade on culm very short, 2 to 6 cm. long. From cone on upper node of culm 3 to 6 very slender peduncles (1 to 3 conspicuous), 15 to 30 cm. long. Each peduncle bears 2 or 3, occasionally 4 to 6, slender racemes, the first two racemes at the apex of peduncle, one terminal, the second subterminal, the others, when present, alternating at short intervals below. Racemes 3 to 10 cm. long.

Spikelets usually hairy, not very closely spaced, alternating in two rows along a slender flattened or triangular rachis, 1.8 to 2.2 mm. long, 0.8 to 1.0 mm. broad (they are much less pointed than those of *A. compressus*). Glumes II and III membraneous, pale green with dark veins hairy, hardly extending or extending to a short point beyond the fruit, mid vein very indistinct. Glume II often reddish coloured. Glume IV and palea chitinous. Stamens three, anthers purple with translucent dots. Stigmas mauve.

Both species produce seed freely.

#### UTILITY

*A. affinis* withstands dry weather better than *A. compressus* and is capable of covering the soil better in dry exposed situations. On poor, unshaded soil, in this country, the former species frequently grows by densely-leafy, short internoded stolons, and it is probable that it will, in time, largely predominate in such conditions.

Under medium shade, however, where both make their best growth, *A. compressus* appears to have a distinct advantage.

There is some slight confusion as to palatability and value of carpet grass as pasture, but this is partly due to the previous confusion of two species with but one name.

There is no doubt that the true *Axonopus compressus* Beauv. is a good pasture grass, being recognised as such in tropical America and Australia. It appears equally true that *A. affinis* has a variable reputation. It is definitely regarded as inferior in Australia, and chemical analyses quoted by McLennan clearly show it to be inferior, as fodder, to *A. compressus*.

In Malaya a few years ago *A. affinis* appeared to be liable to cause purging of cattle, due to a slight increase in hydrocyanic acid content if cut at too short intervals. The author has, however, seen *A. affinis*, under light shade, grazed by cattle with relish, and obviously in preference to *Paspalum conjugatum*.

### SUMMARY

A detailed account is given of the two species *Axonopus compressus* Beauv., and *Axonopus affinis* Chase, and the differences between them.

The chief distinguishing features may be summarised as follows:—

<i>A. compressus</i> Beauv. Savannah Grass.	<i>A. affinis</i> Chase. Carpet Grass.
LEAVES.—Broad, hairy frequently with red colouration.	Narrower, stiff, folded, more or less glabrous.
NODES.—Very hairy.	Hardly hairy.
SPIKELETS.—Long and pointed.	Blunt or short pointed.
ANTHERS.—Yellow with narrow purple outer edges.	Purple, with translucent dots.
STIGMAS.—White.	Mauve.

The writer wishes to acknowledge with thanks much careful work by his Laboratory Assistant, Che Mohd. Kassim, in the preparation of the illustrations.

### BIBLIOGRAPHY

1. AGNES CHASE. "The Carpet Grasses." Journ. Wash. Science, Vol. 28, 4. April 1938.
2. C. V. PIPER and L. CARRIER. "Carpet Grass." U.S. Dept. of Agriculture, Farmers Bull. 1130, April 1920.
3. A. S. HITCHCOCK. "Grasses of British Guiana." Contribution from U.S. Nat. Herbarium. Vol. 22.6.1922.
4. H. N. RIDLEY. "Turf and fodder grasses." Agricultural Bulletin S.S. and F.M.S. Vol. 2, 9. Sept. 1903.
5. H. N. RIDLEY. "Flora of the Malay Peninsula, 1925." Vol. V, page 216.
6. J. N. MILSUM. "Fodder and grazing Grasses in Malaya." Malayan Agricultural Journal, Vol. 12, 1924.
7. J. LAMBOURNE. "A preliminary report on carpet grass." Malayan Agricultural Journal, Vol. 12, 1924.

8. J. LAMBOURNE. "Lawn grasses and their maintenance." *Malayan Agricultural Journal*, Vol. 25, 1937.
  9. C. D. V. GEORGI. "Chemical composition of Carpet grass from Serdang (*A. affinis*)." *Malayan Agricultural Journal*, Vol. 24, 1936.
  10. K. HEYNE. *De Nuttige Planten van Nederlandsch Indie*. (The useful plants of the Neth. Indies.) 1927, page 203.
  11. C. WHITE. "Broad leaved carpet grass." *Queensland Agricultural Journal*, Vol. 43, 1935, p. 503.
  12. C. WHITE. "Carpet Grass." *Queensland Agricultural Journal*, Vol. 44, 1935, p. 117.
  13. L. W. MCLENNAN. "Carpet Grass." *Agricultural Gazette N.S.W.*, Vol. 47, October and November 1936.
  14. D. O. CROSS. "Narrow-leaved Carpet Grass." *Agricultural Gazette, N.S.W.*, Vol. 49, Dec. 1938.
  15. WHITNEY, HOSAKA and RIPPERTON. *Grasses of the Hawaiian Ranges*. Hawaiian Agricultural Experiment Station, Bulletin 82, 1939.
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## PERIODIC LEAF-CHANGE AND FLOWERING OF TREES IN SINGAPORE (II)\*

By R. E. HOLTUM

In my earlier paper on this subject, I published observations made on a number of trees during the years 1927-1931, and summarized previous observations published elsewhere on the behaviour of trees in the eastern tropics. I also gave a short account of the climate of Singapore. The main item of new information arising from my own observations was that a number of deciduous trees had fairly constant leaf-periods, which had no relation to the yearly calendar; and the conclusion drawn from this was that the length of leaf-period in such trees is due primarily to senescence of leaves, the climate of Singapore being so uniform as to have little or no control.

Subsequent observations, in some cases over a total period of ten years or more, have confirmed the fact that many deciduous trees have fairly constant leaf-periods not related to climate; but they have also shown many curious irregularities which are not always easy to explain. It is clear that there is every variety of response from almost complete independence of climatic change to extreme susceptibility, and a tree that is regular in behaviour for a time may later show an unexpected change (*e.g.* *Koompassia*).

My earlier generalizations therefore need modification in some measure, and a fuller discussion of the whole subject is given below, followed by details of behaviour of individual trees.

### Climate

The temperature of Singapore is so uniform throughout the year as to have little significance in the present connection. The only phenomena of temperature-change which influence plant behaviour are sudden falls of 10 to 15 degrees (Fahrenheit) during storms, and possibly also cool days following hot weather. These stimulate certain plants to flower; chiefly orchids, but also some woody plants, notably *Pterocarpus indicus*.

The average rainfall of Singapore is nearly 100 inches (2540 mm.), uniformly distributed, the driest calendar month having a mean of about 6 inches (152 mm). The only constant periodic change in the climate is the wetter season from October to January, when in addition to the greater rainfall there is frequent heavy clouding and light rain, resulting in continuously moist conditions over considerable periods, in contrast to the relatively short

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\* For the first paper on this subject, see Gard. Bull. S.S. 5: 174-206. 1931.

periods of heavy rain characteristic of most of the rest of the year. There is often a sudden break at the end of the wet season, in January or February, and this is usually the most pronounced climatic change in the year. It varies in its intensity.

Though the driest month has a mean rainfall of about six inches, there are drier months than this in almost every year. A list of the calendar months with less than 2.5 inches of rain (63 mm.) since 1890 shows the following frequency of occurrence:

February	..	..	..	7 times
March	..	..	..	3 "
April	..	..	..	1 "
July	..	..	..	6 "
August	..	..	..	3 "
September	..	..	..	2 "

Thus there is an indication that exceptionally dry weather tends to occur either about February–March or July–August, but it will be noted that in 49 years there were only 22 calendar months with less than 2.5 inches of rain, and (as shown by the figures at the end of this paper) there is very great variation in the distribution of rainfall from year to year. In the period 1927–1937, the following were the longest periods without rain:—

24. 1.35–14. 2.35	..	..	22 days
21. 7.35– 9. 8.35	..	..	20 "
3. 2.33–19. 2.33	..	..	17 "
8.12.34–23.12.34	..	..	16 "
13. 7.28–27. 7.28	..	..	15 "
26. 7.29– 9. 8.29	..	..	15 "
24. 7.37– 6. 8.37	..	..	14 "

The extremes of dry weather are thus relatively slight as compared with most tropical climates, and are never such as to necessitate leaf-fall of trees; and though extreme dry weather may usually occur about February and July, it is not frequent enough to ensure uniform behaviour of all trees, and lesser dry periods may occur at almost any time. Dry periods of from 7 to 13 days occurred as follows in 1927–1937:

in January	..	..	..	2 periods
February	..	..	..	4 "
March	..	..	..	5 "
April	..	..	..	1 "
May	..	..	..	5 "
June	..	..	..	3 "
July	..	..	..	9 "
August	..	..	..	2 "
September	..	..	..	4 "
October	..	..	..	2 "
November	..	..	..	— "
December	..	..	..	1 "

A period of seven days without rain, following a period of wet weather, is probably enough to stimulate certain

trees to flower; but response varies according to the condition of the tree, and is in fact so complex that it is difficult to analyse. Reference to *Fagraea fragrans* and *Saraca taipingensis* will give some indications on this point. Most trees (other than those that flower continuously) probably need more than seven days drought as a stimulus to flowering.

Atmospheric humidity is high every night, rising above 90% soon after sunset; in the daytime it may fall to about 60% in dry weather, but in the wet season often only to 85%.

An appendix to this paper gives the daily rainfall, in inches, at the Botanic Gardens, Singapore, from 1927 to 1939.

### Deciduous trees with annual leaf-renewal

Trees of the following species have been strictly annual in their leaf-renewal:

- Kigelia pinnata* (mean date 28 January)
- Hymenaea courbaril* (early February)
- Parkia javanica* (mean date 23 February)
- Terminalia subspatulata* (mean date 6 April)
- Canarium rufum* (mean date 9 May)
- Lecythis* sp. (mean date 11 August)

The coefficients of variation of these trees vary from 2.0% to 7.5%, and presumably indicate corresponding differences in susceptibility to climatic variation.

The mean dates of leaf-renewal are interesting. It is probably significant that the two trees with the lowest variation (*Parkia* and *Kigelia*) renew their leaves in January–February, following the most regular seasonal change in the climate, whereas those with mean date of leaf-renewal in April and May (*Terminalia* and *Canarium*), when there is much variation of climate conditions, show the greatest variation. *Lecythis*, changing about August, is intermediate. *Hymenaea* is not quite deciduous, and no exact dates are recorded, but the tree concerned seems to be quite regular in its behaviour.

There are other trees that appear to have a tendency to a period of slightly less or slightly more than 12 months. Such trees as these may keep to very near 12 months for some years, if they change their leaves at a time when dry weather is most likely to occur; but sooner or later they have a short or a prolonged leaf-period, and this may be the prelude to a series of irregular periods until the change occurs once more at a time when climatic change is most regular. For an example of shortening periods see *Cassia nodosa*; for lengthening periods *Koompassia malaccensis*. The latter had been observed over three periods when I



wrote my earlier paper; it then appeared to have a period of exactly a year, with leaf change in September. It subsequently deferred its change until November and then had several periods of considerably more than 12 months.

Two young trees of *Kigelia pinnata* have indicated that the date of leaf-renewal may be dependent on the date of planting, and also that root-stimulus by manuring and cultivation may induce new growth and result in a change of some months in the date of leaf-renewal. The relation of the first leaf-change to the date of planting of a young tree is one that varies considerably from species to species, and observations on this point would be of considerable interest.

### Deciduous trees with leaf-period of more than a year

Several deciduous trees have been observed to show a mean leaf period significantly more than 12 months. These are as follows:

<i>Species</i>	<i>Period</i> (months)	<i>s.d.</i>		<i>No. of</i> <i>periods</i>
<i>Cedrela Glaziovii</i> A ..	12.5	.70 or	5.6%	11
<i>Koompassia malaccensis</i>	12.7	1.36	10.7%	12
<i>Hevea braziliensis</i> ..	13.3	.86	6.5%	9
<i>Cedrela Glaziovii</i> B ..	14.0	1.7	12.1%	10
<i>Caesalpinia ferrea</i> ..	14.2	1.2	8.5%	5
<i>Homalium grandiflorum</i>	13.7	1.9	13.9%	7
<i>Anisoptera megistocarpa</i>	13.8?	1.65?	12.0%	10?
<i>Parishia Maingayi</i> ..	15.6	.96	6.2%	6
<i>Heritiera elata</i> ..	20.5	2.6	12.7%	4
<i>Heritiera macrophylla</i> ..	32	1.3	4.1%	4

The two trees of *Cedrela Glaziovii* provide a remarkable contrast, as they are growing near together and under apparently identical conditions. It is remarkable that the tree showing a period of only 12.5 months, which one might perhaps think not significantly different from 12.0 months, has had a very small coefficient of variation over a period of eleven years. The other tree, which evidently has a tendency to decidedly longer periods, is probably also more influenced by climatic change. Climatic influence is more clearly seen in the *Koompassia*, which has had its longest leaf-periods when change was due in the wet season. Such a tree may show almost exactly 12-month periods for several years, then a series of longer periods with change later and later in the wet season, then a series of nearly 12-month periods again. The *Koompassia* tree in question would probably be a strictly 12-month tree in a climate with a pronounced annual dry season. (Another *Koompassia* tree seems to be more irregular).

The *Hevea* with a very regular period of over 13 months is also interesting, because most *Hevea* trees in



Singapore are very irregular in their behaviour, changing some or all leaves at any period of dry weather (according to their previous history and the intensity of the drought). Schweizer's observations in a much more seasonal climate in Java indicate also variation in behaviour of different trees of *Hevea*; for further notes on this question, see below under the heading *Deciduous Trees with no regular leaf-periods*.

The behaviour of the *Anisoptera* tree has been decidedly irregular, and it is not at all obvious how climatic influence can have caused the observed variations. The *Homalium* tree also had one exceptionally long period which seems unaccountable on climatic grounds.

The two species of *Heritiera* are the most remarkable cases in this group, one being native to Malaya and the other from Burma. It would be very interesting to have some information about the behaviour of *H. macrophylla* in its seasonal native climate. Such a leaf period as 2½ years in a deciduous tree must surely be very exceptional, though individual leaves of lesser evergreen trees and shrubs in the shade of rain-forest may not infrequently last as long as this.

#### Trees with leaf-periods between 6 and 12 months

A number of trees have shown regular periods of less than a year; these are as follows, with the exception of those having a six-month period, which are considered separately below.

<i>Species</i>	<i>Period (months)</i>	<i>s.d.</i>		<i>No. of periods</i>
<i>Adenanthera pavonina</i> ..	7.25	.74 or	10.2%	16
<i>Cassia fistula</i> A	9.1	.93	10.2%	15
<i>Cassia fistula</i> B	10.5	1.26	12.0%	8
<i>Cassia fistula</i> C	9.6	.84	8.7%	14
<i>Cassia nodosa</i> (1928-35)	11.7	.4	3.4%	7
<i>Cratoxylon formosum</i> A	9.1	1.09	12.0%	15
<i>Cratoxylon formosum</i> B	9.1	.74	8.1%	15
<i>Delonix regia</i> ..	8.8	.94	10.7%	11
<i>Ficus variegata</i> A	6.5	.84	12.9%	20
<i>Ficus variegata</i> B	6.4	.85	13.3%	19
<i>Ficus variegata</i> C	6.1	.65	10.7%	9
<i>Ficus variegata</i> D	6.1	.62	10.1%	13
<i>Lagerstroemia flos-reginae</i> , north side ..	9.2	.88	9.6%	13
<i>Lagerstroemia flos-reginae</i> , south side ..	8.9	.77	8.7%	13
<i>Lagerstroemia flos-reginae</i> old tree ..	9.4	.99	10.5%	13
<i>Salmalia malabarica</i> A	10.5	.44	4.2%	13
<i>Salmalia malabarica</i> B	9.3	.98	10.5%	12
<i>Sterculia macrophylla</i> Pg.	6.9	—	—	4
<i>Sterculia macrophylla</i> S.	7.0	—	—	4
<i>Sterculia</i> sp. ..	10.1	1.26	12.5%	15

It will be noted that nearly all of these trees have a coefficient of variation of about 10%. It is notable that one of the two exceptions, namely the tree of *Cassia nodosa* with a coefficient of only 3.4% in the period 1928–35, showed subsequently a very irregular behaviour. This is discussed further under the heading of irregular trees.

Apart from the indication that a considerable number of deciduous trees have regular periods independent of the climatic cycle, the most interesting feature of the above table is the comparison of different trees of the same species.

In the case of *Salmalia malabarica* the tree with the more regular period is the more vigorous. This species is interesting as being the only one that has a considerable obligatory resting period; such trees are often intolerant of the Singapore climate. The standard deviations of the three trees of *Cassia fistula* are also in the order of their vigour, the most vigorous showing the least deviation. This may be partly connected with the fact that in this species no exact date for leaf-renewal can be given, the process being slow and not always uniform all over the tree; the observer is therefore liable to greater variation in recording dates for the less vigorous trees. There is an indication that some trees of this species in Singapore have a period of 12 months.

The two trees *Cratoxylon formosum* are in different localities, and have never changed simultaneously, but both have a period of 9.1 months. One tree has a substantially greater variation than the other, though both are equally vigorous and of about the same size. It is to be noted that this species appears to have a period of 12 months in the more seasonal climate of Penang.

The four trees of *Ficus variegata* are of considerable interest, as they come very near the six-month trees. It is clear however that trees A & B, which have been longest under observation, have a period significantly longer than six months, and also a rather high standard deviation, whereas the three six-month trees appear to have a low standard deviation. As pointed out below, however, observation must be carried out over a longer period of years if a true picture of their behaviour is to be obtained.

The two trees of *Lagerstroemia*, like those of *Cratoxylon*, are situated some distance apart, have almost equal periods, and do not change simultaneously. The tree of which the two halves have different periods is considerably younger than the other.

The *Sterculia macrophylla* at Penang is interesting as showing a period of seven months in the much more seasonal Penang climate. A second Singapore tree seems

to have a considerably longer period; but it has not been observed long enough since its treatment of cultivation and manuring to allow of a definite statement being made.

### Six-month trees

A few species of trees have a regular period of six months. There are indications that in some cases trees of *Peltophorum* have longer periods than this, but in the cases observed the trees were either young or in poor condition or affected with insect pests. The list of trees observed in the six-month class is as follows:—

	<i>s.d.</i>	<i>c.v.</i>	<i>Mean dates</i>		<i>No. of periods</i>
<i>Couroupita guianensis</i> ..	.43	7.2%	15 Mar.	20 Sept.	16
<i>Peltophorum pterocarpum</i> ..	.43	7.2%	12 Feb.	10 Aug.	22
<i>Terminalia catappa</i> ..	.64	10.5%	8 Feb.	11 Aug.	22

It is remarkable that the exotic *Couroupita* has been more regular than the local *Terminalia* in its behaviour. The dates February–March and August–September for leaf-change follow closely the periods of incidence of the driest weather and are probably controlled by these periods.

### Deciduous trees with no regular leaf-periods

There is probably no very sharp distinction between this class and that of the regular trees, the gap being bridged by those which have high standard deviation. The irregular trees here considered are in fact those which are most affected by small climatic changes, which in Singapore are of irregular occurrence. The most remarkable of the irregular trees under observation are *Cassia nodosa*, *Dyera costulata*, *Ficus caulocarpa*, *Hevea braziliensis*, *Mangifera indica*, *Sindora Wallichii*, and *Sterculia carthagenensis*. Each of these presents some peculiar features, which are discussed under the appropriate headings below. The most striking may be mentioned here. *Cassia nodosa* showed a very regular period of 11.7 months for several years, and then behaved very irregularly. *Ficus caulocarpa* is the most irregular of all, and I cannot trace any connection between its behaviour and climatic change. *Hevea* trees mostly lose some leaves, and sometimes all, when there is dry weather, but the single tree with a regular period of 13.3 months is a notable exception. *Sterculia carthagenensis* is a very interesting case, discussed below in some detail.



It has been clearly shown by Schweizer's experiments that *Hevea* leaves have a minimum life of about 5 months; and it is probable that most other irregular trees have similarly a minimum period for which the leaves must be retained, the leaves being liable to fall in any dry weather after they have attained this minimum. There is probably always considerable variation from tree to tree in this class, according to the individual nature of the trees, their position (soil, exposure etc.) and previous history.

### Flowering of Deciduous and Evergreen Trees

The flowering of deciduous trees always takes place at a definite point in the leaf-cycle; on the old wood before new leaf growth (*Erythrina indica*), simultaneously with the growth of new leaf shoots (*Cratoxylon formosum*, *Cassia fistula*), or at the end of the new leafy shoots (*Lagerstroemia*, *Peltophorum*). Flowering may be much or little, or even often absent in some cases (*Homalium*, *Terminalia subspathulata*). The extent of flowering depends no doubt on the climatic conditions at the time the flower buds are formed. It is notable that *Delonix* trees flowering in Singapore at some seasons are much fuller of flowers than those flowering at other seasons. In some species, on the other hand, flowering is very much the same whatever the season (*e.g.* *Lagerstroemia*) and there is probably in all cases some difference in response according to innate differences from tree to tree. But whatever these differences in response, flowering always occurs at a definite point in the leaf-cycle, and cannot occur at any other time. From this it follows that, with trees having a leaf-period of less than 12 months, there is no definite flowering season, and little response to climatic change, but a sporadic flowering of individual trees throughout the year.

The flowering of evergreen trees, on the other hand, is usually not dependent on the leaf-cycle, and bears no relation to new leaf growth. Flowering is dependent on dry weather, but the intensity of drought needed to produce flowering, and the time which elapses between the onset of dry weather and the opening of flowers, vary greatly from species to species. Examples are given under *Saraca taipingensis* and *Fagraea fragrans*. Some evergreen trees however flower at the end of new leaf-growth (*e.g.* *Eugenia grandis*, *Cinnamomum iners*).

Evergreen trees produce new leaf-growth at intervals of a few months (sometimes as much as a year or more), the intervals apparently much less regular than the leaf-periods of most deciduous trees. The old leaves usually do not fall as soon as the new have grown, but remain



on the tree for some time afterwards, their total life-period being often very long. There are however cases rather intermediate between the normal deciduous and evergreen types, such as *Dyera costulata* and *Eugenia grandis* (see my 1931 paper, p. 191). Probably in most cases new leaf growth of evergreen trees is dependent on some climatic stimulus, often rainy weather; but little information on this point is available. Some data will be found below under *Mangifera foetida* and *Saraca taipingensis*.

### Statistical significance of the records

In all cases the mean leaf-period has been calculated, and where the number of observations is sufficient, the standard deviation, which is the usual measure of variability. This is calculated by taking the difference of each leaf-period from the mean, squaring these differences, dividing their sum by  $n-1$  ( $n$  being the number of periods) and taking the square root of the result. If one date of a series has been missed, the double period is divided, and two equal periods entered for calculation of differences from the mean, but the sum of the squares is divided by  $n-2$  instead of  $n-1$ .

As noted above, it appears that standard deviation, when expressed as a percentage of the mean period, gives a measure of the susceptibility of a tree to climatic influences. It is notable that in two instances (*Cassia fistula* and *Salmalia malabarica*) a more vigorous tree has a smaller deviation than a less vigorous tree of the same species, indicating that a more vigorous tree is less susceptible to climatic influence. It may be that the more vigorous tree, having a larger and more widely spreading root-system, has access to a larger amount of soil moisture, and is correspondingly less affected by a period of dry weather.

I am grateful to Dr. E. J. MASKELL for advice concerning the data presented in this paper, and for making a statistical comparison of some of them, to assess their significance. The results of this treatment of a few of the records, summarized in the following paragraphs, will give a general idea of the significance of the records as a whole.

Taking two trees which have leaf-periods of more than a year, namely *Hevea brasiliensis* and *Sterculia macrophylla*, calculation indicates that the probability in either case that the figures presented show chance behaviour of trees whose true period is 12 months, is less than .01. That is, the probability that these trees have a natural period of more than 12 months is very high.

Taking pairs of trees of the same species which have shown different mean periods, the following results were found. In the case of *Salmalia malabarica*, the probability that the differences observed between the two trees are a chance result is less than .02; this indicates that the differences observed are fully significant. In the case of the two trees of *Cedrela Glaziovii*, the probability is greater than .02, but less than .05; this also indicates a significant difference. In the case of *Ficus variegata*, however, comparing trees A and B, A and C, the differences are found not to be significant. In these trees, the mean periods are near together, and the deviations rather high, so that a longer period of observation is needed to indicate significant differences between them.

It should be noted however that though the differences between a pair of trees such as the two *Salmalias* may be significant, this does not necessarily indicate that the whole difference is due to the individual natures of the trees. A tree with good soil and other favourable environmental factors may be more vigorous than a tree less favoured, and the two might on that account show some difference of leaf-period. On this point, we have no evidence. All we can say is that in an identical climate two trees of the same species may show a significant difference of behaviour, part of this being presumably due to innate differences between the two trees and part to differences of soil conditions and other topographical factors. In the case of the two *Cedrela* trees, the differences of soil and topography appear to be negligible, but one cannot be entirely sure of this. An appropriate experiment would be to propagate the two trees vegetatively, and observe whether the offspring, planted together in a different place, continued to show the differences of their parents.

### Conclusion

The observations presented in this paper indicate clearly that the climate of Singapore is so uniform on the whole that many trees change their leaves at intervals which have no relation, or little relation, to climatic change. It is clear however that there is much variation in regularity of behaviour among such trees, even between different individuals of the same species. One can find all conditions from trees with very high constancy of period (the period bearing no relation to the calendar year) to trees that are so susceptible that they may renew at least some of their leaves at any small climatic change.

The constant-period trees appear to be organized on the principle that their leaves are efficient for a certain

period, and are then shed and renewed, whatever the season. For these trees, no climatic change experienced in Singapore is sufficient to make them change their leaves much earlier or later than their proper period, which is dependent on the nature of each tree, and perhaps also on its soil conditions or other local factors. However, trees of these same species in climates with long dry seasons may change their leaves at intervals of exactly a year. It is the climatic uniformity of Singapore which permits such trees to show their individuality; in the interplay of internal and external factors, the internal are here by far the stronger.

At the other extreme are trees which are considerably affected by such climatic changes as do occur in Singapore. As such changes are very irregular over a great part of the year, trees of this kind are irregular in behaviour. They appear to be organized on the principle that their leaves have a *minimum* life; any dry period occurring after the minimum may cause some leaves to fall, with subsequent leaf-renewal. There is no sharp distinction between these trees and those which have constant leaf-periods; the gap is bridged by trees showing varying degrees of deviation from regular periods.

Another point to observe, deserving of future attention, is that interference with the roots of trees may completely change the rhythm of their leafy shoots. It seems likely that stimulation of roots at a sufficient interval after the last new leaf-growth will stimulate new leaf-growth, followed by fall of the old leaves; but that the reaction will depend on the age of the last leaf-growth, much in the same way that *Hevea* leaves have a minimum life. But different trees will doubtless behave in different ways, and much of interest may emerge from watching their reactions.

Evergreen trees differ from deciduous trees in not losing their old leaves when new ones are produced; the growth of new leaves is not a consequence of the loss of the old, and must be due to some other stimulus. Observations on the behaviour of evergreen trees are few (*see Mangifera foetida*, in this paper), but I think they also will be found to vary in their response to climatic stimulus. It is clear that some (*e.g.* *Saraca*) are stimulated by wet weather to produce new leaves, and that such production comes at irregular intervals. The length of such intervals and their dependence or otherwise on climatic stimulus probably vary as much from species to species as in the case of deciduous trees. A further important point of difference between evergreen and deciduous trees is that in the former flowering is usually independent of vegetative growth, whereas in the latter flowering always comes at a definite point in the leaf-cycle.



## Records of Individual Trees\*

*Adenanthera pavonina* L.

The tree reported on in 1931 has been under continuous observation since that time, and has maintained an average leaf-period of 7.25 months, with a standard deviation of .74 month over 16 periods. The longest period was 8.4 months and the shortest 6.2; both these occurred in the records formerly reported. Leaf-renewal has occurred in every month of the year except February, June and November.

Leaf-renewal after the 8.4 month period occurred towards the end of a 2-month drought; if this prolonged dry weather was the cause of deferring leaf-renewal, it is difficult to see why leaf-renewal after the short period of 6.2 months took place at the end of one month's dry weather. In both cases the new leaves developed before any considerable rainfall had broken the drought. A subsequent record of leaf-renewal on 9th July, 1938 gives an average of about 7.5 months for two leaf-periods after 11th April, 1937.

It should be noted that this species is said to be annual in its behaviour at Peradeniya, losing its leaves towards the end of the year. On a recent visit which I paid to Colombo in October, I noticed that all trees were in old leaf with ripe fruits, and the same appeared to be the case at Bombay a few days later. See however remarks under *Peltophorum ferrugineum*.

The following table gives dates of leaf-renewal, with the length of each leaf-period, and also the standard deviation as calculated from these figures.

				Months					Months
27.	8.27	..	..	—	15.	1.33	..	..	8.2
22.	3.28	..	..	6.8	6.	9.33	..	..	7.7
21.	10.28	..	..	7.0	April	1934	..	..	7.+
28.	4.29	..	..	6.2	1.	12.34	..	..	7.+
8.	12.29	..	..	7.3	15.	7.35	..	..	7.5
21.	8.30	..	..	8.4	1.	3.36	..	..	8.5
10.	3.31	..	..	6.6	10.	10.36	..	..	7.3
4.	10.31	..	..	6.8	11.	4.37	..	..	6.0
8.	5.32	..	..	7.1					

16 Periods.

Mean period: 7.25 months.

Extremes: 8.4 and 6.2 months.

Standard deviation: .74 month or 10.2%.

*Anisoptera megistocarpa* van Sl.

A large tree of this species in the Gardens Jungle has been under observation since 1928; it has shown considerable variation in behaviour, with long leaf-periods

\* In the records which follow, dates of leaf-renewal are the dates on which leaf-buds were seen to be starting new growth.



throughout. The tree is slowly deciduous during many weeks, new growth appearing when it is almost bare of leaves. It has had six periods varying between 12 and 16.5 months, and two much longer periods of 23.8 and 28.2 months. The crown of the tree is clearly visible from my house, though distant, and I am confident that these two long periods represent intervals between new growth following bare phases. It is possible however that (as with the tree of *Dyera*) new growth may have occurred without a preceding leaf-fall during these long periods; I might have missed such new growth, as there is little colour change between new and old foliage. If we assume that the long periods are in fact double periods (so far as new growth is concerned), we find that the standard deviation is 12%, which is no greater than in a number of other trees; taking them as single periods, the standard deviation is very high.

In any event, more observation is needed to understand the behaviour of this tree. One cannot see any relation between the dates of leaf-renewal and rainfall. Leaf-renewal in March, 1931, March, 1932 and April, 1933 took place after rather dry weather in February (average 115 mm.) which was absent in 1935; but if a dry February causes leaf-renewal, it is curious that the much drier month of February, 1936 (43 mm.) had not a more immediate effect. The dates of new leaf-growth, and the intervals in months between them, were as follows.

			Months				Months
18.	8.28	.. ..	—	2.	6.34	.. ..	14.0
	8.12.29	.. ..	15.7	27.	5.36	.. ..	23.8
12.	3.31	.. ..	15.1	15.	10.37	.. ..	16.5
13.	3.32	.. ..	12.0	22.	2.40	.. ..	28.2
1.	4.33	.. ..	12.6				

Reckoning the periods 23.8 and 28.2 as double periods (i.e. as  $2 \times 11.9$  and  $2 \times 14.1$  months respectively), we have the following:—

10 periods; mean period 13.8 months,

extremes 12.0 and 16.5 months.

Standard deviation: 1.65 months or 12.0%.

### *Caesalpinia ferrea* Mart.

A single tree of this south American species, apparently the only mature tree of its kind in Singapore, grows in the Botanic Gardens. It has made vigorous growth, and is very handsome, but flowers poorly and sets very few fruits. The tree is deciduous, its leaf-fall taking place slowly over a period of several months. Before all the leaves are gone, new growth appears on isolated twigs (as in *Cassia nodosa*), but general new leaf growth, which is very rapid when it does occur, is deferred until practically all old

leaves are gone. The dates given are for the occurrence of general new leaf growth, and are therefore less precise than those given for some other trees.

An isolated observation of this tree was made in 1929; continuous records date from 1934. The gap in observations is exactly four times the mean period for 1934–1940. For the years 1934–1940, the standard deviation is below 10%, so it is fairly clear that this is a tree with a period of more than 12 months. A few seedlings have now been obtained from it, and their development will be watched with interest. The following are the observed dates of general leaf-renewal.

<i>Months</i>				<i>Months</i>			
25.8.29	..	..	—	26.9.37	..	..	14.5
23.5.34	..	4	× 14.2	1.1.39	..	..	15.2
19.6.35	..	..	12.9	22.4.40	..	..	15.7
12.7.36	..	..	12.8				

For the years 1934–1940 (5 periods) we have:—

Mean period: 14.2 months.

Standard deviation: 1.2 months or 8.5%.

### **Canarium rufum** Benn.

This local tree has been under observation only since 1935. It appears to have a 12-month period. It is on the edge of the Gardens jungle, growing under good conditions. Leaf-fall is rather sudden, and leaf-renewal takes place as soon as the tree is bare. New leaf buds have opened on the following dates.

<i>Months</i>					
1.5.35	..	..	—	Mean leaf-period:	12.0 months.
20.5.36	..	..	12.6	Standard deviation:	.65 month
4.6.37	..	..	12.5	or	5.4%.
20.4.39	..	2	× 11.3	Mean date:	9 May.
30.4.40	..	..	12.3		

### **Cassia fistula** L.

The two trees mentioned in 1931 have been under observation since that time, and also a third tree. The two former trees have latterly both shown signs of lack of vigour, but the third tree is very vigorous and has flowered heavily on all occasions. As noted previously, it is not easy to fix an exact date for leaf-renewal of trees of this species; the dates are therefore subject to a greater margin of error than most of the other observations recorded in this paper. The tree B showed such a slow change that no observations on it were made after 1935. A fourth tree lately brought under observation near the others has had one period of 10.6 months.

Two exceptionally large and vigorous trees at Government House, Singapore, have renewed their leaves and flowered in May or June in the following years: 1928, 1931,

1938, 1939. It seems likely that these trees have a period very nearly of 12 months. It is evident therefore that observations on further trees are desirable.

The dates of leaf-renewal of the three trees for which the longest observations are available, with other data, are as follows:

A		B		C	
	Months		Months		Months
11.12.27	.. —	8. 3.28	.. —	11.12.27	.. —
11. 9.28	.. 9.0	13. 1.29	.. 10.2	28.10.28	.. 10.6
1. 6.29	.. 8.7	24.11.29	.. 10.4	22. 2.31	3 × 9.3
1. 3.30	.. 9.0	10. 9.30	.. 9.6	13.12.31	.. 9.7
1.12.30	.. 9.0	25. 5.31	.. 8.5	27. 8.32	.. 8.4
29. 8.31	.. 8.9	8. 5.32	.. 11.5	28. 6.33	.. 10.0
8. 5.32	.. 8.3	16. 5.33	.. 12.3	Mar. 1935	2 × 10.5
1. 3.33	.. 9.8	10. 3.35	2 × 10.9	10. 1.36	.. 10.
29. 3.35	3 × 8.3	Mean period:	10.5	4.10.36	.. 8.8
26. 2.36	.. 10.9	months.		28. 6.37	.. 8.7
early		Standard deviation:		May 1938	.. 10.
Jan. 1937	.. 10.5	1.26 months or 12.0%.		26. 2.39	.. 9.
Oct. 1937	.. 9.5			Mean period:	9.6
5. 4.39	2 × 9.0			months.	
Mean period:	9.1			Extremes:	8.4 and
months.				10.6 months.	
Extremes:	8.3 and			Standard deviation:	
10.9 months.				.84 month or 8.7%.	
Standard deviation:					
.93 month or 10.2%.					

### Cassia nodosa Buch.-Ham.

The tree mentioned in 1931 continued its leaf-renewals after slow and prolonged leaf-fall in the early part of the year, tending to become earlier each year up to 1935, for which the date recorded is 10 March. The dates given are for general new growth of leaf buds, and are usually about a month later than the first new buds which develop here and there on small branches in advance of the remainder of the tree. The standard deviation for this period is remarkably low.

Then in December, 1935, possibly as a result of the rather dry period from July to October, about  $\frac{3}{4}$  of the branches on the tree produced new leaves. The remaining branches did not bear new leaves until March, 1936. The branches which had new growth in December, 1935 renewed their leaves again in July, 1936. In April, 1937 all branches renewed their leaves.

This tree is said to have been produced from a seed from Pahang, where the species is common, and leaf-renewal with flowering is general about May. It appears likely that the more uniform climate of Singapore has allowed our tree to show a tendency to instability or to sensitiveness to climatic changes. A number of young trees of this species have lately been planted, and their behaviour will

be watched with interest. Data for the period 1928-1935 are given below.

			Months	
28.5.28	..	..	—	
15.5.29	..	..	12.1	
15.4.30	..	..	11.0	Mean period: 11.7 months.
12.4.31	..	..	11.9	Extremes: 11.0 and 12.1 months.
16.4.32	..	..	12.1	Standard deviation: .4 month
9.4.33	..	..	11.8	or 3.4%.
20.3.34	..	..	11.4	
10.3.35	..	..	11.7	

### Cedrela Glaziovii C. DC.

The trees of this species were wrongly ascribed to *C. toona* in my 1931 paper. These two trees have been under observation since that time and have shown a remarkable difference in behaviour. Both are tall vigorous trees growing near together under good soil conditions. They behave alike in their slow leaf-fall, from the top downwards, and the appearance of new leaves first on the top branches after the whole tree is bare. One tree has had a mean leaf-period of 12.5 months, advancing its time of leaf-fall from July to December during the period under review, with a very small standard deviation. For the first few years it appeared likely that this tree had a period of exactly 12 months, but it now seems more likely that there is a significant departure from this figure.

The other tree has shown less regularity (though its coefficient of variation is only 12%), and has throughout had leaf-periods decidedly more than 12 months, with a mean of 14.0. Most of the periods have been 13 to 14 months, but one was 17.7. This long period included the whole of 1932, the driest year in the period 1927-38. For other cases of difference of behaviour between trees of the same species, see *Ficus variegata*, *Hevea* and *Peltophorum*.

The following table shows how one tree had ten leaf-periods and the other only nine, in the same period of years.

			Months		Months
8. 7.28	..	..	—	Aug. 1928	.. .. —
4. 8.29	..	..	12.9	Sept. 1929	.. .. 13.
30. 7.30	..	..	11.9	end Sept. 1930	.. .. 12.5
1. 8.31	..	..	12.0	13.12.31	.. .. 14.7
9. 8.32	..	..	12.3	4. 6.33	.. .. 17.7
13. 8.33	..	..	12.1	July 1934	.. .. 13.
10. 8.34	..	..	11.9	12. 8.35	.. .. 13.
10. 8.35	..	..	12.0	Oct. 1936	.. .. 14.
12. 9.36	..	..	13.1	end Oct. 1937	.. .. 12.5
12. 9.37	..	..	12.0	2.12.38	.. .. 13.1
17.10.38	..	..	13.2	19. 4.40	.. .. 16.6
15.12.39	..	..	14.0	10 periods:	mean period 14.0
11 periods:	mean period 12.5			months.	
Extremes:	11.9 and 14.0 months.			Extremes:	12.5 and 17.7 months.
Standard deviation:	.70 month			Standard deviation:	1.7 months
or 5.6%.				or 12.1%.	



***Ceiba pentandra* (L.) var. *caribaea* (DC) Bakh.**

A tree of this variety (the West Indian Kapok), received as a stump from Buitenzorg and planted in October 1933, has shown a six-month leaf-period since 1936. The new leaves appear before the old have quite fallen; the change was very gradual in September, 1938 and March, 1939. Observed dates (incomplete) of new leaf production were:

8. 4.36	Sept. 1938
27.10.36	March 1939
25. 4.37	March 1940
15.10.37	Sept. 1940

Another tree of the same origin, planted at another place but at the same time, renewed its leaves on 28th December, 1936, 1st June, 1937, 9th February, 1939 and 26th July, 1939. It has thus shown a similar six-month period, but has changed its leaves at different times from the first tree. The reason is probably that this tree was cultivated and manured some time after planting (the first tree has never had such treatment), but the date of this treatment was not recorded. For a similar case, see *Kigelia*.

A seedling raised from seed from the Gold Coast has also shown a six-month period. *Ceiba pentandra* in Java has a twelve-month period. Possibly these young trees will lengthen their period as they grow older.

***Couroupita guianensis* Aubl.**

An old tree of this species was reported as having three six-month periods in 1929-1931. A record over 16 periods is here presented, the average being still exactly six months and the standard deviation identical with that of the tree of the local species *Peltophorum pterocarpum*. Leaf-fall is very rapid, and also leaf-renewal; the dates given are therefore closely comparable. The tree is only bare for a day or two.

A young tree, planted in 1925 in a thicket among other trees which restricted its growth, did not behave at all regularly at first, but it appears to be settling down to a more regular rhythm as it grows older; it now has its crown clear of other trees and is growing more vigorously, but has not yet begun to flower. It does not change its leaves at the same time as the old tree.

In *De Tropische Natuur*, XXIII (1934), p. 244, it is recorded that the *Couroupita* trees at Buitenzorg change their leaves in March-April and September-October, thus

agreeing with the old Singapore tree. Mr. Ahmadi, Superintendent, Municipal Gardens, Bombay, informs me that the Couroupita trees in the Victoria Gardens, Bombay, change their leaves regularly in March and October. This regularity of behaviour in such different climates is remarkable.

The observed dates of leaf-renewal of the young tree in Singapore were as follows:

<i>Months</i>				<i>Months</i>			
19. 4.32	..	..	—	9. 7.36	..	..	7.9
7. 1.35	..	..	8.5	25. 1.37	..	..	6.5
27. 1.34	..	..	12.7	20. 7.37	..	..	5.9
23. 5.35	..	2	× 7.9 ?	15. 8.39	..	4	× 6.2 ?
13.11.35	..	..	5.7	22. 2.40	..	..	6.2
				18. 8.40	..	..	5.9

The data for the old Singapore tree are as follows.

<i>Months</i>				<i>Months</i>			
15. 9.29	..	..	—	8. 9.33	..	..	5.6
23. 3.30	..	..	6.3	19. 3.34	..	..	6.4
16. 9.30	..	..	5.8	7. 9.34	..	..	5.6
22. 3.32	..	..	6.1	12. 3.35	..	..	6.2
18. 9.31	..	..	5.9	15. 9.35	..	..	6.1
5. 3.32	..	..	5.6	25. 3.36	..	..	6.3
10. 9.32	..	..	6.2	5.10.36	..	..	6.4
19. 3.33	..	..	6.3	17. 4.37	..	..	6.4
				12. 9.37	..	..	4.8

16 periods.

Mean period: 6.0 months.

Extremes: 4.8 and 6.4 months.

Standard deviation: .43 month or 7.2%.

Mean dates: 15 March and 20 September.

### **Cratoxylon formosum** (Jack) Dyer.

Two trees of this species, in different parts of the Botanic Gardens, Singapore, have been kept under observation from 1927 onwards. As shown below, their periods have been closely similar, and on the whole very regular, averaging about 9 months, but the trees are quite apart in their dates of leaf-renewal. The behaviour of these trees is in my opinion one of the most remarkable examples in the series of observations recorded in this paper.

A tree of this species in the Waterfall Gardens, Penang, has been noted by me during visits in January and February 1931, 1932, 1933, 1935, 1936, 1937 and 1939. In each of these years the tree has renewed its leaves about the end of January (*i.e.* in the dry season). It is possible of course that this species is one that varies considerably in its leaf-periods from tree to tree, but the difference of behaviour in the seasonal climate of Penang seems to me likely to be significant.

The dates of leaf renewal of the Singapore trees have been as follows.

A			B		
		Months			Months
1.	9.27	.. .. —	6.	2.28	.. .. —
10.	6.28	.. .. 9.3	21.	10.28	.. .. 8.5
17.	3.29	.. .. 9.2	30.	6.29	.. .. 8.3
23.	2.30	.. .. 11.2	7.	4.30	.. .. 9.2
27.	9.30	.. .. 7.2	12.	1.31	.. .. 9.2
1.	8.31	.. .. 10.1	11.	10.31	.. .. 9.0
1.	4.32	.. .. 8.0	3.	8.32	.. .. 9.7
11.	12.32	.. .. 8.3	16.	4.33	.. .. 8.4
13.	9.33	.. .. 9.1	1.	2.34	.. .. 9.5
end June	1934	.. .. 9.4	30.	12.34	.. .. 10.9
25.	3.35	.. .. 9.0	12.	9.35	.. .. 8.5
16.	11.35	.. .. 7.7	26.	5.36	.. .. 8.5
20.	9.36	.. .. 10.1	8.	3.37	.. .. 9.4
19.	7.37	.. .. 10.0	2.	10.38	.. 2 × 9.4
8.	3.39	.. 2 × 9.9	10.	7.39	.. .. 9.3
Mean period: 9.1 months.			Mean period: 9.1 months.		
Extremes: 7.2 and 11.2 months.			Extremes: 8.3 and 10.9 months.		
Standard deviation: 1.09 month or 12.0%.			Standard deviation: .74 month or 8.1%.		

### *Delonix regia* (Boj.) Raf. (*Poinciana regia* Boj.).

An old tree of this species was under observation between 1928 and 1936, over eleven leaf-periods. As noted in my earlier paper, leaf-renewal is slow, and it is impossible to give accurate dates, or dates which are strictly comparable from one leaf-period to another. It is however evident that the mean period of the tree is in the neighbourhood of 9 months. After a lapse of 3 years without observations the tree was noted as in new leaf in June, 1939, which agrees with the last observations of July, 1936 (4 periods of 8.8 months occupying 2 years 11 months).

Trees of *Delonix regia* are commonly planted in Singapore, but even those planted simultaneously do not always keep in step together. It takes them a few years to develop a regular leaf rhythm, and this may perhaps change gradually with the age of the tree. Observations on this point, made on a group of young trees planted together, would be of great interest. It would be necessary however to treat all trees alike as regards cultivation (*see Kigelia*).

As noted in my earlier paper, some *Delonix* trees may be seen in flower at any time of the year in Singapore, but it appears that at some seasons flowering is more abundant than at others. Possibly the climatic conditions at the time when flower buds are produced may be responsible for this; *i.e.* it may be that trees which are bare during wet weather produce fewer flower-buds than those which are bare during dry weather. There is however no proof of this. At

Penang a *Delonix* tree renewed its leaves in January, 1931, 1932 and 1933. Further Penang records are desirable. The Singapore tree has renewed its leaves as follows.

		Months			Months
24. 6.28	.. ..	—	Jan. 1933	.. ..	10.
30. 3.29	.. ..	9.2	Aug. 1933	.. ..	8.
22.12.29	.. ..	8.7	Mar.-Ap. 1934	.. ..	8
10.11.30	.. ..	10.6	Jan. 1935	.. ..	8
1. 7.31	.. ..	7.7	Sept.-Oct. 1935	.. ..	8
March 1932	.. ..	8.	July 1936	.. ..	9
Mean period: 8.8 month.					
Standard deviation: .94 month or 10.7%.					

### *Dyera costulata* Hook. fil.

As reported in 1931, two trees of this species have been under observation. Leaf-renewal tends to be at rather irregular intervals, somewhat as in *Hevea*. On the big tree, which has two main trunks, leaves are sometimes renewed on a few branches only, or on one main branch system, between general renewals. New leaf growth occurring in the wet season (October, November) has in all cases preceded fall of the old leaves; at other times the old leaves have fallen before the new leaves began to unfold.

The big tree has had complete leaf-changes at intervals of from 3 to 11 months, sometimes with partial changes in between. Out of the 18 such periods, 9 have been about 6 months, 4 considerably less than 6, and 5 considerably more. A comparison with rainfall records indicates that there is some tendency for leaf-fall to follow dry weather; but this does not invariably occur. As above remarked, new leaves sometimes appear before the old leaves have fallen; in four such cases (all those noted) the period since the preceding leaf-fall was almost exactly six months. In other cases, under apparently similar conditions, no leaf-renewal has been recorded, and the old leaves appear to have persisted for 10 or 11 months (1931-32, 1934-35 and 1938-39). Where new leaves appear before leaf-fall, the old leaves are always shed within about two weeks following.

The smaller tree under observation (with one trunk) has changed its leaves rather regularly each year about March-June. In 3 years (1928, 1929, 1932) it has also changed again about six months later, but so far as my observations go, this has not occurred in other years. Taking only the changes in March to June, the mean period is 12.3 months, and the standard deviation .84 month (6.8%). This tree also occasionally produces new leaves on a few branches without a general renewal. When new leaf growth was general in November, 1932 it was not preceded by leaf fall.



Dyera trees are fairly frequent in the Gardens Jungle, and they tend to change their leaves at the same time, though they do not always behave alike. The two trees under observation have changed their leaves simultaneously (or approximately so) on the majority of occasions, but on others have been curiously diverse in behaviour. The following are dates of general changes only.

<i>Large Tree</i>				<i>Small Tree</i>			
<i>Months</i>				<i>Months</i>			
6.	9.27	..	—	17.	3.28	..	—
17.	3.28	..	6.4	11.	9.28	..	5.7
14.	6.28	..	2.9	14.	4.29	..	7.1 12.9
6.	4.29	..	9.7	3.11.29	..	..	6.7
20.10.29	..	..	6.5	25.	5.30	..	6.7 13.3
25.	5.30	..	7.2	1.	6.31	..	12.2
1.10.30	..	..	4.2	22.	5.32	..	11.7
2.	6.31	..	8.0	3.11.32	..	..	5.4
12.	4.32	..	10.3	21.	4.33	..	5.6 11.0
20.10.32	..	..	6.3	21.	5.34	..	13.0
7.	8.33	..	9.5	25.	4.35	..	11.1
21.	5.34	..	9.5	4.	5.36	..	12.3
3.	5.35	..	11.4	14.	5.37	..	12.3
9.11.35	..	..	6.2	23.	6.38	..	13.3
31.	5.36	..	6.7				
3.12.36	..	..	6.1				
3.	6.37	..	6.0				
25.	9.37	..	3.7				
23.	6.38	..	8.9				

### *Erythrina lithosperma* Miq.

Trees of this species in Singapore are remarkably constant in flowering in December and January, towards the end of the wet season. The trees are not deciduous, but this flowering appears to be connected with new vegetative growth which takes place early in the wet season, the onset of which is rather regular about October. I have no full record of the behaviour of one of these trees throughout the year, and only enter this observation here as the flowering of *Erythrina lithosperma* is one of the most regular seasonal phenomena in Singapore. The trees are not very showy nor abundant.

### *Fagraea fragrans* Roxb.

As reported in this Bulletin, Vol. IX pp. 73-78 (1935), trees of this species, which are abundant in Singapore, flower gregariously about May every year. The trees are evergreen, and their vegetative growth is practically continuous, but their flowering is such a regular phenomenon that it should be mentioned here. The height of the flowering period, which lasts about 2-3 weeks, occurs

approximately four months after the end of the wet season, when the first dry period occurs. A week of dry weather, with no more than about .1 inch of rain, following much wetter weather, appears to stimulate the formation of flower buds. Fruits ripen about  $3\frac{1}{2}$  months after flowering. There tends to be a small flowering about October–November, but this is irregular, and a few flowers may occur on isolated trees also at other times, but no general flowering of all trees.

### *Ficus caulocarpa* Miq.

The tree reported upon in 1931 (under the name *F. glabella*) has been under observation since that time and has renewed its leaves three times each year, except 1935 and perhaps 1938, in which it changed four times. The causes of the length of the individual periods are doubtless complex, but it is fairly clear in a few instances that distribution of rainfall has had an influence. 1931 was a very wet year, and the long leaf-period was longer than usual; this was probably the cause of an unusually late first change in 1932. In 1934 December was unusually dry, and this probably accelerated the first change in 1935; but why the next period should have been so very short is not at all clear. In several years there is a definite succession of periods, approximately to 3, 4 and 5 months, but in other years this succession is much less distinct. The mean dates of leaf renewal (1928–37), are 12 February, 9 June and 8 November (giving intervals of 96, 117 and 152 days), the standard deviations being 19, 22 and 17 days; these deviations are distinctly high as compared with those shown by most of the deciduous trees here reported.

The amount of rain falling during a leaf-period bears no relation to the length of the period; I have also compared the rainfall from 14 days before the end of one period to 14 days before the end of the next, but this also shows no correlation with length of period.

Another younger tree, about a mile away, was under observation for a time, but probably not all changes were observed. Leaf-renewal dates were noted for this tree on 7 occasions between November, 1934 and June, 1937. The differences in time between the nearest leaf-renewals of the Gardens tree were 13, 23, 33, 32, 15, 13 and 53 days.

A young plant of the same species, which had started epiphytic growth on an old tree in the Gardens, changed its leaves once simultaneously with the large tree, but on two other occasions at times 40 and 41 days different.

It thus appears probable that the factors controlling leaf-fall and leaf-renewal in this species are complex and

vary from tree to tree. They are certainly not simply related to climatic conditions. It is possible that fruiting may influence the length of leaf-period; it seems to be rather infrequent, and the small figs are not easily observed on the high branches of the Gardens tree. Unfortunately I have no records of fruiting.

The dates of leaf-renewal observed are as follows:—

1927					15 Oct.
1928	..	..	29 Jan.	3 June	4 Nov.
1929	..	..	3 Feb.	17 May	20 Oct.
1930	..	..	23 Jan.	8 June	11 Nov.
1931	..	..	10 Feb.	28 June	2 Dec.
1932	..	..	12 March	1 July	9 Nov.
1933	..	..	16 Feb.	3 July	29 Oct.
1934	..	..	3 Feb.	19 May	2 Nov.
1935	..	..	20 Jan.	7 April	14 July
1936	..	..	24 March	10 July	30 Nov.
1937	..	..	17 Feb.	27 May	20 Oct.
1938	..	..	unrecorded		20 Aug.
1939	..	..	24 April	27 June	2 Sept.
1940	..	..	25 Jan.	13 June	31 Dec.

### *Ficus variegata* Bl.

This is a common species in Singapore, and seedlings are abundant in the Botanic Gardens. A tree was mentioned in my 1931 paper under the name *F. polysyce*.

This tree appeared at first to have a period of six months, but later proved to have a rather longer period, showing an average of 6.5 months, with standard deviation of .84 or 12.9%. Its most peculiar behaviour was in 1932, when, having renewed its leaves in March, it persisted until November with the next crop of leaves, and then changed again in June 1933, the only leaf-renewal in that year.

A second tree, observed (with two gaps) from 1929 to 1939 was rather less regular, as shown below. Two other trees, observed only from 1932 and 1933, have shown greater regularity, with a less tendency so far to exceed a six months average. Mr. Corner has pointed out to me that the first mentioned tree is a male tree (figs contain male and gall flowers only) and one of the last two trees is female.

It was mentioned in 1931 that the male tree bore six crops of fruits in a year. The females trees under observation bear less frequent fruit crops (3 to 4 in a year), but in neither case could any relation between fruiting and leaf change be noted. The trees are cauliflorous, belonging to the subgenus *Neomorphe*. (For further information on this species, see Corner's paper in Journ. Malayan Branch

R. Asiatic Soc. XI: 48-52. 1933). The dates of leaf-renewal of the four trees and their leaf-periods in months are as follows:—

A				B			
			Months				Months
12. 8.28	..	..	—	25. 8.29	..	..	—
6. 1.29	..	..	4.8	2. 3.30	..	..	6.2
14. 7.29	..	..	6.3	7. 4.31	..	2 ×	6.6
7. 2.30	..	..	6.7	Oct. 1931	..	..	6.
5. 8.30	..	..	6.0	22. 5.32	..	..	7.
8. 2.31	..	..	6.1	23.10.32	..	..	5.0
20. 8.31	..	..	6.4	Feb. 1933	..	..	4.
6. 3.32	..	..	6.5	27. 8.33	..	..	6.
Nov. 1932	..	..	8.	4. 3.34	..	..	6.2
11. 6.33	..	..	7.	18. 9.34	..	..	6.5
26. 1.34	..	..	7.5	31. 3.35	..	..	6.4
6. 9.34	..	..	7.3	Nov. 1935	..	..	7.
15. 3.35	..	..	6.3	June 1936	..	..	7.
Oct. 1935	..	..	7.	20.11.36	..	..	5.
April 1936	..	..	6.	1. 6.37	..	..	6.4
30.10.36	..	..	6.	13.12.38	..	3 ×	6.1
12. 5.37	..	..	6.4	June 1939	..	..	6.
11.10.38	..	3 ×	5.7				
11. 5.39	..	..	7.0				
C				D			
			Months				Months
21. 1.33	..	..	—	9. 8.32	..	..	—
25. 1.34	..	2 ×	6.1	14. 1.33	..	..	5.2
15. 8.34	..	..	6.5	Feb. 1934	..	2 ×	6.5
22. 1.35	..	..	5.2	21. 8.34	..	..	6.
19. 7.35	..	..	6.0	18. 2.35	..	..	6.
11. 2.36	..	..	6.8	6. 8.35	..	..	5.6
Sept. 1936	..	..	7.	22. 3.36	..	..	7.5
March 1937	..	..	6.	Sept. 1936	..	..	6.
end Aug. 1937	..	..	5.	30. 3.37	..	..	6.
				end Sept. 1937	..	..	6.
				30. 9.38	..	2 ×	6.
				13. 3.39	..	..	5.4

Mean periods: A, 6.5; B, 6.4; C, 6.1; D, 6.1 months.

Standard deviations: A, .84; B, .85; C, .65; D, .62 month.

Coefficients of variation: A, 12.9%; B, 13.3%; C, 10.7%; D, 10.1%.

### *Heritiera elata* Ridl.

A record of a leaf-period of nearly two years for a tree of this species was reported in my former paper. Subsequently there was a gap of four years in observations, and then three more periods, successively of 17, 22 and 20 months were recorded. The tree is usually not bare before new leaf-growth occurs; the new growth is conspicuous because of its pale colour. Flowering occurs on the old wood, usually during the period of new growth, but may perhaps (as with *H. macrophylla*) occur at other times. The tree is a very tall one, remaining from primitive forest. A young tree, about 100 yards away, was observed to make new growth at the same time as the old tree in 1940.



The periods seem rather unequal in length, but the standard deviation is not excessive as compared with other trees. All recorded cases of leaf-renewal have occurred after unusually dry periods. This tree is probably one with a naturally long leaf-period (though the period is less than that of *H. macrophylla*) which is rather much influenced by climatic change occurring towards the end of its normal leaf-period. Observations of leaf-renewal are as follows.

				Months					Months
17.	3.29	..	..	—	March 1935	..	..	—	
19.	2.31	..	..	23	Aug. 1936	..	..	17	
					1. 6.38	..	..	22	
					31. 1.40	..	..	20	
Mean period: 20.5 months.									
Standard deviation: 2.6 months or 12.7%.									

### *Heritiera macrophylla* Wall.

A small but quite vigorous tree of this species, which is native in Burma has been under observation since March 1929. It has an exceptionally long leaf-period, more than 2½ years on four successive occasions. Leaf-fall is prolonged over perhaps two months or more, at first slow, then progressively more rapid. Leaf-renewal is quite rapid, and is complete in a few weeks. In one case leaf-renewal took place on one branch after another over a period of six months instead of on all branches together.

It is notable that the Malayan species *H. elata* also has a long leaf-period. It would be interesting to have records of the widely distributed coastal tree *H. littoralis*; also to know something about the behaviour of *H. macrophylla* in its native climate.

The dates of leaf-renewal of the tree of *H. macrophylla*, and lengths of leaf-periods, are as follows.

				Months				
30.	3.29	..	..	..	—			
	10.12.31	..	..	..	32			
	14. 7.34	to	Jan. 1935	..	31	(to 37 months)		
	18. 2.37	..	..	..	31			
	30.11.39	..	..	..	33.4			

### *Hevea braziliensis* Muell.-Arg.

The four trees mentioned in my earlier paper have been kept under observation since that time. Three of them illustrate the usual behaviour of *Hevea* trees in Singapore, namely response to dry weather whenever it comes, and consequent irregularity of leaf-renewal. The two larger trees have sometimes changed their leaves completely at the same time; sometimes a complete change

by one tree has been accompanied by a partial change in the other. The summary, printed below, though incomplete, gives a sufficient record to illustrate their behaviour.

One of the young budded trees, recorded in the previous paper as never undergoing a complete leaf change, but always changing leaves on a branch (or a few branches) at a time, continued to behave in the same way for some time afterwards. It was later once observed to change all its leaves simultaneously, but no full records have been kept. It may show a greater tendency to complete change as it grows older.

The other young budded tree, reported in 1931 as having renewed its leaves completely three times, has consistently continued this habit, with a period which appears to be significantly more than 12 months, the mean for nine periods being 13.3 months, with standard deviation of only 6.5%. The leaves of this tree are small, and it may be a morphologically distinct variety.

It is interesting to compare these observations with those of Schweizer (*Mitt. der Naturforsch. Ges. Bern*, 1932, pp. 1-8) at Djambi in Java, where there is a regular dry season. Leaf change of the Hevea trees at Djambi is related to the onset of the dry season, but some trees are always earlier or later than others in leaf-renewal. Characters of earliness or lateness are shared by all trees of the same clone. One tree was found to change its leaves frequently, a branch at a time; after manuring with Ammonium sulphate, the leaves all fell together, rather late, at the next dry season, but after two years the tree resumed its irregular habit.

Schweizer defoliated certain trees (the behaviour of which had been previously recorded) at various times in relation to the season of leaf-change. If the trees were defoliated more than 5 months before normal leaf-change, they produced new growth and the next change occurred at the usual time. If defoliation was carried out only 2-3 months before the date of normal leaf-fall, the subsequent leaves remained on the tree up to 3 months after the usual date of change. That is, the minimum life of Hevea leaves appears to be 4-5 months.

In Singapore, dry weather is irregular in its occurrence (*see* introductory remarks in this paper) and it seems probable that any dry period will affect some Hevea trees which have leaves more than 4-5 months old. If the dry weather is severe, all the leaves on the tree may fall; if not severe, only the oldest leaves. As there are few budded

trees in Singapore, the behaviour of the trees is very irregular, and after every dry period some trees may be seen with autumn colours or bare branches.

For other examples of irregular leaf-change, see *Sterculia carthaginensis* and *Mangifera indica*.

The single regular tree has shown the following succession of leaf-periods.

				<i>Months</i>				<i>Months</i>	
22. 7.28	..	..	—	25. 2.34	..	..	15.0		
1. 9.29	..	..	13.3	20. 3.35	..	..	12.8		
22. 9.30	..	..	12.7	April 1936	..	..	13.		
27. 9.31	..	..	12.2	7. 5.37	..	..	13.		
27.11.32	..	..	14.0	8. 7.38	..	..	14.0		
Mean period: 13.3 months.									
Extremes: 12.2 and 15 months.									
Standard deviation: .86 month or 6.5%.									

Partial or complete (full) changes of leaves of the two large irregular trees were observed as follows:

				<i>Tree M</i>		<i>Tree W</i>	
1927	..	..	Nov.	part	Aug.	full	
1928	..	..	..	..	March	part	
1928	..	..	Aug.	full	Aug.	part	
1929	..	..	April	part	March	full	
			Sept.	part			
1930	..	..	March	full	March	full	
1931	..	..	May	part	July	full	
			Aug.	part			
1932	..	..	March	full	unrecorded		
			Oct.	part			
1933	..	..	Feb.	full	Jan.	full	
			Aug.	full			
1934	..	..	unrecorded		unrecorded		
1935	..	..	Feb.	full			
			Oct.	full	Oct.	full	
1936	..	..	Aug.	part	unrecorded		
1937	..	..	March	full	March	full	

### *Homalium grandiflorum* Benth.

A tree of this species, which is native from Tenasserim southwards, has been under observation from 1932 to 1939, all leaf-changes except one having been observed. It will be seen that all periods were more than a year, the shortest being 12.5 months; one period of 17.5 months was however much longer than the others. It is not obvious why this very long period should have occurred. 1934 was a wet year (115 inches), but April, May and June, when leaf-fall might have been expected, were the driest months. Leaf-renewal took place after only 12.6 months on 30 December, 1936, though October and November had been wet months.

This tree flowers very rarely, with the new leaves.

Only one flowering was observed in the period under review. The observed dates of leaf-renewal are as follows:—

			<i>Months</i>				<i>Months</i>
8. 2.32	..	..	—	3.12.36	..	..	12.6
5. 4.33	..	..	12.9	18. 2.39	..	2 ×	13.3
20. 9.34	..	..	17.5	6. 3.40	..	..	12.6
14.11.35	..	..	12.8				
Mean period: 13.7 months.							
Standard deviation: 1.9 months, or 13.9%.							

### *Hymenaea courbaril* L.

A fine tree of this West Indian species has been under observation since 1927 and was reported upon in my earlier paper. It is never bare of leaves, but it has produced new leaves regularly every year in January or February, simultaneously with the fall of the old leaves. Flowering follows, at the end of the new growth, in May or early June, and the fruits ripen and fall towards the end of the year. Exact dates are difficult to record with this tree, as new growth often begins on one branch and gradually spreads; but the tree is undoubtedly very regular in behaviour. There are indications that early or late ending of the wet season influence the time of leaf-renewal. Thus in 1928 wet weather persisted until February and new leaf-growth was not observed until 19th February. In 1930 new growth was observed on 12th January, following a dry December. In 1931 January was wet throughout, and the first new leaves were seen on 22nd February.

It is evident however that all trees of this species do not behave alike. In 1931 I reported on a tree that had flushes of new leaves on various branches in turn throughout the year, though occasionally renewing its leaves almost entirely at about the same time as the first tree. A third tree has since been noticed, which renewed its leaves in September 1935 and 1936. This tree renewed its leaves at the same time as the first, in February, 1940.

### *Kigelia pinnata* DC.

A tree of this African species, reported upon in 1931, has continued very regular in its behaviour, renewing its leaves rapidly in January or February each year, the mean date being 22nd January. As will be seen below, the standard deviation is very small; this is particularly significant, as the time of leaf-renewal is more sharply defined than in some other trees, and so the dates are more strictly comparable. Leaf-fall is complete within a fortnight, and



new growth usually begins just before the tree is bare. Flowering takes place on the old wood, sometimes just before leaf-fall, but more usually within two months afterwards. The flowers (which are open at night) are regularly visited by the local bats, but fruits are not set very freely.

A very interesting comparison of behaviour is provided by some young trees, raised from seeds obtained from Africa. These trees were planted out, as young seedlings, on 19th October, 1931. They dropped their leaves and made new growth, in November, 1932, November, 1933 and November, 1934. Then in March, 1935 they were dug and manured, and they made new growth in April, dropping the old leaves soon after. Leaf-fall and new growth subsequently took place in April, 1936 and April, 1937. This appears to indicate that the species tends to keep very accurately to a 12-month period, but that stimulus to root activity may induce premature new growth. Schweizer found that manuring of *Hevea* trees affected their subsequent leaf-fall and leaf renewal (see *Hevea brasiliensis*).

Though the first *Kigelia* tree has been very regular in its time of leaf-renewal, it has varied a little with the time of onset of drier weather after the wet season. Thus it was very early in January, 1935 after the unusually dry December, 1934.

				Months					Months
10.	2.29	..	..	—	14.	1.34	..	..	12.0
17.	2.30	..	..	12.2	5.	1.35	..	..	11.7
10.	2.31	..	..	11.8	13.	2.36	..	..	13.3
27.	1.32	..	..	11.5	5.	2.37	..	..	11.7
14.	1.33	..	..	11.4	15.	1.39	..	2 ×	11.7
Mean period: 11.9 months.									
Extremes: 11.4 and 13.3 months.									
Standard deviation: .57 month or 4.8%.									
Mean date: 28 January.									

### ***Koompassia malaccensis* Benth.**

An old tree of this species, remaining from former primitive forest, was reported in 1931 to have renewed its leaves in three successive years in the month of September. This regularity subsequently changed, leaf-renewal being deferred until 8 November in 1930. In that year August was exceptionally dry, but there was a good deal of rain from September onwards, and possibly this wet weather was the cause of deferred leaf-fall. The next year leaf-renewal took place in December; then in 1933 there was no leaf-change at all, the next being in March, 1934.

After that there are two gaps in observations, dates noted being 17 May, 1936, 8 July, 1938, 15 June, 1939 and 12 May, 1940.

The mean period for 12 periods has been 12·7 months and the standard deviation not abnormally large; but I think that the incidence of dry weather or rain has considerable influence. Thus, once leaf-fall became deferred from September into the wet season, it became later and later, extending to March in 1934 when January and February were both very wet. In 1936 February was dry, but March very wet. New leaf-change is likely to continue about June and July, when fairly dry weather is frequent, for some years. If it does so, the mean period of 12·7 months will be seen to be too high. The rather early change in 1940 was probably due to unusual dry weather early in the year.

There is another tree of this species, beside a road outside the Gardens, doubtless also a relic of the former forest, which appears to have shorter and less regular periods, but I have not adequate observations on this tree.

The dates of leaf renewal, and the intervening periods in months, are as follows:—

				<i>Months</i>					<i>Months</i>
17.	9.27	..	..	—	18.	3.34	..	..	14.8
11.	9.28	..	..	11.8	17.	5.36	..	2 ×	13.0
8.	9.29	..	..	11.9	8.	7.38	..	2 ×	12.9
21.	8.30	..	..	11.5	15.	6.39	..	..	11.2
8.	11.31	..	..	14.5	12.	5.40	..	..	10.9
25.	12.32	..	..	13.4					

12 periods.

Mean period: 12·7 months.

Extremes: 10.9 and 14.8 months.

Standard deviation: 1.36 months or 10.7%.

### *Lagerstrœmia flos-reginæ* Retz.

The same two trees mentioned in my earlier paper were kept under observation until 1937. The older tree continued to renew its leaves first on the lower branches. The early stages of growth of new shoots are very gradual and it is not easy to fix exactly comparable dates, even for the same branch. Part of the variation shown therefore may be due to this cause; but still it is not larger than in a number of others.

The smaller tree continued as before to change the north side at a different time from the south, though the matter was later somewhat complicated by the development of a small central part which was more or less intermediate. The origin of this behaviour can probably be traced to the fact that when the tree was first planted a larger tree stood near it on the north side, shading that side considerably. The north side of the tree, as shown in the table below,

had a somewhat longer average period and a somewhat greater standard deviation. The two sides were near together in 1927 (only a month apart) but the north side gradually lagged behind, at the end of 10 years being six months later than the south side.

A number of young trees of this species were planted out by one of the roads in Singapore about 10 years ago. At first most of these trees flowered about the same time, but later flowerings have shown increasing differences from tree to tree. It seems probable that each tree, according to its nature and surroundings, develops a fairly constant period of its own, and that there are small significant differences of period from tree to tree.

A tree in Penang renewed its leaves in 3 successive years in January or February. It is likely therefore that this species is sufficiently influenced by the regularity of climate at Penang to change its leaves at the dry season every year. Further observations on this point are now in progress.

The behaviour of the two Singapore trees is indicated by the following data:

<i>Smaller tree north side</i>			<i>Smaller tree south side</i>			<i>Old tree</i>		
Months			Months			Months		
20. 8.27	..	—	20. 7.27	..	—	3. 9.27	..	—
10. 6.28	..	9.7	12. 5.28	..	9.8	27. 5.28	..	8.8
21. 4.29	..	10.4	10. 3.29	..	10.0	10. 3.29	..	9.5
23. 2.30	..	10.1	17.11.29	..	8.2	17.11.29	..	8.2
25.11.30	..	9.	1. 9.30	..	9.4	29.10.30	..	11.4
6. 9.31	..	9.4	3. 5.31	..	8.1	15. 6.31	..	7.6
5. 6.32	..	9.0	12. 2.32	..	9.3	27. 3.32	..	9.4
12. 3.33	..	9.2	20.11.32	..	9.3	18.12.32	..	8.7
1. 1.34	..	8.6	30. 7.33	..	8.3	24.10.33	..	10.2
15. 4.35	2 ×	7.8	30.12.34	2 ×	8.5	15. 6.35	2 ×	9.8
20. 8.37	3 ×	9.4	8.10.35	..	9.3	24. 2.36	..	8.3
Mean period:	9.2		9. 7.36	..	9.0	Dec. 1936	..	9.5
months.			24. 2.37	..	7.5	Oct. 1937	..	10.
Standard deviation:	.88 months or 9.6%.		Mean period:	8.9		Mean period:	9.4	
			months.			months.		
			Standard deviation:	.77 months or 8.7%.		Extremes:	7.6 and	
							11.4 months.	
						Standard deviation:	.99 months or 10.5%.	

### *Lecythis* sp.

The tree of this species (probably *L. ollaria* L.) briefly reported upon in my previous paper has now completed 11 periods in almost exactly 11 years, with a standard deviation of only .71 month; it is thus one of the most regular trees

under observation. The fluctuations from year to year are not large, the longest period being 13.3 months and the shortest 11 months. I can see no correlation between rainfall records and these late or early leaf-changes.

The leaves of this tree turn rather bright yellow quite suddenly, and are all fallen in 2-3 weeks. New buds begin to open as soon as the tree is bare, or sometimes before all the old leaves have gone. The dates given are therefore closely comparable. This tree has never flowered, though it is fully mature.

A small tree, probably of the same species, planted near the former tree on 24th February, 1928, renewed its leaves about February 1931, 1932 and January, 1933. Subsequently it was dug and manured (no exact records kept) on more than one occasion and subsequent changes were irregular. It will now again be brought under observation.

The dates of leaf change of the older tree are as follows:—

			<i>Months</i>				<i>Months</i>
8.7.28	..	..	—	16.9.34	..	..	12.3
18.8.29	..	..	13.3	21.8.35	..	..	11.2
8.8.30	..	..	11.7	28.8.36	..	..	12.2
30.8.31	..	..	12.7	29.7.37	..	..	11.0
16.9.32	..	..	12.5	20.7.38	..	..	11.7
7.9.33	..	..	11.7	30.6.39	..	..	11.3

Mean period: 12.0 months.

Mean date: 11 August.

Standard deviation: .71 month or 5.9%.

### ***Mangifera foetida* Lour.**

A tree of this species grows beside my house and has been under observation since 1927 except during absences in 1930, 1934 and 1938. It is not deciduous but has presented a rather regular behaviour as regards leaf-renewal and is worth recording. When new growth occurs, each twig produces either new leaves or flowers, or both. In one case only new leaves were produced and then a general flowering occurred three months later; in another case a general growth of new leaves followed a month after a general flowering. The usual procedure however is for leaves and flowers to be produced simultaneously, and the records below are for such (except that of 20th April, 1935 when no flowers were produced). It will be seen that the tree is less regular than some of the deciduous



trees, but has a standard deviation of only 11.6%, thus indicating the probability of a leaf-renewal not altogether dependent on climatic factors. The old leaves do not fall immediately the new begin to develop, as in *Mangifera indica*; an inspection of the tree shows that on some twigs leaves persist for at least 2½ years, while on others less than 18 months. The actual dates of general leaf-renewal are as follows:

			Months				Months
23. 9.27	..	..	—	26. 2.33	..	..	9.7
24. 6.28	..	..	9.0	5.11.33	..	..	8.3
3. 2.29	..	..	7.4	20. 4.35	..	..	17.5
18. 8.29	..	..	6.5	27.12.35	..	..	8.2
23. 3.30	..	..	7.2	1. 8.36	..	..	7.1
6. 9.31	..	..	17.5	1. 4.37	..	..	8.0
5. 5.32	..	..	8.0	23. 9.38	..	..	17.7

Assuming 16 periods: mean period is 8.25 months.

Standard deviation: .96 month or 11.6%.

### *Mangifera indica* L.

The two trees by the lake in the Botanic Gardens, mentioned in my previous paper, were kept under observation until 1937. After 1930 the trees rarely changed their leaves completely, but usually changed on a group of branches at a time. Change, whether partial or complete, usually took place simultaneously on the two trees, but sometimes one tree had a partial change, while the other did not. Leaf-fall always accompanies leaf-renewal, and never precedes it, so that the trees are never bare.

Flowering is rare, having occurred three times only in 10 years. There may have been a few flowers at other times, but no general flowering. As in other countries, flowering appears to be quite independent of leaf change. Flowering follows dry weather, but not all dry periods produce flowering.

It appears that the leaves usually last 9 to 12 months, but may exceptionally last only 4 to 5 months on part of a tree. The case is evidently a complex one, and needs more careful observation. Though the behaviour of these trees may seem to be rather like that of Hevea, in the *Mangifera* leaf-renewal precedes leaf-fall, whereas the fall comes first in Hevea. This may mean a quite different mechanism of response to climatic change, but careful analysis of the behaviour of the trees is needed before we can be sure of this. *Mangifera* trees would be interesting subjects for experiment on the lines indicated by Schweizer.

The following table summarizes the behaviour of the two trees from 1928 to 1937. "Full" means a complete leaf-change, "part" means leaf-renewal on part of the tree only.

	<i>North tree</i>	<i>South tree</i>	<i>Flowering</i>
1928 ..	July, full	July, full	
1929 ..	June, full	June, full	3.2.29
1930 ..	March, full	May, full	
1931 ..	end May, part	end March, full	
	July, part	July, part	
1932 ..	April, part	April, part	
	Aug., part	Aug., part	
1933 ..	Feb., part	Feb., part	26.2.33
	Aug., nearly full	June, part	
		Aug., part	
1934 ..	no record	Nov., full	25.2.34
1935 ..	March, full	Aug., part	
	end Oct. part	Nov., part	
1936 ..	end March, almost full	end March, almost full	
		June, rest of tree	
		Sept., part	
1937 ..	Feb., part	April, part	
	April, part		

### *Parishia Maingayi* Hook. fil.

A tree of this species has been observed at leaf-change on five occasions, but not all consecutively. It appears probable however that the period is well over a year, in the neighbourhood of 15 or 16 months. I do not think it possible that the period is so short as half this, as the tree is in a fairly conspicuous place beside the potting shed at the Gardens, and though it was not on my regular list of trees, I could hardly fail to have observed it if it changed more frequently. It loses its leaves completely and stands bare for two weeks or more before leaf-renewal.

Herbarium specimens taken from the same tree prior to my observation of leaf-change indicate that the tree was flowering on the following dates: 25th April, 1923, 17th June, 1926 and 29th April, 1930. These specimens were probably taken about a month after the opening of the new leaf-buds. With this assumption, the dates in 1926 and 1930 agree with a leaf-period of about 15 months, but that of 1923 does not. The observed dates of leaf-renewal, and the estimated leaf-periods, are as follows:—

	<i>Months</i>	<i>Months</i>
20.10.32 .. ..	—	19. 5.39 .. 2 × 15.2
21. 7.35 .. 2 ×	16.5	10. 8.40 .. .. 14.7
10.11.36 .. ..	15.6	

Probable mean period: 15.6 months.

Standard deviation: .96 month or 6.2%.

**Parkia javanica** (Lam.) Merr.

The tree of this species mentioned (as *P. Roxburghii*) in my earlier paper has behaved in a more regular manner than any other of which records have been kept. Its inflorescences appear in September or October, after which leaf-fall begins slowly, being completed about the beginning of February, the fruits ripening at the same time. New leaf-growth begins after the tree has been bare for about a fortnight. The mean date of leaf-renewal is 23rd February, and the standard deviation only .24 month or 7 days.

A very fine old tree of the same species in another part of Singapore has been observed in 1931, 1932, 1935, 1936 and 1937 to renew its leaves in March, about a month later than the tree in the Gardens. The data for the Gardens tree are as follows:

Months				Months					
27.	2.28	..	..	—	4.	3.34	..	..	12.3
27.	2.29	..	..	12.0	20.	2.35	..	..	11.6
17.	2.30	..	..	11.7	23.	2.36	..	..	12.1
19.	2.31	..	..	12.1	15.	2.37	..	..	11.7
21.	2.32	..	..	12.1	1.	3.39	..	2 ×	12.2
23.	2.33	..	..	12.1					

Mean period: 12.0 months.

Mean date: 23 February.

Standard deviation: .24 month or 2.0%.

**Peltophorum pterocarpum** (DC.) Backer.

Two old trees of this species, mentioned in my earlier paper (as *P. ferrugineum*), have been regularly observed for 10 years, and have been very regular in their behaviour, the leaf-period averaging exactly six months, with standard deviation of less than half a month. The mean dates of 12th February and 10th August compare with 8th February and 11th August for *Terminalia catappa* over the same period.

The tree E mentioned in my earlier paper was evidently not in a vigorous state. Its leaf-changes were at rather long intervals (up to 9.5 months) and not at all regular. Observation of this tree was not continued.

The young tree F behaved much more regularly after the two short periods of 4.4 and 4.7 months in 1929–30. If the observations from 15th January, 1930 onwards are taken, the standard deviation is only .75 month or 11.0%, which is not excessive; I think the short periods were due to attack by caterpillars. Possibly the tree will approximate to 6 months as it grows older. Compare the behaviour of the young tree of Couroupita.

As noted in 1931, this species flowers at the end of the vegetative growth, the fruits ripening about the time of

leaf-fall or somewhat earlier. Flowering is sometimes absent, but this does not appear to affect the length of the leaf-period appreciably.

The behaviour of this species in Ceylon and Java is evidently irregular (*see* my 1931 paper, p. 201, references to Wright and Coster). When I was in Bombay in October 1937, I noticed that all the trees bore fruits, the result of flowering earlier in the year, and that most bore also some flowers, though not a full flowering; but there was no sign of new leaves. The Superintendent of the Victoria Gardens at Bombay kindly informs me that the trees lose their leaves gradually from December to February and produce new leaves in March. They thus renew their leaves once a year, in contrast to *Couroupita guianensis*, which changes twice a year both in Singapore and Bombay. I noted that the *Peltophorum* trees of Bombay were much taller than those I have seen in Malaya, though I could otherwise see no difference. It is possible that the Malayan trees belong to a distinct race with the peculiarity of a tendency to a short leaf-period.

<i>Two old trees</i>				<i>Tree F</i>			
			Months				Months
8.	1.28	..	—	1.	4.28	..	—
24.	6.28	..	5.5	11.11.28	..	..	7.3
3.	2.29	..	7.3	14.	4.29	..	4.1
21.	7.29	..	5.5	25.	8.29	..	4.4
30.	1.30	..	6.2	15.	1.30	..	4.7
8.	8.30	..	6.2	22.	7.30	..	6.2
4.	2.31	..	5.9	10.	3.31	..	7.5
23.	8.31	..	6.4	Nov. 1931	..	..	8.
28.	2.32	..	6.2	26.	6.32	..	7.5
11.	9.32	..	6.4	Feb. 1933	..	..	7.4
4.	3.33	..	5.8	17.	9.33	..	7.
26.	8.33	..	5.7	7.	1.35	2 ×	7.8
25.	2.34	..	6.0	20.	7.35	..	6.5
25.	8.34	..	6.0	1.	3.36	..	7.4
27.	2.35	..	6.1	2.10.36	..	..	7.0
22.	8.35	..	5.8	20.	4.37	..	6.6
21.	2.36	..	6.0	Mean period: 6.8 months.			
28.	8.36	..	6.2	Standard deviation: 1.27 months			
6.	2.37	..	5.3	or 18.7%.			
10.	8.37	..	6.1	Mean period from 15.1.30 on-			
13.	7.38	..	5.6	wards: 7.3 months.			
20.	2.39	..	7.2	Standard deviation: .75 month			
Mean period: 6.0 months.				or 11.0%.			
Standard deviation: .43 month							
or 7.2%.							
Mean dates: 12 Feb. and 10							
Aug.							

### *Pterocarpus indicus* Willd.

There is a note about this species in my former paper (p. 202). I have little further to add concerning the periodicity of leaf-change of trees in Singapore. They are



certainly less regular and less free-flowering than in the seasonal climate of Penang; and trees in Singapore tend to change their leaves a branch or more at a time, often taking weeks or months to renew their leaves on all branches. Flowering follows new leaf-growth, and the extent of flower-bud production is probably influenced by climatic factors. Trees of this species in any one locality show a remarkable gregarious flowering which has been little noted in botanical literature.

The inflorescences develop up to a stage when the flower buds are well grown, and then rest for a time; then all buds which have reached this stage will suddenly flower, often making a most spectacular display, lasting only a day. The next lot of buds will go through the same process, each inflorescence flowering usually in two or three stages. It is a remarkable sight in Penang to see many trees clothed almost all over with gold; the flowers are small, and in a full display do not show individually.

The stimulus causing all buds at the receptive stage to develop is undoubtedly a fall of temperature, as in other cases of gregarious flowering (notably of the common orchid *Dendrobium crumenatum*). It appears that three days only are needed from the stimulus to the opening of the flowers. The stimulus may be a sudden fall of about 10° F., such as often accompanies a storm during the heat of the day; or a cool day, in which the temperature does not rise appreciably above 80° F.

All cases of flowering recorded by me in Singapore in the year 1940 (21 occasions) have followed three days after one or other of these temperature conditions. The sudden fall of temperature has ranged from 7° to 15° F. The largest flowering of all followed three days after a day of very uniform cool temperature.

As an indication of the slow rate of leaf-change, and the dispersal of flowering of one tree over considerable periods, the following case is of interest. A tree near my house bore flowers on 21 separate occasions between 9th April and 20th July, 1940. Most of these were only small flowerings, only two involving any large part of the crown of the tree. In the previous year (1939) the same tree flowered on 8 occasions in August and September. The biggest general flowering of trees in Singapore in 1939 was in June, and in 1940 on 30th May.

### *Salmalia malabarica* (DC.) Schott & Endl.

The two trees reported on in 1931 (under the name *Bombax malabaricum*) have been kept under observation, and have continued to behave in a similar manner, the upper tree with a consistently longer period than the lower, as

shown below. The standard deviation of the tree with longer period (which is also the more vigorous of the two) is only .44 month; of the other tree .98 month. The trees always have a bare stage of 2-3 months irrespective of the time of year. Leaf-renewal has occurred in almost every month of the year.

It should be noted that these two trees are not growing under very favourable soil conditions and that their growth is poor. They will form interesting material for cultivation and manurial experiments (*see* remarks under *Kigelia*), which have now begun.

<i>Upper Tree</i>			<i>Lower Tree</i>		
	<i>Months</i>			<i>Months</i>	
30. 3.28	..	—	30. 3.28	..	—
17. 2.29	..	10.6	16.12.28	..	8.5
18.12.29	..	10.0	6.10.29	..	9.7
1.11.30	..	10.4	10. 6.30	..	8.1
4.10.31	..	11.1	3. 5.31	..	10.8
1. 8.32	..	9.9	6. 3.32	..	10.1
4. 6.33	..	10.1	1.12.32	..	8.9
1. 5.34	..	10.9	6. 8.33	..	8.2
7. 4.35	..	11.2	20. 4.34	..	8.5
16. 2.36	..	10.3	18. 3.35	..	10.9
21. 8.39	..	4 × 10.5	6.10.36	..	2 × 9.3
Mean period:	10.5 months.		15. 7.37	..	9.3
Extremes:	9.9 and 11.2 months.		Mean period:	9.3 months.	
Standard deviation:	(excluding 1936-39) .44 month or 4.2%.		Extremes:	8.2 and 10.9 months.	
			Standard deviation:	.98 month or 10.5%.	

### *Saraca taipingensis* Cantley.

A fine tree of this handsome Malayan species has been under observation for some years. The tree is evergreen, flowering on the old wood, independently of the production of new leaves. New leaves are produced in flushes at irregular intervals, but the old leaves do not immediately fall.

Though I cannot trace a definite connection between flowering and dry weather, it is fairly clear that flowering follows about a month or so after the beginning of a period of dry weather. The extent of the flowering naturally depends on how recently the tree flowered last. There are usually two fairly full flowerings in a year, and often small flowerings between. The flowerings recorded between 1927 and 1937 have been in the following months:—

January	..	Once	July	..	Once
February	..	Three times	August	..	Six times
March	..	Six times	September	..	Four times
April	..	Once	October	..	Twice
June	..	Once			

This indicates that the flowering tends to be in February-March and August-September, following the principal dry periods.

New leaves come in flushes at irregular intervals. As the old leaves do not fall when the new develop, the new growth is not dependent on the age of the old leaves. It seems to be most frequent soon after wet weather which follows a dry period, but this is not invariably the case, and the response is probably a rather complex one, dependent on the condition of the tree as well as on the weather.

#### *Sindora Wallichii* Benth.

The two trees of this species mentioned in 1931 have continued to behave irregularly as regards leaf-change, but records are incomplete. The tendency seems to be for a minimum leaf-period of about 12 months, with possible retention of leaves up to about 18 months. There is some indication that continued wet weather about 12 months from the last leaf-change prolongs the life of the old leaves; but the two trees do not always behave alike in this matter. Thus, they both renewed their leaves completely in February 1931; one tree renewed them again in February, 1932, though January, 1932 was not a very dry month, but the other delayed until August 1932 before renewal. The first tree had previously renewed its leaves in September, 1929, but failed to do so in September, 1930, though July and August were both unusually dry, deferring renewal until February, 1931.

The trees are slowly deciduous over a rather long period, and sometimes leaf-renewal occurs on part of the tree only, on other parts later. The response is evidently a complicated one.

#### *Sterculia carthaginensis* Cav.

The tree of this species mentioned in 1931 has been under observation since that time and has proved to be a very interesting case, comparable with that of *Hevea*, but less sensitive to climatic change. Its behaviour is worth considering in some detail.

The first leaf-renewal observed was on 11th December, 1927. The period from 12th November to 10th December was exceptionally dry, rainfall amounting to only 2.60 inches, instead of an average of about 10 inches. The next leaf-renewal was observed on 22 July, 1928, following a dry June. The next renewal occurred on 10th March, 1929; the rainfall in February was 10.97 inches, but there was a rather dry period from the 4th to 15th inclusive (12 days) with 1.00 inch, which may have caused leaf-fall to begin.

The weather was wet from August to November, 1929, December having only 4.49 inches. The tree had new leaves on a few branches about 10th December, but did not renew



all leaves until 17th February, 1930; the weather was dry from 12th January onwards (1–11th January, 3·17 inches; 12–31st January, 0·72 inch). It is strange that the two unusually dry months of July (1·89 inches) and August (1·13 inches) did not cause another general leaf-change, but there were small developments of new leaves at various times between August and November, 1930, (16th to 29th September and October 7th to 16th, were also dry periods). The next general leaf-renewal took place on 21st February, 1931; January was very wet up to the 19th, but from the 20th to 16th February the rainfall was only 1·80 inches. There was no more dry weather during the rest of the year (not more than six consecutive days without rain at any time) but a few new leaves were produced by the tree in December.

In 1932 the early part of January was dry (1–17th, ·56 inch), but leaf-renewal was deferred until 20th February. Following dry weather in July and August, there was occasional small leaf-renewal on various branches between July and October, but no general renewal until 16th January, 1933. There was hardly any wet season in the latter part of 1932, and only 1·19 inches rain from 3rd to 19th December; this presumably induced an early leaf-renewal in 1933.

In 1934 and 1935 there was again leaf-renewal in January, that of 1935 being early (12th) following a very dry December. There was an unusually large partial leaf-renewal on 18th September, 1935, about half the tree being involved; this followed a very dry July and August (2·73 and 3·03 inches). November and December, 1935, were wet, and also January, 1936; dry weather began on February 1st and a general leaf-renewal (involving the fall of those leaves produced in September, 1935) began on 3rd March, 1936.

The wet season at the end of 1936 was normal with a short break at the beginning of January, 1937, the rest of January being wet. Leaf-renewal occurred on 13th February. No further change occurred up to October, 1937. I have no record of the behaviour of the tree at the beginning of 1938. There was a dry fortnight in January and leaf-renewal probably took place in February. July was very dry with 2·4 inches and there was another dry period in October (2·7 inches in 24 days). It was presumably this which caused a complete leaf-renewal on 30 November. Though there was a good deal of dry weather in February and March, 1939, leaf-renewal did not occur until 8th May, a period of 5·3 months.

This tree is clearly unstable. It appears to have a minimum period of five months (5·5 months from the



half-renewal of 18th September, 1935 to 2nd March, 1936, and 5.3 months from 30th November, 1938 to 8th May, 1939) and a maximum of about 12 months (prolonged for some leaves to 13.7 months, on one occasion, following the large partial change of September, 1935). It appears that after about 5 months any pronounced dry weather may cause at least a partial leaf-fall, followed by leaf-renewal on the branches affected; leaf-renewal occurs a month or more after the onset of the dry weather (in a complete change, leaf-fall is complete in 2-4 weeks after the first signs of brown leaves). But it should be noted that where new leaves are produced on only a few small branches, these fall at the next general leaf-fall, even though this occurs only 2 or 3 months later.

The following table shows dates of complete changes only, with the intervening periods in months. For the years 1929-1937, the mean period was 12.1 months, with standard deviation .88 month or 7.3%.

<i>Months</i>			<i>Months</i>				
11.12.27	..	..	—	21. 1.34	..	..	12.2
22. 7.28	...	..	7.4	12. 1.35	..	..	11.7
10. 3.39	..	..	7.6	2. 3.36	..	..	13.7
17. 2.30	..	..	11.2	13. 2.37	..	..	11.4
21. 2.31	..	..	12.1	30.11.38	..	2	× 10.8
20. 2.32	..	..	12.0	8. 5.39	..	..	5.3
16. 1.33	..	..	10.9	22. 2.40	..	..	9.5

### *Sterculia macrophylla* Vent.

I have short series of records of three trees of this species, one in Penang and two in Singapore. Two of the trees have shown a fairly regular period of 6.4 to 8.2 months; the third tree was in poor condition, and much more irregular, in 1927-31. This third tree was subsequently cultivated and became more vigorous. It showed a period of 9.2 months in 1938-39. The records indicate this species as a short-period tree, both at Penang and Singapore. Its natural distribution is said to be confined to Malaysia. Records of its behaviour in the more strongly seasonal climate of East Java would be interesting. The following are data available for the three trees above mentioned.

<i>Penang</i>		<i>Singapore</i>		<i>Singapore</i>		
<i>Months</i>		<i>Months</i>		<i>Months</i>		
8. 1.31	..	—	28. 2.35	..	—	
14. 9.31	..	8.2	8. 9.35	..	6.4	
June 1932	..	6.	30. 3.36	..	6.8	
3. 1.33	..	6.5	20.11.36	..	7.7	
Aug. 1933	..	7	27. 6.37	..	7.2	
				7. 9.27	..	—
				5. 8.28	..	10.9
				1. 6.29	..	9.9
				20. 6.30	..	12.6
				2. 2.31	..	7.4
				8.10.38	..	—
				15. 7.39	..	9.2
				13. 3.40	..	8.0

**Sterculia sp.**

This tree, the species of which has not been identified, has been under observation for 12 years and has had a mean leaf-period of 10.1 months, with a good deal of variation. The standard deviation however is little more than 10% of the mean period. The data are as follows.

				<i>Months</i>				<i>Months</i>	
16.	9.27	..	..	—	Dec. 1933	..	2	×	9.5
12.	8.28	..	..	10.9	25. 8.35	..	2	×	10.
1.	6.29	..	..	9.7	28. 5.36	..	..	..	9.1
14.	4.30	..	..	10.4	March 1937	..	..	..	9.5
5.	4.31	..	..	11.7	22. 8.39	..	3	×	9.7
10.	3.32	..	..	11.2	21. 4.40	..	..	..	8.0
13.	3.33	..	..	12.1					
15 periods.									
Mean period: 10.1 months.									
Standard deviation: 1.26 month or 12.5%.									

**Tamarindus indica L.**

The old tree mentioned in my paper of 1931 died not long afterwards. The young tree was kept under observation, but being planted in a clay soil was not in a very vigorous condition. It showed a tendency to have periods of less than a year for three years, but then had a period of 17.7 months, the subsequent leaf-growth being poor and slow in developing. In September, 1938, three months after a leaf-renewal, the tree was well dug and manured, new leaf-growth occurring two months later. The future development will be watched with interest. The dates of new leaf-growth are as follows.

				<i>Months</i>						<i>Months</i>	
15.	2.31	..	..	—	15.12.34	..	..	..	..	10.	
28.	2.32	..	..	12.4	4.12.35	..	..	..	..	11.7	
24.	3.33	..	..	12.8	25. 5.37	..	..	..	..	17.7	
15.	2.34	..	..	10.7	1. 6.38	..	..	..	..	12.2	
Manured 18.9.38.											
November 1938, more new leaves.											

**Terminalia catappa L.**

Records have been continued of the behaviour of the tree mentioned in 1931. It has subsequently shown more irregularity than was indicated in the period 1927-31. This irregularity was chiefly in 1932-34, and is probably to be traced to the dry weather of August to December, 1932, which caused a leaf-renewal on 25th December, 1932, after a period of only 4.5 months. This was followed by three rather long periods, which brought the month of leaf-change to August once more. The long period of 1936 is surprising,

as the months of June, July and August were all fairly dry. New growth of leaf-buds is rapid and simultaneous all over the tree, so that dates are closely comparable.

As noted previously, this species changes its leaves twice a year in the strongly seasonal climate of east Java, in Ceylon, and in West Africa. In East Java it changes its leaves in the latter part of the wet season, and again in the latter part of the dry season. On the analogy of the behaviour of the Singapore tree, one would expect the leaf-periods in East Java ending February–March, during which the weather is much wetter than in the other period, to be longer, and the drier leaf-period, ending August–September, to be shorter. Records on this point would be interesting. It is clear that the species tends to have a leaf-period of about six months, and that the present tree is more sensitive to external influence than the tree of Couroupita, but less so than the trees of *Ficus variegata* mentioned in this paper.

At Peradeniya there are two dry seasons (one longer than the other) and the change occurs during the dry seasons. In Singapore the mean dates of leaf-change of the tree observed (8th February and 11th August) also correspond with the periods when dry weather is most frequently experienced.

Recorded dates of leaf-renewal of the Singapore tree are as follows.

<i>Months</i>				<i>Months</i>			
8.	1.28	..	.. —	11.	6.33	..	.. 6.6
8.	7.28	..	.. 6.0	21.	1.34	..	.. 7.3
3.	2.29	..	.. 6.8	20.	8.34	..	.. 7.0
11.	8.29	..	.. 6.3	28.	2.35	..	.. 6.2
9.	2.30	..	.. 6.0	10.	8.35	..	.. 5.5
8.	8.30	..	.. 6.0	18.	2.36	..	.. 6.3
6.	2.31	..	.. 6.0	20.	9.36	..	.. 7.1
20.	8.31	..	.. 6.5	12.	3.37	..	.. 5.6
6.	2.32	..	.. 5.5	9.	9.37	..	.. 5.9
9.	8.32	..	.. 6.1	1.	9.38	..	2 × 5.9
25.	12.32	..	.. 4.5	15.	3.39	..	.. 6.5

Mean period: 6.1 months.

Extremes: 7.3 and 4.5 months.

Standard deviation: .64 month or 10.5%.

Mean dates: 8th Feb. and 11th Aug.

### ***Terminalia subspathulata* King.**

This local species is represented by a fine tree on the edge of the Gardens Jungle in Singapore. This tree has been very regular in its behaviour since 1928. It begins to lose its leaves about October and loses them slowly all through the wetter season, more rapidly when the drier weather begins in January or February, and is nearly bare

for perhaps a month before the new buds begin to open. The opening of the buds is quite rapid and simultaneous all over the tree, so that dates are closely comparable. Flowering does not occur every year.

The factors which influence the date of leaf-renewal are probably rather complex, as the period of leaf-fall extends over several months. There is little doubt that the tree has a natural tendency to a 12-month leaf-period, and also that the occurrence of the bare period immediately following the break at the end of the wet season is significant; but the slow loss of leaves through the wet season is curious. The data for this tree are as follows.

			<i>Months</i>				<i>Months</i>
19.4.28	..	..	—	10.5.34	..	..	13.3
17.3.29	..	..	10.9	27.3.35	..	..	10.6
16.3.30	..	..	12.0	10.4.36	..	..	12.5
31.3.31	..	..	12.5	29.4.37	..	..	12.6
10.4.32	..	..	12.3	12.4.39	..	2 ×	11.7
2.4.33	..	..	11.7	12.3.40	..	..	11.0
Mean period: 11.9 months.							
Standard deviation: .83 month or 7.0%.							
Mean date: 6th April.							



	January	February	March	April	May	June	July	August	Sept.	October	Nov.	Dec.
1	3.94	2.07	—	.70	.01	—	—	—	—	2.45	—	.09
2	.91	.40	—	.01	.70	—	.02	—	.02	.40	1.15	.24
3	.24	1.22	—	.01	1.60	.01	1.31	.13	.08	.20	.20	.08
4	.06	.05	.99	.03	.66	.25	.06	—	—	.91	—	.06
5	—	.07	3.76	.07	—	.16	.52	—	1.31	—	.50	.01
6	.01	.07	.29	—	—	—	.10	.11	—	.50	.31	.09
7	—	—	.27	—	.57	—	.01	.07	—	.17	.08	—
8	.02	—	.31	.06	.03	—	.13	—	—	.56	1.13	.01
9	.14	—	1.21	.13	1.39	.45	.04	—	—	.36	.71	—
10	.99	.01	.02	.30	—	1.39	.89	—	—	—	—	—
11	.03	.31	—	—	—	—	—	.27	.14	—	3.18	1.52
12	1.27	.12	—	1.64	.62	.11	.03	—	.03	—	—	.59
13	—	.15	—	—	—	—	—	.01	—	.01	—	.21
14	1.01	.19	—	—	.45	—	—	—	—	—	.01	.07
15	2.35	.03	.11	—	—	—	.29	.02	—	.11	.27	—
16	.06	1.29	—	—	.07	—	.41	—	—	—	—	.15
17	.18	—	—	.08	.28	.03	.07	—	.44	—	.13	—
18	—	—	.21	.14	.26	—	—	—	—	—	.01	.01
19	1.41	—	2.89	1.89	—	.05	.05	—	.09	—	—	—
20	.21	.60	2.01	1.47	1.12	.12	.10	.92	—	—	.04	.08
21	.08	.82	.06	.13	.23	.38	—	.19	.03	—	.13	.02
22	—	.20	.05	1.27	.13	.04	—	1.46	.46	.16	—	.04
23	.06	—	1.87	.55	—	.13	—	1.31	.07	—	.07	.49
24	1.37	.01	.04	.84	—	—	—	—	.54	—	.99	2.59
25	.01	—	.06	.89	.03	.37	—	.04	.06	.22	.13	.01
26	—	.01	—	.16	.02	.15	—	—	1.22	.34	.12	3.67
27	—	.95	—	—	.21	.94	—	.80	.36	.70	.01	.51
28	1.68	2.40	.09	.06	—	—	—	.04	.02	.01	—	.57
29	.62	—	—	1.72	.76	—	—	—	—	.03	.04	.22
30	.03	—	.41	.68	—	—	—	—	.78	.35	—	—
31	1.64	—	2.15	—	—	—	—	—	—	.49	—	.02
	18.32	10.97	16.80	11.83	9.14	4.58	3.98	5.37	5.65	7.97	9.28	11.35

Total for the year: 115.24 inches.

## RAINFALL, IN INCHES, AT THE BOTANIC GARDENS, SINGAPORE

1928

	January	February	March	April	May	June	July	August	Sept.	October	Nov.	Dec.
1	.01	—	—	1.70	—	—	—	.21	—	.84	1.11	—
2	2.04	1.07	—	—	—	—	.09	—	—	.03	.67	.25
3	1.37	.16	—	—	—	—	—	1.37	1.23	.10	1.36	—
4	.01	.06	—	—	—	.35	.52	—	—	—	—	.07
5	.09	—	—	.92	—	—	—	—	—	.24	.03	.78
6	.75	—	—	.08	.29	.08	—	.06	—	—	1.39	—
7	.20	2.02	—	.93	—	—	1.16	.04	.26	.38	—	.90
8	.03	—	—	1.68	.95	—	—	—	.40	—	.21	.65
9	1.00	—	—	.45	1.25	.16	.89	—	.33	.36	2.00	1.51
10	.58	—	1.52	.98	—	.35	—	.65	—	—	1.65	.32
11	.48	.42	—	—	.39	—	2.04	—	.06	—	—	—
12	4.08	1.06	—	.06	.02	.08	.19	.61	2.56	—	1.39	.41
13	.02	—	—	.65	—	1.54	—	.09	.59	.03	.20	.17
14	.76	—	—	—	—	—	—	—	.32	.15	.15	.26
15	—	.50	.09	1.14	—	—	—	.62	.18	.18	1.41	1.25
16	—	.57	.02	.29	.15	—	—	—	—	2.46	4.29	.71
17	—	.26	.25	—	—	—	—	—	—	.41	.26	—
18	—	.02	1.29	—	.20	—	—	—	—	.13	.18	—
19	.06	.01	1.17	1.05	—	.31	—	1.11	—	1.04	.59	—
20	.02	.55	—	1.32	—	—	—	.30	—	.15	—	—
21	.06	—	.50	—	—	—	—	—	.48	.15	—	.03
22	.50	—	1.10	—	—	—	—	—	1.62	—	—	.47
23	.71	.41	—	.55	—	.65	—	—	—	.31	—	.22
24	.08	3.02	—	—	.13	—	—	1.75	1.14	—	.13	—
25	1.20	.16	.16	—	—	—	—	1.25	—	.61	.19	.01
26	.15	—	.01	—	—	—	—	.72	—	—	—	.17
27	.01	—	2.01	.07	—	—	—	.15	.02	—	—	—
28	—	1.05	.12	—	.37	—	.12	—	—	—	—	1.44
29	—	.15	.51	—	.08	—	—	1.42	—	—	.44	.23
30	.08	—	—	—	.10	.18	2.32	—	.61	—	—	—
31	—	—	—	—	—	—	—	.39	—	—	—	.43
	14.29	11.49	8.75	11.87	3.63	3.70	7.33	10.74	9.80	8.08	17.68	10.28

	January	February	March	April	May	June	July	August	Sept.	October	Nov.	Dec.
1	.96	.65	—	.06	—	.09	—	—	.10	—	.46	.14
2	.68	1.70	—	.77	—	—	—	—	—	—	—	.45
3	—	—	—	—	.16	—	—	—	—	—	—	.23
4	—	.14	—	.06	—	—	—	—	.07	.10	—	.04
5	2.48	.33	—	—	2.85	.73	—	—	.64	—	—	.27
6	.30	.29	—	—	.21	.03	—	—	.11	1.30	.49	.01
7	—	—	—	—	—	.09	—	—	.05	.15	—	.08
8	—	.08	—	—	.16	.30	—	—	—	—	.01	.11
9	—	—	—	—	—	—	—	—	—	.30	.12	—
10	—	—	1.95	—	—	.37	—	.20	.05	.19	2.30	—
11	—	1.67	.20	—	—	—	—	1.61	—	.67	.06	—
12	.15	.05	.13	.62	.56	.02	—	1.31	.70	—	—	—
13	—	.25	.11	—	.27	—	.28	—	—	.08	.27	—
14	.10	—	.20	.01	.34	—	—	—	.11	—	2.56	—
15	—	.91	.21	.01	—	.22	.31	.07	.50	.03	.14	.29
16	.16	—	—	—	—	—	.64	—	.21	—	.01	.56
17	.16	.13	.01	.02	—	—	—	—	—	—	—	—
18	—	.14	.03	—	—	.73	.08	—	—	.52	1.65	—
19	—	—	.68	.09	—	—	.09	—	.05	.24	.33	.56
20	—	—	.18	.10	1.26	—	.12	—	—	—	—	.23
21	—	.94	—	—	—	—	—	—	—	.19	.46	.11
22	.23	—	—	—	—	—	—	—	—	.06	.06	—
23	—	.67	—	.34	.07	.45	—	.37	.02	—	—	—
24	—	—	.81	—	—	1.72	.63	.34	—	2.06	—	—
25	—	.57	1.96	.14	.92	.82	—	—	.05	—	.51	.02
26	—	.47	.57	—	.28	—	—	.09	—	.10	—	—
27	—	—	.04	—	.22	2.52	—	—	.13	1.56	—	.92
28	—	—	—	.29	.13	.02	—	.07	5.80	.25	1.96	—
29	—	—	—	—	—	—	—	1.93	.45	.18	.08	.31
30	—	—	1.98	—	1.24	—	—	1.98	—	.33	—	.16
31	—	—	—	—	—	—	—	—	—	—	—	—
	5.22	8.99	9.06	2.51	8.67	8.11	2.15	7.97	9.04	8.31	11.61	4.49

Total for the year: 86.05 inches.

## RAINFALL, IN INCHES, AT THE BOTANIC GARDENS, SINGAPORE

1930

	January	February	March	April	May	June	July	August	Sept.	October	Nov.	Dec.
1	—	—	—	.16	.24	—	—	—	.02	—	1.34	1.44
2	—	—	—	—	1.42	—	—	—	—	-.06	—	—
3	-.09	—	—	—	.51	—	—	—	—	—	.04	.09
4	1.12	—	-.01	.52	2.27	—	—	—	—	-.09	.20	.27
5	.35	—	—	2.48	—	—	—	—	-.19	-.08	.56	.83
6	—	—	—	2.62	—	.12	.28	.18	—	1.13	.48	—
7	-.06	—	—	.13	.03	—	—	—	1.95	—	-.01	.03
8	—	—	.40	—	.91	—	—	—	—	—	—	.88
9	—	1.84	—	—	.19	—	—	—	—	—	—	—
10	1.13	1.91	.86	.02	.07	—	—	—	—	—	—	—
11	.42	—	.35	1.70	1.29	3.79	-.01	.24	.05	—	—	.17
12	—	—	.58	—	.25	—	.10	—	.02	—	.02	.55
13	—	—	—	—	—	—	—	.06	1.29	—	—	—
14	.04	—	.15	1.34	—	1.38	—	—	—	.25	.03	.43
15	.10	—	1.79	.09	—	—	—	—	—	—	—	1.47
16	.30	-.05	—	—	—	.11	—	—	—	—	.02	.31
17	—	.03	1.31	—	.67	5.48	—	.22	—	1.33	2.38	—
18	—	.16	.13	—	—	1.01	—	—	—	1.57	1.65	.80
19	—	—	—	.24	—	.22	—	—	—	.07	.08	.13
20	-.07	—	—	.16	.67	.11	—	.01	—	—	.03	.50
21	—	—	—	.84	—	—	—	—	—	—	.09	—
22	—	—	.13	.57	—	.31	—	—	—	.25	.39	.53
23	—	—	—	.26	—	—	.36	—	—	.40	—	—
24	—	—	—	3.37	1.83	—	.30	—	—	.21	—	—
25	—	—	—	—	.17	—	—	.31	.24	.72	.18	.89
26	—	.10	—	—	—	—	—	.11	.23	1.65	—	.01
27	.21	—	—	—	—	—	—	—	—	.20	—	.09
28	—	.29	—	—	—	—	.63	—	—	—	.56	.02
29	—	—	—	—	—	—	.14	—	2.50	—	2.33	.16
30	—	—	—	—	—	—	.07	—	.13	.13	.15	.07
31	—	—	—	—	—	—	—	—	.64	.23	.29	.41
	3.89	4.38	5.71	14.50	10.52	12.53	1.89	1.13	7.21	9.01	10.82	10.08



1931

	January	February	March	April	May	June	July	August	Sept.	October	Nov.	Dec.
1	.41	—	—	.12	.04	.01	1.43	—	—	.07	.85	.68
2	.13	—	.04	.10	—	—	.03	—	—	1.28	.09	—
3	.47	1.01	.21	.85	.35	1.33	.63	—	.05	—	.02	—
4	.02	—	—	.01	.35	2.12	.07	.67	—	.43	.16	.04
5	—	—	.49	1.90	—	.22	—	—	.02	—	1.73	.17
6	.66	—	.06	—	—	—	—	—	—	—	2.59	2.61
7	.16	.29	.16	.34	.21	—	.82	.24	—	—	—	—
8	.08	—	—	—	—	—	—	—	.19	1.17	.78	.02
9	.03	—	—	.32	—	—	.41	—	—	.49	—	.48
10	.14	—	.81	—	.40	—	—	—	.23	—	.79	.01
11	.30	—	.40	.64	.09	.67	—	1.61	.10	.30	.26	.15
12	1.67	—	1.04	—	1.43	—	—	.03	.03	—	.11	—
13	1.20	—	—	—	.14	.08	—	.29	.88	—	—	.54
14	1.41	—	.34	.02	—	—	—	.14	—	—	—	.26
15	1.44	.12	—	.08	—	—	—	—	1.01	.05	—	.11
16	.51	.03	—	—	—	—	—	—	—	.06	1.16	.16
17	.19	2.23	—	—	1.48	.03	—	—	—	—	.04	—
18	1.21	.02	—	1.31	—	—	.05	—	—	—	1.08	—
19	.76	—	.02	—	—	—	—	—	1.69	.64	—	.45
20	—	—	.24	—	—	—	—	—	.06	—	—	—
21	.08	—	.01	.21	—	.29	1.37	—	1.54	—	—	—
22	.10	—	1.52	—	1.02	.42	—	.07	2.09	.71	—	.10
23	.57	—	—	.39	.09	.46	—	—	.06	.19	.06	.25
24	.36	1.02	—	.22	—	1.39	.47	—	1.09	—	.71	2.56
25	—	—	—	—	—	.51	—	—	—	—	.35	.79
26	—	—	—	.21	.99	—	2.39	1.89	—	.31	1.08	.80
27	—	—	—	.29	.07	—	—	.21	—	—	—	.36
28	.24	—	—	.24	.18	—	.17	.23	.12	1.32	.76	.13
29	—	—	.28	.31	2.14	—	.34	.82	—	—	.90	—
30	—	—	.65	—	—	—	—	—	.42	1.28	—	.57
31	—	—	1.27	—	.12	—	.41	.01	—	—	—	.07
	12.14	4.72	7.54	7.56	9.10	7.53	8.54	6.21	9.58	8.30	13.52	11.54

Total for the year 109.28 inches.

RAINFALL, IN INCHES, AT THE BOTANIC GARDENS, SINGAPORE

1932

	January	February	March	April	May	June	July	August	Sept.	October	Nov.	Dec.
1	—	—	1.27	.04	.89	—	.66	—	—	—	.37	.02
2	—	—	—	.96	.01	—	1.63	—	.10	.22	.16	2.10
3	—	—	—	.40	—	.48	—	.22	—	—	—	.08
4	—	—	—	—	.95	—	.01	—	.87	—	.03	.31
5	—	.03	—	.40	—	—	.02	—	.35	—	.24	.05
6	.31	—	—	—	—	.88	1.23	—	—	—	—	.07
7	.12	.29	—	.70	.22	—	2.10	—	—	—	—	—
8	—	—	—	.36	1.51	.39	2.88	.03	.31	—	.13	—
9	—	—	—	.05	—	—	—	—	.17	—	.14	.51
10	—	.21	—	.75	—	.14	2.40	—	3.25	—	1.76	—
11	—	—	—	—	—	—	.14	—	—	—	.71	—
12	—	—	—	—	1.81	—	—	.09	—	.60	.34	.01
13	—	—	.01	1.06	—	—	—	—	—	.11	—	.16
14	.13	—	.04	—	—	.02	—	—	—	—	—	—
15	—	.83	—	.06	—	.06	—	.04	.22	—	.62	—
16	—	—	—	.03	.03	—	—	.02	—	.02	.04	—
17	—	—	—	.10	—	.20	—	.07	.52	—	—	—
18	.51	—	—	.11	.54	.03	—	.29	—	.11	.32	—
19	—	1.25	—	—	—	—	—	.05	—	.07	.02	—
20	.37	.60	.06	—	.05	.16	—	.08	—	.09	.03	.95
21	1.11	1.02	.72	.47	.24	—	.40	.10	—	—	—	.15
22	1.14	.12	1.94	—	—	.70	.55	—	.05	—	—	.23
23	.23	—	.60	.38	2.67	—	—	—	.20	.33	—	—
24	.03	.31	.56	—	3.94	—	—	—	1.85	.28	—	—
25	.01	—	—	.04	.31	—	—	.12	—	—	—	.09
26	1.14	.24	1.02	—	—	1.89	—	.19	—	—	.13	.29
27	1.09	—	.12	.13	—	.08	—	—	—	1.04	—	.17
28	.35	—	—	—	.17	—	.07	.41	—	—	—	1.20
29	—	—	.33	—	—	—	—	.12	.54	.36	—	.20
30	.13	—	.03	—	1.28	—	1.90	—	.02	.02	.15	—
31	—	—	—	—	—	—	—	—	—	.04	—	—
	6.67	4.90	6.70	6.04	14.62	5.03	13.99	1.83	8.54	3.29	5.19	6.59

	1933	January	February	March	April	May	June	July	August	Sept.	October	Nov.	Dec.
1				.78	.57					.03			.02
2			1.93	1.14	.82			1.47		.74		.24	.25
3	2.82							.08				.28	.02
4	.93							1.48				.10	
5	.15			.28							.39	.41	
6	.48			.06	1.10						.11		.05
7	.20			.39	.04			2.21			.49	.06	.47
8	.09			1.87	.03			2.06	.20	.76	4.40	.25	
9				1.17	.26	.06		.73		1.28			
10				1.79			.07				.45		.63
11				.72			.59				.41		
12	.71			.52		.11	.27	.34			.20	.02	.66
13				.36	.36	.03	.22	.23	.10				.73
14				.25	.25	.31	1.05	.38	1.10				
15				.21	.21	.06		.23				1.33	.33
16				.12	.12			.39		.46	.03	.07	
17				.23	.23	1.16	.08		.52				
18	.87			.41	.41	.21	1.09		.23			.14	.25
19	.64			.07			1.89			.28		3.59	.27
20	1.18		.40		.12	.25	.03	.10	.32			.15	
21	.34					.05			.62	.25		1.23	
22	.09					70				.42			.58
23						.02				1.10	.15		.24
24	.28			.04	.02	.04				.24	.30		.67
25	.75		.05	.10	.68				.04	.44			1.38
26	.04		.83	.14	.57	.79			.08	1.03		.14	.42
27			.66				.01			.21	.24	1.62	
28			.25				.23	.24	.25	.02			
29				1.15					3.15	.21	2.08	.35	
30						1.37		1.38		1.23	.19	.03	
31			1.24										
	9.57	4.12	10.60	6.94	5.16	5.53	11.32	6.64	8.70	9.56	12.05	6.97	

Total for the year 97.16 inches.

## RAINFALL, IN INCHES, AT THE BOTANIC GARDENS, SINGAPORE

1934

	January	February	March	April	May	June	July	August	Sept.	October	Nov.	Dec.
1	—	—	.30	—	.02	—	—	—	1.82	—	1.88	.06
2	—	—	.22	—	.08	1.69	—	—	2.57	—	.26	—
3	.10	—	.75	—	1.01	.05	—	—	.44	—	—	.66
4	.45	.19	.10	—	.10	—	—	.06	.09	—	.03	.51
5	.03	.48	.02	.09	.37	—	—	—	.87	—	—	.03
6	3.70	.04	1.00	—	—	—	—	.18	—	—	.24	.33
7	6.90	1.02	1.89	.02	—	—	—	—	—	—	—	.26
8	2.52	—	4.83	—	—	—	—	—	—	.21	.45	—
9	—	.03	—	—	—	—	.08	—	—	.30	.16	—
10	.10	.60	.71	.02	.06	.46	—	—	—	—	.06	—
11	.11	.42	—	1.10	.85	.39	—	.08	—	1.24	.61	—
12	.10	1.00	.85	.05	—	.02	.39	—	—	.21	—	—
13	.25	—	.04	.95	—	—	—	.06	—	.01	1.16	—
14	.70	—	.05	2.10	—	—	2.35	—	—	.70	1.92	—
15	.16	—	.25	—	.27	—	1.91	—	—	.15	.94	—
16	4.45	1.82	.21	.20	2.45	.06	—	—	—	—	.41	—
17	.25	—	.58	—	.73	.04	.76	1.71	1.20	3.02	.26	.01
18	.02	.81	—	—	—	.11	.59	.04	—	.02	.37	—
19	.01	—	.06	—	—	—	.32	1.04	—	.12	.28	—
20	2.50	—	—	—	—	.02	.96	—	—	—	—	—
21	.11	—	.25	.84	—	.71	—	.03	.99	—	.07	—
22	—	—	.71	—	—	—	1.23	.23	—	.10	.02	—
23	—	.40	—	—	—	.16	.07	—	.03	—	—	—
24	—	.50	.05	—	—	.15	.33	—	—	—	—	.06
25	—	—	—	—	—	1.60	.40	.42	—	—	4.02	—
26	—	—	.27	—	—	.09	1.81	.34	—	—	—	—
27	—	—	.47	.14	—	—	.48	—	—	—	.24	—
28	—	—	—	—	.16	—	—	—	—	2.16	.44	.25
29	—	—	—	.26	—	—	—	—	—	.02	.46	.21
30	—	—	—	.04	—	.32	—	—	.04	.12	.69	—
31	—	—	.26	—	—	—	—	3.56	—	—	—	.20
	22.46	7.31	13.87	5.81	6.10	6.07	11.68	7.75	8.05	8.38	14.97	2.58



1935

	January	February	March	April	May	June	July	August	Sept.	October	Nov.	Dec.
1	—	—	.44	—	1.01	1.82	—	—	—	—	—	.92
2	—	—	.17	—	.16	.80	.90	—	—	.02	—	.52
3	1.45	—	.86	.66	—	.81	—	—	—	—	2.91	.28
4	.06	—	—	.06	.46	.05	.14	—	—	—	1.11	—
5	.29	—	—	.02	—	—	—	—	—	.29	.02	—
6	.58	—	.81	—	—	.53	—	—	—	—	—	.01
7	3.61	—	.07	—	1.73	—	—	—	—	—	.91	.03
8	1.37	—	.04	—	—	.21	.57	—	—	—	.10	—
9	—	—	.03	.13	—	—	—	—	.92	.04	—	1.33
10	—	—	.06	—	—	1.34	—	1.07	—	—	.30	—
11	—	—	.39	.25	1.70	—	—	—	—	—	—	—
12	—	—	—	.13	—	—	—	.23	—	—	.04	—
13	—	—	—	.42	—	—	.11	.26	.31	—	.91	1.56
14	.95	—	—	1.60	.14	—	—	.15	1.63	—	.23	1.86
15	—	.25	.14	.45	.28	.08	—	—	—	.21	—	1.74
16	—	1.17	.62	.02	1.08	.08	—	—	—	.22	.15	—
17	—	1.65	2.90	.06	—	.02	—	—	—	—	—	—
18	—	1.24	—	—	.02	—	—	.26	—	—	—	—
19	—	.15	—	—	—	1.12	—	.03	—	—	—	—
20	.16	.11	.13	.73	—	—	—	—	—	.59	.33	.12
21	—	.26	.37	—	.01	—	—	—	—	.14	.30	.09
22	3.10	—	—	—	1.30	.59	—	—	—	.16	—	.03
23	.55	—	—	—	—	—	1.01	.31	—	.50	1.62	.38
24	—	—	.22	.02	.45	—	—	—	—	—	.02	1.71
25	—	—	—	—	—	1.57	—	.02	.37	.26	.10	.01
26	—	—	1.61	—	—	.14	—	—	—	1.68	.32	.17
27	—	—	.30	—	—	.05	—	.15	.29	.51	1.28	.57
28	—	—	1.02	—	—	—	—	.33	.13	—	.95	.13
29	—	—	—	.06	—	—	—	.21	.02	—	.03	.02
30	—	—	—	.18	—	.07	—	—	—	—	.24	.33
31	—	—	—	—	—	—	—	—	—	—	—	1.35
	12.12	4.83	10.18	4.79	8.34	8.78	2.73	3.02	3.67	4.62	11.87	14.48

Total for the year 89.43 inches.

	January	February	March	April	May	June	July	August	Sept.	October	Nov.	Dec.
1	.24	—	—	.29	—	—	—	—	—	—	—	—
2	.01	—	—	.93	—	—	.09	.09	.05	—	.81	1.22
3	.09	1.43	—	—	.28	.07	—	—	—	—	1.38	.04
4	.02	—	—	—	.90	—	—	.14	—	1.09	—	.01
5	.99	—	.42	.24	—	—	.06	.17	—	.57	—	.61
6	.70	—	.32	.49	.24	—	—	.04	—	—	.21	.28
7	.07	—	—	1.07	—	—	—	.71	.05	—	2.48	—
8	—	.04	—	—	.89	—	2.74	—	—	.31	.84	.21
9	—	—	—	—	.09	—	—	.14	—	1.33	—	.25
10	—	—	—	—	.89	.33	—	—	—	.36	—	—
11	2.44	—	.93	.07	.13	.21	.74	—	—	.61	—	—
12	.74	—	.64	.44	—	—	—	—	—	—	.04	—
13	—	.04	.32	.07	.46	—	—	.43	.06	—	1.05	—
14	.04	.06	2.42	.47	—	—	.83	—	—	.17	—	—
15	.21	—	.16	.32	.39	.29	—	.14	.14	—	—	.13
16	—	—	.42	.32	.32	—	—	.72	—	—	—	.70
17	.03	.02	.11	—	1.24	—	—	.08	—	—	—	—
18	—	—	.67	—	—	—	—	.43	—	—	—	—
19	—	—	—	.45	.10	—	—	.08	—	.73	2.72	3.38
20	.01	—	—	—	1.00	—	—	.43	.70	.20	.39	—
21	—	.02	—	.13	—	.34	—	.04	—	—	.02	—
22	.06	—	3.16	—	.07	—	—	.02	—	.38	—	.33
23	—	.08	—	—	—	1.20	—	.22	—	.21	.10	—
24	—	—	.03	.22	—	—	.16	.52	.65	—	—	—
25	—	—	—	.59	—	.84	—	—	.02	1.62	.19	—
26	—	—	—	—	.58	—	—	—	—	.31	.31	—
27	.13	—	.16	—	—	—	—	.03	—	.61	2.15	—
28	—	—	.20	—	—	—	—	.02	—	.15	.13	1.07
29	.91	—	—	—	—	—	—	—	—	.01	.23	.01
30	.38	—	—	.87	—	—	—	.08	—	—	1.52	—
31	—	—	2.86	—	—	—	—	—	.04	1.86	.06	2.03
	7.07	1.69	12.82	6.65	7.58	3.28	4.62	4.02	1.71	10.37	14.84	10.27

Total for the year 84.09 inches

	January	February	March	April	May	June	July	August	Sept.	October	Nov.	Dec.
1		.86	—	—	—	—	—	—	.34	1.52	.37	.86
2	—	1.38	.01	—	.05	—	.56	—	.06	—	—	.69
3	.35	—	.25	—	—	—	—	—	.42	.05	—	.06
4	—	.04	—	.57	.10	—	—	—	.73	—	—	.05
5	—	—	—	.02	—	—	—	—	—	—	1.36	.37
6	—	—	—	.05	.78	—	.37	—	—	1.33	—	.65
7	—	—	—	1.06	—	2.00	.06	.12	—	.13	1.08	—
8	—	—	—	—	.37	—	—	.25	—	—	—	.42
9	.33	—	—	—	—	—	.83	—	—	—	.27	—
10	—	—	—	—	—	—	.06	—	—	—	.06	—
11	.69	.81	.05	1.01	—	.08	.58	.20	.53	.02	—	.95
12	3.89	—	1.22	—	.27	—	—	—	.31	—	—	.06
13	—	—	—	.45	.10	—	—	—	.02	—	1.21	—
14	—	.68	—	.39	—	.07	—	.77	—	.04	—	1.80
15	.66	.72	—	—	.24	.14	—	1.31	1.71	—	.46	1.68
16	1.70	.23	—	—	.20	—	—	—	—	—	—	.47
17	—	.63	—	.01	.20	—	—	1.17	—	—	.61	.92
18	—	.12	—	.36	1.20	—	—	—	—	.33	1.83	.55
19	—	—	.41	.26	.06	—	—	.50	—	.85	—	1.20
20	—	—	—	.15	—	—	—	—	.07	.17	.21	.34
21	—	1.13	—	—	—	—	—	—	.80	.02	.06	.76
22	1.20	—	.02	.28	—	—	.06	—	.04	—	.86	—
23	—	—	.04	.33	—	—	.09	—	.17	—	.25	—
24	—	—	—	2.51	—	.68	—	—	.03	.40	—	—
25	—	.03	.02	.94	.08	.01	—	.34	1.51	.06	—	1.45
26	.92	.03	—	—	3.16	.04	—	—	.68	.02	—	—
27	.33	.28	2.04	—	—	—	—	—	.04	—	—	—
28	.03	—	—	.64	—	—	—	—	—	—	—	—
29	—	—	.49	—	—	—	—	—	—	1.01	.35	—
30	—	—	—	—	1.21	—	—	—	—	.09	—	.08
31	—	—	—	—	.34	—	—	—	—	—	—	—
	10.10	6.91	4.57	9.52	8.16	3.02	2.61	4.66	7.55	6.76	10.62	13.36

Total for the year 87.84 inches.

## RAINFALL, IN INCHES, AT THE BOTANIC GARDENS, SINGAPORE

1938

	January	February	March	April	May	June	July	August	Sept.	October	Nov.	Dec.
1	—	—	.23	.25	—	1.01	—	2.12	.11	—	—	—
2	1.23	1.08	—	.05	1.15	—	—	.51	—	.37	—	—
3	.39	.04	—	.37	.13	—	.19	—	—	—	—	—
4	—	—	—	1.16	1.16	—	—	—	.99	—	—	—
5	.02	—	—	.21	—	2.16	—	—	—	.67	—	.25
6	—	3.59	.25	.39	.19	1.82	—	—	.11	.06	.96	.55
7	—	2.31	—	—	—	—	—	—	—	—	.40	2.48
8	3.28	—	.20	—	—	—	—	—	—	—	.05	.22
9	—	.70	—	—	.03	—	.38	—	—	—	—	.02
10	—	.20	—	.93	.24	—	—	—	—	.15	—	—
11	—	—	1.06	—	—	—	.71	.04	.76	.15	.07	.14
12	—	—	—	—	—	.05	.23	.59	.26	1.27	.25	.53
13	—	.16	1.21	—	—	1.11	.63	—	—	—	—	—
14	—	—	.19	.34	.17	—	—	—	—	—	—	—
15	—	—	—	—	—	.11	—	—	—	.16	—	.73
16	.18	—	.55	—	—	—	—	.11	—	—	.32	.42
17	—	—	.59	—	.39	—	—	—	—	—	.03	—
18	—	—	.19	—	1.51	—	—	.14	2.62	—	.22	—
19	.09	—	—	.02	—	—	—	.16	—	.20	—	.33
20	.09	—	—	—	—	—	.10	—	.18	—	—	.33
21	—	—	1.35	.25	—	—	—	.10	.72	—	.02	—
22	—	—	1.02	1.01	.06	—	—	—	—	—	.37	—
23	.10	—	—	—	—	.77	—	—	—	—	—	—
24	.35	—	.09	.46	1.01	—	—	.27	—	1.01	.08	—
25	.77	—	—	—	—	—	—	1.11	.02	.52	—	—
26	.10	.10	.17	1.22	—	—	—	—	—	2.37	—	—
27	2.79	.70	.04	.91	—	.61	—	—	—	.22	—	1.18
28	.08	.38	—	—	—	—	—	—	—	.03	1.02	.07
29	.19	—	—	.07	.61	—	—	—	1.57	—	.16	.07
30	.07	—	1.28	—	—	.91	—	—	—	—	—	—
31	.52	.38	—	—	—	—	—	1.78	—	.15	—	—
	10.25	8.88	8.80	7.64	6.65	8.55	2.14	6.93	8.34	7.03	6.25	9.20



	January	February	March	April	May	June	July	August	Sept.	October	Nov.	Dec.
1	.02	—	.28	—	—	—	—	.07	.83	.08	1.41	1.88
2	.11	—	—	—	—	.09	.41	.41	—	—	—	—
3	—	.71	1.54	—	—	—	—	—	.05	.17	.04	—
4	—	—	—	.01	—	.32	—	—	—	1.38	—	—
5	.62	1.18	.77	.68	—	—	—	.75	—	—	—	.21
6	—	.15	—	.52	—	—	.36	3.75	.45	—	—	.14
7	.42	.49	—	—	.20	.99	—	—	—	.36	1.76	.34
8	—	.11	.08	2.98	.49	—	—	—	—	—	.09	—
9	—	—	.27	—	1.00	—	—	.01	—	—	—	.27
10	—	—	—	—	—	1.66	—	—	—	1.68	1.02	—
11	—	—	—	—	—	—	—	.10	—	1.01	.16	—
12	—	—	—	.45	.45	—	.22	—	.83	1.03	1.13	.11
13	.94	—	—	.13	.13	—	—	—	1.76	.37	—	—
14	—	—	—	.53	.53	—	—	—	.07	—	.03	7.63
15	—	—	—	—	—	.38	—	1.82	.45	.58	—	.68
16	—	—	—	.82	.82	.06	—	.07	—	—	—	2.27
17	.12	—	—	—	—	—	1.21	1.33	.28	—	.06	—
18	—	—	—	—	—	1.55	—	1.18	.70	.22	—	—
19	.55	—	.20	—	—	—	—	—	—	.03	—	—
20	.51	—	—	—	—	—	—	—	.22	—	—	—
21	—	.57	—	—	—	—	—	—	.03	.19	.19	.13
22	.12	.44	—	—	—	—	—	—	—	.19	—	—
23	.44	—	—	—	—	—	.07	—	—	—	—	—
24	1.11	.05	—	—	—	.13	—	.02	3.89	.23	1.23	—
25	.08	—	—	—	—	—	—	.09	—	—	—	—
26	.14	—	.53	.92	.92	—	.35	—	—	.27	—	.04
27	.04	1.73	—	—	—	.02	—	—	—	.34	1.47	—
28	—	—	—	—	—	—	.90	1.70	—	—	—	.005
29	—	—	—	—	—	—	—	2.21	—	—	1.14	—
30	—	—	.78	.55	—	—	.77	.38	—	.53	—	—
31	2.22	—	—	—	—	—	—	2.01	—	—	—	.08
	7.44	5.43	4.45	7.59	4.54	5.20	4.29	15.90	9.56	8.66	9.73	13.78

Total for the year 96.57 inches.











PUBLICATIONS OF THE BOTANIC GARDENS,  
SINGAPORE

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THE  
**GARDENS' BULLETIN**  
STRAITS SETTLEMENTS

Vol. XI

30th August, 1941

Part 3

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1941







THE  
GARDENS' BULLETIN  
STRAITS SETTLEMENTS

Vol. XI

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Part 3

NOTES ON THE SYSTEMATY AND DISTRIBUTION  
OF MALAYAN PHANEROGAMS, IV: IXORA

By E. J. H. CORNER,  
*Botanic Gardens, Singapore*

After studying for several years the living plants of *Ixora* in Malaya, I find that the two most valuable guides to the affinity, and therefore to the identification, of the species are the colour of the corolla and the fragrance or scentlessness of the flower. After these one must have recourse to the size of the bracts and sepals and the shape and venation of the leaf. The size and hairiness of the corolla and even the shape of the petals I find to be most variable and, for the majority of the Malayan species, by no means specific. But the most important character of the genus is found in the structure of the inflorescence, whether its branches are articulate or not, because this criterion distinguishes *I. grandifolia*, with its inarticulate inflorescence falling off in one piece, from all other Malayan species. It is a primitive mark that connects *Ixora* with such genera as *Pavetta* and *Tarenna*.

It seems that the extraordinary variability in the size of the leaf and corolla is not appreciated. From the most recent works on the genus (Craib, Bremekamp) the impression is gained that many new species can be blocked out from the old and that minute differences in hairiness, leaf-size, or shape, and length of corolla-tube suffice to define them. But I am certain that this view is mistaken and, if followed, must lead to the making of so many "species" that the classification of the genus will become impossible. Such splitting, based on relatively few herbarium specimens, merely obscures the issue which is to have names for the major, well-defined groups of individuals. Moreover, through limitation to the herbarium, many equally variable and important characters such as the colour of the flowers and the shininess of the leaves must be omitted, though from such features the living plants are most easily recognised. If it is permissible to make species on the

size of the leaf, so it is on the colour of the corolla *e.g.* *I. candida* and *I. lutea*. But the more one studies the wild plants the more one will encounter intermediates between the microspecies of the "splitters". For example, a good case might be put forward for uniting *I. chinensis*, *I. javanica*, *I. congesta*, *I. Lobbii* and *I. Robinsonii* because there are a few plants which cannot be classified as one or the other, but can be referred equally well to two of the species. To the field botanist in Malaya, *Ixora* is clearly in a 'state of evolution' comparable with that of *Rubus*, *Rosa*, or *Oenothera* and, systematically, as complicated. We must, therefore, compromise between the needs of the field-botanist and the scruples of the herbarium to procure a satisfactory classification.

To prove my point, I have defined the Malayan species in the widest possible sense and, under the red-flowered species, have indicated to some extent their variation by numbering the recognisable forms. It will be seen that these show such gradation that none can be separated as a species *e.g.* *I. javanica* with the corolla varying from 2-5 cm. long, 1-2.5 cm. wide, and from a basic yellow through pink to deep red. That these continuous variations should have been overlooked by previous authors must throw grave doubts on the value of their classifications. Certainly the keys of King, Ridley and Pitard are impracticable. I believe that by combining all such variable characters as the size, shape, texture, colour, shininess and venation of the leaf, the length of the stipule, petiole and peduncle, the variation in size of the corymbs and flowers and the colour of the petals, no less than a hundred 'forms' of *I. javanica* could be detailed for Malaya alone. And how many of these characters and combinations of characters would be hereditary? I think that the main species of *Ixora* are known. It is now time for the field-botanist and the geneticist to explore their variation.

I have not attempted to dissect Bremekamp's latest paper on the Malaysian species (Bull. Jard. Bot. Buit. ser. 3, vol. 14, 1937). I doubt if anyone will be prepared to struggle through so much detail before the name of a species can be found. The classificatory value of the details I consider so dubious and trivial that I would regard most of Bremekamp's species as forms of subspecies and his series as species, did our study of these forest plants usefully extend to such fractionising. If so many "species" can be recognised in the herbarium, what is to become of the genus when we shall have reckoned also with all the characters that disappear from the living plants on drying? If the length of the rudimentary sepals is so important or the



## GROUP C

- Corolla-tube less than 1.5 cm. long: fragrant:  
wild
- Flower-clusters 2-5 cm. wide: corolla-tube  
8-12 mm. long: lowlands .. .. *I. concinna*
  - Clusters 6-20 cm. wide: tube 3-9 mm. long:  
mountains .. .. *I. micrantha*
- Corolla-tube more than 1.5 cm. long: not  
fragrant
- Sepals 2-5 mm. long, longer than the ovary,  
rather leafy
  - Flowers yellow-red: leaves not cordate:  
wild .. .. *I. Kingstonii*
  - Flowers pink: leaves often cordate:  
cult. .. .. *I. coccinea* var. *rosea*
  - Sepals .5-1.5 mm. long, triangular, tooth-  
like, shorter than the ovary
  - Leaf more or less sessile, the base  
narrowly to widely cordate, at least  
on the vegetative shoots
  - Leaf 5-18 cm. wide: infloresc.  
branches red: petals blunt:  
wild
    - Dwarf shrub  $\frac{1}{2}$  m. high:  
leaves crowded .. *I. Scortechinii*
    - Spindly shrub 1-2 $\frac{1}{4}$  m. high:  
leaves well-spaced .. var. *caulescens*  - Leaf 1-7 cm. wide: infloresc.  
branches green: petals pointed:  
cult.
    - Flower red or orange turning  
red
    - Leaves acute: petals  
lanceolate-elliptic .. *I. coccinea*
    - Leaves often blunt: petals  
ovate-elliptic .. var. *bandhuca*  
var. *lutea*
    - Flowers yellow, unchanging
    - Petals yellow fading to pale  
pinkish white .. .. var. *decolorans*
    - Petals yellow then streaked  
with rose-pink .. var. *aureo-rosea*
    - Petals pink, turning deep clear  
pink .. .. var. *rosea*  - Leaf stalked, the base never cordate:  
infloresc. branches mostly red
  - Leaf-stalk 1-3 mm. long:  
cult.
    - Leaves small, narrow,  
.7-2.5 cm. wide: petals  
pointed .. .. *I. "Sunkist"*  
p. 235
    - Leaves rather blunt, 2.2-  
6.5 cm. wide: petals  
blunt
    - Corolla 1.4-1.6 cm.  
wide, tube 3-3.5  
cm. long .. .. *I. chinensis*



- Corolla 1-1.2 cm.  
wide, tube 1.8 cm.  
long .. ..
- Leaf-stalk 3-20 mm. long:  
wild or cult.
- Riverside shrubs with  
lanceolate leaves .7-3  
cm. wide
- Leaves glossy: side-  
veins 8-15 pairs,  
distinctly inarching  
near the margin ..
- Leaves rather dull:  
side-veins 6-10  
pairs, not inarching
- Not riverside: leaves 3-15  
cm. wide
- Mountain shrub of  
the Tahan neigh-  
bourhood (Ulu Pa-  
hang, Trengganu,  
Kelantan): leaves  
leathery, very gra-  
dually tapered into  
the stalk: petals  
pointed ..
- Leaves scarcely lea-  
thery: stalk always  
distinct from the  
blade
- Leaves with 14-26  
pairs of side-  
veins, distinctly  
inarching
- Leaf rather nar-  
rowly elliptic to  
narrowly ob-  
ovate, acumi-  
nate, up to 8.5  
cm. wide: side-  
veins 14-26  
pairs: petals  
acute ..
- Leaf rather  
broadly elliptic,  
up to 15.5 cm.  
wide: side-veins  
13-19 pairs:  
petals mostly  
blunt ..
- Leaves with 6-14  
pairs of side-  
veins, up to 11.5  
cm. wide
- Side-veins 6-12  
pairs, distinctly  
inarching ..
- var. *dixiana*
- I. Lobbii* var.  
*stenophylla*
- I. javanica*
- I. Robinsonii*
- I. Lobbii*
- I. congesta*
- I. javanica*
- var. *retinervia*

Side-veins not inarching	
Side-veins 9-14 pairs ..	var. <i>multinervia</i>
Side-veins 6-9 (-10) pairs	var. <i>paucinervia</i>
Flowers buff-yellow or pale orange buff ..	"Yellow Javanica"
Flowers yellow then clear pink, never red	"Pink Javanica"
Flowers yellow turning reddish pink or red	"Red Javanica"

### *I. amoena* Don

Gen. Syst. 3, 1834, p. 571.

Typus:—

Wallich 6121 D, E, F, (Penang): fide Hooker.

Interpretations:—

Hooker, F.B.I. 3, p. 146.

Pitard, Fl. Gen. Indoch., 3, p. 328.

Craib, Fl. Siam. En., 2, p. 149.

Misinterpretations:—

King and Gamble, Mat. Fl. Mal. Pen. 4, p. 154 as *I. stricta* Roxb.

Ridley, Fl. Mal. Pen. 2, p. 94, as *I. stricta* Roxb.

Synonyms:—

*Izora stricta* var. *amoena* Ridley, Fl. Mal. Pen. 2, 1923, p. 94.

From the published descriptions, it is impossible to see how *I. amoena* differs from *I. javanica*. The latest opinion is that of Craib who states that *I. javanica* has longer stipules, but, as he gives not the length of stipule in either, one cannot appreciate the difference. In *I. javanica* I find that the stipular point varies from 1-8 mm. even on the same plant but that it is generally long in plants growing in shady places, especially by riversides, and short in plants in the full open. Hooker says that *I. amoena* has a laxer habit and "longer, lanceolate, more membranous leaves" with more distinct petioles than *I. javanica*. Pitard copies Hooker. King and Gamble remark that only a slight difference in reticulation of the leaves distinguishes *I. amoena* from *I. javanica* (= *I. stricta* in their sense). Ridley distinguishes his variety *amoena* by the more coriaceous leaves in contradiction to Hooker, though both cite Wallich's collection. In the following list of identified specimens, a still greater variety of treatment will be discovered. Hence I regard *I. amoena* as a synonym of *I. javanica*.

IDENTIFIED SPECIMENS OF *I. AMOENA* IN THE SINGAPORE HERBARIUM

Craib's identifications:—

Keith 129 (= *I. javanica* form 1): Kiah 24360 (= *I. javanica* form 2). Haniff and Nur 3910 (= *I. javanica* form 9): Curtis 2607, Ridley 8354 (= *I. javanica* form 10): Ridley 14998 (= *I. javanica* form 23): (evidently Craib has not considered the variation in flower-size).

British Museum's identification:—

Robinson and Kloss, Korinchi Exp. 19.3.14 (= *I. javanica* form 29).

Merrill's identifications:—

Moulton 6703/15 (= *I. Lobbii* form 3): (almost identical specimens from the Anamba and Natuna Islands, v. Steenis 897 and Henderson 20185, are determined by v. Steenis as *I. javanica*).

Winkler 2154 (= *I. javanica* var. *retinervia*, probably).

I. *Brunonis* Don

Gen. Syst. 3, 1834, p. 573.

A shrub up to 3 m. high: twigs, corymbs and undersides of leaves rather closely hispid-hairy, uppersides of leaves soon glabrous.

Leaf-blade 14-34 × 4-10.5 cm., lanceolate-obovate, or nearly oblong, cuspidate-acuminate, the base narrowly to rather broadly cordate, membranous: side-veins 11-17 pairs, more or less inarching near the margin: petiole 0-5 mm. long, very short, hispid: stipular point 9-20 mm. long, filiform.

Corymb 6-12 cm. wide, generally dense and sessile, or with a peduncle up to 2 cm. long, the bracts, sepals, branches and corolla hispid hairy: bracts 5-10 mm. long, filiform: flowers white, fragrant: sepals 2.5-5 mm. long, filiform: corolla-tube 3-4 cm. long, the outside of the tube and the mouth hairy: petals 6-9 mm. long × 2-3 mm. wide, oblong, acute, hairy on the outside.

Distribution:—Burma, Siam, North Malaya (Penang, Upper Perak, Kedah).

Type:—Wallich 6136 (Penang).

Very little is known about this species which appears to be rather rare. The oblong-obovate, cuspidate, hairy leaf with almost sessile, cordate base is distinctive.

I. *chinensis* Lam.

Chinese *Ixora*

Encycl. 3, 1789, p. 344.

Synonyms:—

*I. stricta* Roxb. Hort. Beng. 1814, p. 10: Fl. Ind. 1, 1820, p. 388: Fl. Gen. Indoch. III, p. 326: haud sensu Hooker, King, Gamble, Ridley.

*Flamma silvarum peregrina* Rumph. Herb. Amb. 4, p. 107, t. 47.

Icones:—

Rumphius loc. cit.

Curtis, Bot. Mag. t. 169 (as *I. coccinea*).

Wight, Ic. t. 184 (as *I. stricta*).

Bot. Reg. t. 782 (as *I. crocata*).

Typus:—

Sonnerat, spec. sinense, in Herb. Lam.

A glabrous shrub, ? flowering all the year in Malayan countries.

*Leaf-blade* 4-15.5 × 2.2-6.5 cm., elliptic, lanceolate-elliptic or narrowly obovate, *subacute or blunt*, tapering gradually to the suddenly rounded narrow base or even narrowly cordate, not amplexicaul, *sessile*, more or less coriaceous, rather dull green often yellowish green, with 6-10 pairs of side-veins not or indistinctly anarching: *petiole* 1-3 cm. long: stipular point 1-3 cm. long.

*Corymb* 5-10 cm. wide, dense, sessile or with a peduncle up to 1.5 cm. long, *with crimson, articulate branches*; sepals blunt to subacute, shorter than the ovary: corolla-tube 3-3.5 cm. long, the limb 1.4-1.6 cm. wide, *the petals broadly elliptic or orbicular, very blunt with the edges not or scarcely recurved, apricot yellow turning brick red.*

*Distribution*:—S. China, Indochina: elsewhere introduced.

I follow Merrill in his interpretation of this species (Interpr. Rumph. Herb. Amb. p. 487) though he did not give botanical evidence or a description of the species that he had in mind. But the small, sessile, blunt, few-veined leaves and extraordinarily blunt, broad petals, which make the flower look very full, readily distinguish it and by this means one can certainly unite the plants of Rumphius, Lamarck and Roxburgh. Pitard's description (Fl. Gen. Indoch.) corresponds exactly.

Whether *I. chinensis* is specifically distinct from *I. javanica* I do not know. The very short petiole of *I. chinensis* appears to be the only diagnostic character. A critical study of the wild species in Siam and Indochina (cf. *I. amoena* sensu Pitard) is much needed. *I. crocata* Lindley, which has always been referred to *I. stricta* sensu Hooker (= *I. javanica*), seems to me unquestionably *I. chinensis*. Whether the illustration of *I. javanica*, Bot. Mag. t. 4586, represents *I. javanica* or *I. chinensis* I cannot decide.

On the other hand, *I. chinensis* has been often mistaken for *I. coccinea* and it seems that it still is. The more or less amplexicaul leaf-base and pointed petals distinguish *I. coccinea*, but fragmentary herbarium specimens may not be easy to identify because the leaves on short flowering stems may be reduced and have a base more like that of *I. chinensis*. Moreover, the garden variety called *I. dixiana* is referred in the Index Kewensis to *I. coccinea* though it is certainly a dwarf form of *I. chinensis*. *I. dixiana*, in fact, differs from *I. chinensis* only in its dwarf habit (1½-1 m. high) and small flowers (corolla-tube 1.8 cm. long, limb 1-1.2 cm. wide). I am inclined to think that the plant called by the garden name "Sunkist" in this paper is a hybrid between *I. chinensis* and *I. javanica* or *I. Lobbi*. I have seen no published description that would fit it.

*I. stricta* Roxb. sensu Hooker, King and Ridley is *I. javanica*.



**f. clerodendron** Ridley

Trans. Linn. Soc. 3, 1893, p. 311.

A small, little branched shrub; young parts pubescent.

Leaf-blade  $23 \times 9$  cm., lanceolate or obovate, narrowed to both ends, glabrous above, pubescent beneath: stipules 1.2 cm. long, triangular subulate.

Corymb 2.5 cm. wide, dense, pubescent, many-flowered: flower white: sepals 6 mm. long, ovate, pubescent, longer than the ovary, red: corolla-tube 2.5 cm. long: petals 3 mm. long, oblong-ovate, subacute, white.

Fruit 6 mm. long, grey with red-streaks, crowned with the red sepals.

Distribution:—Pahang (Malaya).

Type:—Ridley's specimen from Kuala Tembeling.

This description is taken from Ridley's. There is no specimen in the Singapore Herbarium. The species must come very close to *I. pumila* which differs in the smaller, lanceolate sepals and relatively broader leaves. I suspect that they may be identical. Both are from the same district of Pahang.

**I. coccinea** L.

Indian *Ixora*

Sp. Pl. 3rd Ed., 1764, p. 159. (excl. synonym).

Synonyms:—

*I. grandiflora* Br., Bot. Reg. t. 154.

Icons:—

Bot. Reg. t. 154 (as *I. grandiflora*).

Wight lc. t. 153 (as *I. coccinea*).

A shrub or treelet to 4 m. high, flowering throughout the year, glabrous except the puberulous branches of the corymb.

Leaf-blade  $3.5-13 \times 1-7$  cm., elliptic, varying blunt to acute, the base more or less widely cordate and amplexicaul, sessile or shortly stalked, (often narrowly cordate or broadly rounded and shortly stalked on short flowering twigs), rather dark shiny green, scarcely coriaceous: side-veins 9-14 pairs, inarching near the edge: petiole 0-7 mm. long: stipular point 2-7 mm. long.

Corymb 5-10 cm. wide, sessile or with a short peduncle up to 2.5 cm. long, the branches puberulous, articulate, green, the flowers in trichasia the central one generally sessile, the laterals shortly stalked: sepals broad, subacute, reddish, shorter than the green ovary; corolla-tube 2-3.5 cm. long, the limb 1.3-3 cm. wide, the petals 2-8 cm. wide, lanceolate-elliptic, acute, pinkish yellow or reddish pink with orange base turning blood red or crimson.

Distribution:—N.E. India, China, Indochina; elsewhere introduced.

Type:—Osbeck's specimen of the Flora Zeylanica.

**var. bandhuca**

*Ixora* Bandhuca

Syn. *I. bandhuca* Roxb. Fl. Ind. I, 1820, p. 386.

Wight lc. t. 149 (copy of Roxburgh's drawing of *I. bandhuca*).

Bot. Reg. t. 513.

A bushier, more spreading shrub: *leaves obtuse or sub-acute: petals 8-10 mm. wide, ovate-elliptic, rather suddenly pointed, not lanceolate-acute, hence the flower fuller: corolla-tube 3.5-4 cm. long, limb 2.5-3 cm. wide.*

Distribution:--Hindustan.

var. *lutea*

Yellow Coccinea

Syn. *I. lutea* Hutchinson Bot. Mag. t. 8439.

Petals buff-yellow, unchanging or fading pale yellow, never reddening, ovate-elliptic: sepals green: corolla-tube whitish.

Origin:—Royal Botanic Gardens, Peradeniya, Ceylon.

var. *decolorans* var. nov.

Pallid Coccinea

Lamina semper minore, 2.5-7.5 × 1.5-3.8 cm., elliptica, *acuta, basi anguste cordata*, (laminis ramulorum floriferorum saepe vix cordatis vel cuneatis), costis lateralibus utrinsecus 7-12: petiolo 1-2 mm. longo.

*Floribus luteis dein roseo-pallescens vel albido-roseis; corollae tubo albido, 2.7-3.1 cm. longo; corollae limbo 2-2.3 cm. lato, petalis 6-7 cm. latis, ovato-ellipticis, acutis.*

Origin:—horti?

Typus:—frutex in hort. bot. Singap.

var. *aureo-rosea* var. nov.

Gold Coccinea

Petalis luteis dein marginem versus roseis vel roseo-striatis, semper aureo-roseis, nunquam coccineis, late ellipticis, acutis, 7-8 mm. latis: corollae tubo 4-4.5 cm. longo, pallide roseo-luteo, limbo 2.7-3 cm. lato.

Origin:—horti?

Typus:—frutex in hort. bot. Singap.

var. *rosea* var. nov.

Pink Coccinea

? *Pavetta incarnata* Bl. Bijdr., 1825, p. 950.

*Floribus roseis, primo pallide roseis, nec rubris nec luteis: sepalis 2-2.5 mm. longis, late lanceolatis, foliaceis, roseo-marginatis, ovario longioribus: corollae tubo 1.5-2.5 cm. longo, pallide roseis, limbo 1.2-2.3 cm. lato: petalis 2-6 cm. latis, oblongo-ellipticis, acutis vel subacutis, proxime marginibus recurvatis: ovario 1-1.5 mm. longo, virido: ramulis inflorescentia viridis.*

Origin:—? : cult. in Malaya.

Typus:—Corner 34514 (Woodleigh Nursery, Singapore, 5.11.37 = Form 8).

*I. coccinea* was, and perhaps still is, confused with *I. chinensis*, as I have mentioned under that species. But the description of Linnaeus indicates how *I. coccinea* must be interpreted, that is "foliis ovalibus semiamplexicaulibus", and in this wide sense it is a useful species. I have often observed that the leaves on flowering twigs incline to the shape of those of *I. chinensis* so that such a twig by itself may be difficult to distinguish from one of *I. chinensis* except for the pointed petals. However, amplexicaul cordate leaves can always be found on sterile shoots of *I. coccinea* and never on those of *I. chinensis*, or indeed, of any

other red-flowered species in the sense in which I understand them. I believe also, that one may find that *I. coccinea* has always green and *I. chinensis* red corymb-branches.

*I. bandhuca* seems not to be recognised nowadays. From dried specimens it is no doubt difficult, but with the living plants it is easy. The difference from *I. coccinea* is well shown in Wight's two plates which are copies of Roxburgh's drawings. The distinctions are, however, merely varietal. The var. *bandhuca* is the commonest variety of *I. coccinea* in Malaya.

*I. lutea* is clearly only a colour-variety of typical *I. coccinea*, in which the red colour does not develop. Hence I have reduced it to varietal rank. The amplexicaul leaves distinguish it from the yellow variety of *I. javanica*.

The var. *decolorans* is proposed for a bush growing in the Singapore Botanic Gardens and which has been mistakenly called *I. bandhuca* for many years. I have not found a description of it. The washed-out colour of the flower is not beautiful.

The var. *aureo-rosea* I propose for another plant growing in the Singapore Botanic Gardens, and believed to have been introduced from Kew. I can find no description of it either. It is a magnificent, free-flowering plant of considerable vigour for which a name has long been needed.

The variety *rosea* is probably *Pavetta incarnata* Bl. of which there is no modern or ample description. It has the sessile amplexicaul, pointed leaves typical of *I. coccinea* on the vegetative shoot, but those on the flowering shoots have generally a simple, rounded base suggesting that of *I. javanica*. The sepals offer the only discrepancy in identifying the variety with *I. coccinea*, the sepals of which do not exceed the ovary in length, but a specific value can hardly be attached to this feature when the overwhelming similarity with *I. coccinea* in other respects is borne in mind. I do not find that a pink variety of *I. coccinea* has been described and as this is a frequent plant in Malayan gardens it is in need of a name. If *I. rosea* Wallich (Bot. Mag. 2428, Bot. Reg. 540) is correctly identified with *I. stricta* sensu Hooker (= *I. javanica*) then it cannot be my var. *rosea*, though t. 2428 is very suggestive of it, excepting the pubescence.

What I have called *I. coccinea* form 4 has been grown for several years in the Singapore Botanic Gardens as *I. oculata*, which name I cannot find in botanical literature.

As I have remarked under *I. chinensis*, the garden species *I. dixiana* is a variety of it and not of *I. coccinea* as stated in the Index Kewensis.

KEY TO THE FORMS AND VARIETIES OF *I. COCCINEA*

## Petals red

- Petals lanceolate elliptic, attenuate, .2-8 cm. wide .. .. . *I. coccinea*
- Corolla-tube 2-2.5 cm. long  
Limb 1.3-1.6 cm. wide: petals .2-.3 cm. wide .. .. . Form 1
- Corolla-tube 3-3.5 cm. long  
Limb 1.5-1.7 cm. wide, petals .4-.5 cm. wide .. .. . Form 2
- Limb 2-2.3 cm. wide: petals .5-.6 cm. wide .. .. . Form 3
- Limb 2.7-3 cm. wide: petals .6-.8 cm. wide .. .. . Form 4
- Petals ovate elliptic, rather suddenly pointed, .8-1 cm. wide .. .. . var. *bandhuca*
- Petals yellow, never reddening .. .. . var. *lutea*
- Corolla-tube 3.2-3.7 cm. long: limb 2.4-2.7 cm. wide: petals .6-.8 cm. wide .. .. . Form 5
- Corolla-tube 4-4.5 cm. long: limb 2.7-3 cm. wide: petals .8-.9 cm. wide .. .. . Form 6
- Petals yellow, fading pale pinkish white .. .. . var. *decolorans*
- Petals yellow then streaked with rose, rather broad .. .. . var. *aureo-rosea*
- Petals pale pink turning deep pink, never red or yellow, oblong elliptic .. .. . var. *rosea*
- Corolla-tube 1.5-1.8 cm. long: limb 2-2.3 cm. wide: petals .5-.6 cm. wide, subacute .. .. . Form 7
- Corolla-tube 2-2.5 cm. long: limb 1.2-1.5 cm. wide: petals .2-.3 cm. wide, acute with a minute mucro .. .. . Form 8

***I. concinna* Hook. f.**Trogon *Ixora*

F.B.I. 3, 1880, p. 147.

A small to medium-sized tree up to 20 m. high: *wholly glabrous*.

*Leaf-blade* 6.5-18 × 2-7 cm., elliptic, tapered to each end, more or less acuminate, membranous or subcoriaceous: *side-veins* 8-13 pairs, distinctly inarching: *petiole* .2-1.2 cm. long.

*Corymb* 2.5-5 cm. wide, sessile or on a short peduncle up to 1.2 cm. long, the branches slender 1 mm. wide or less, articulate, glabrous (? red or green): *sepals* .5-2.5 mm. long, lanceolate-triangular, *variable in size*, shorter than the ovary, as long as or longer than in different collections, never leafy: *corolla-tube* 8-12 mm. long, *short, yellowish pink to reddish pink: corolla-limb* .7-1 cm. wide, *the petals acute, yellow turning pinkish and finally dull-red*, or partly red: *ovary* 1-1.5 mm. long: *flowers fragrant*.

*Fruit* .7-1 cm. wide.

*Distribution*:—Malaya, Sumatra, Borneo.

*Type*:—Wallich 6149 (Singapore).

This is one of the less variable *Ixoras*. It is distinguished by its small leaves and flower-clusters and its fragrant flowers. The variable features are the texture of the leaf and the length of the sepals. The leaf may be membranous or distinctly coriaceous, perhaps dependent on the size of the tree and its situation. The sepals may be shorter than



the ovary or considerably longer or of intermediate length, their length being fairly constant in each collection. Although this variation seems to have escaped the attention of botanists, so that we have been spared from numerous micro-species which would have made the identification of the trees impossible until one had seen the sepals, the range of variation is greater than that of any other species, being 5 times the minimum length of the sepals.

*I. concinna* has been mistaken in the Singapore Herbarium and in Ridley's Flora for my *I. javanica* var. *retinervia* from which it differs in its smaller, fragrant flowers, less pointed leaves with the veins making a more acute angle with the midrib and not so distinctly inarching, its laxer and more slender inflorescence branches (2 mm. wide in *I. javanica* var. *retinervia*) and smaller fruits (1-1.3 cm. wide in var. *retinervia*).

### *I. congesta* Roxb.

Malayan *Ixora*

Fl. Ind. 1, 1820, p. 397.

Synonyms:—

*I. Griffithii* Hook. Bot. Mag. 1847, t. 4325.

*I. fulgens* Roxb. sensu Hook. fil. F.B.I. 3, 1880, p. 146.

An evergreen shrub or small tree like *I. javanica* but:—  
*Leaf-blade* generally larger or broader, 13-31 × 5-15.5 cm. wide, with more numerous, stronger lateral veins (13-19 pairs) generally with distinctly inarching marginal loops.

*Sepals* blunt to acute, generally acute.

*Petals* yellow or pinkish yellow turning red, generally blunt to subacute.

Distribution:—W. Malaysia to the Moluccas.

Bremekamp has recently substituted the name *I. Griffithii* for Malayan plants which have been referred to *I. congesta* (Journ. Bot. 75, 1937, p. 169). Roxburgh described *I. congesta* from a plant growing in the Calcutta Botanic Gardens and said to have been derived from the Moluccas. There is no type and the description is brief. Hence Bremekamp writes of it "species moluccana dicta, parum descripta et absentia typi haud certe noscenda, dubiosissima". Why then did Hooker reduce *I. Griffithii* to *I. congesta*, in which he was followed by Kurz, King, Gamble, and Craib? I think that Bremekamp has overlooked the traditions of Indian Botany which were handed from Roxburgh to Hooker through the succession of Superintendents of the Calcutta Botanic Gardens and through Roxburgh's own circle of botanists, of which Wight and Arnott have given us the picture. As no reason is advanced for rejecting this long-standing interpretation of *I. congesta*, one must continue to employ it in accordance with the Rules of Nomenclature. *I. fulgens* offers a parallel case where the full description of Rumphius should enable

one to identify Roxburgh's species, but Bremekamp denies the Moluccan origin of *I. fulgens*.

Merrill has identified *I. congesta* with *I. fulgens* but, as I have shown under that species, nobody has yet identified *I. fulgens* (Enum. Philipp. Fl. 3, p. 548). Rumphius' plate, which is the type of *I. fulgens*, shows an *Ixora* with pointed petals. The only form of *I. congesta* with pointed petals is my form 9 and that most botanists would probably not admit as *I. congesta*.

Although it is generally easy to distinguish *I. congesta*, *I. Lobbi* and *I. javanica*, there are collections in the Singapore herbarium which connect them as I have mentioned under those species. What I have called *I. congesta* form 9 is especially problematic.

#### KEY TO THE FORMS OF *I. CONGESTA*

- Corolla-tube 3.7-4.5 cm. long  
 Limb 1.5-1.8 cm. wide: petals .4-.5 cm. wide, blunt to subacute .. .. . Form 1  
 Limb 1.8-2.1 cm. wide: petals .5-.6 cm. wide, subacute .. Form 2  
 Corolla-tube 2.5-3.8 cm. long  
 Limb 1-1.3 cm. wide  
 Petals .3-.4 cm. wide, subacute .. .. . Form 3  
 Petals .5-.7 cm. wide, blunt .. .. . Form 4  
 Limb 1.4-1.8 cm. wide: petals blunt to subacute  
 Petals .3-.5 cm. wide .. .. . Form 5  
 Petals .5-.7 cm. wide .. .. . Form 6  
 Limb 1.8-2.1 cm. wide  
 Petals .3-.5 cm. wide, subacute .. .. . Form 7  
 Limb 2-2.8 cm. wide: petals .5-.7 cm. wide  
 Petals blunt to subacute .. .. . Form 8  
 Petals acute .. .. . Form 9  
 Limb 2.5-3.8 cm. wide: petals blunt to subacute  
 Petals .5-.7 cm. wide, orange yellow then red: limb 2.5-3.8 cm. wide: veins of leaf 9-14 pairs .. Form 10  
 Petals .7-.8 cm. wide, pale yellow then salmon pink: limb 2.5-3 cm. wide: veins of leaf 14-19 pairs .. Form 11

#### Form 1

Corolla-tube 3.75-4.5 cm. long, limb 1.5-1.75 cm. wide: petals .35 cm. wide, blunt to subacute.

#### Malayan Collections

Perak; Derry 10716, Henderson 10202.  
 Johore; Corner 32226, s.n. 1.9.35 (Kota Tinggi-Mawai Road).  
 Singapore; Cantley s.n., Ridley 4168 (det. *I. Lobbi*), s.n. 9.11.99 (Chua Chu Kang).

#### Form 2

Corolla-tube, 3.75-4.25 cm. long, limb 1.75-2.1 cm. wide: petals .5-6 cm. wide, subacute.

#### Malayan Collections

Malacca; Goodenough 1907.

#### Form 3

Corolla-tube 3-3.75 cm. long, limb 1-1.25 cm. wide: petals .35-.45 cm. wide, blunt to subacute.

*Malayan Collections*

Penang; Curtis 2975.  
 Perak; Cantley s.n., Kunstler 675, Wolferston s.n. April 1900,  
 Wray 702.  
 Pahang; Henderson 24432.  
 Selangor; Ridley 13409.  
 Johore; Corner 25968, Ridley s.n. 1900 (Batu Pahat), Singapore  
 F.827.  
 Singapore; Cantley 2668, 2672, 3005, Goodenough s.n. 1892  
 (Pulau Ubin) Ridley 5675, 6911, s.n. 1890 (Tg. Penjuru).

*Form 4*

as Form 3 but petals .5–.65 cm. wide.

*Malayan Collections*

Singapore; Cantley/s.n. (det. *I. stricta*).

*Form 5*

Corolla-tube 3–3.75 cm. long, limb 1.5–1.75 cm. wide: petals  
 .35–.5 cm. wide, blunt to subacute.

*Malayan Collections*

Penang; Curtis 667, 1729, 2257 (det. *I. Lobbia* by King &  
 Gamble).  
 Perak; Curtis s.n. Feb. 1900 (Lumut), Henderson 10203, Ridley  
 s.n. Feb. 1892 (Lumut).  
 Pahang; Nur 18786.  
 Selangor; Goodenough 10481, Hume 7162, 7607.  
 Negri Sembilan; Holttum 9691, 9768, Nur 11570.  
 Malacca; Alvins s.n., Burkill 788 (det. *I. fulgens*), Derry 8,  
 Goodenough 1692.  
 Johore; Corner 29766, Kiah 32326, Ridley s.n. 1894 (S. Bau).  
 Singapore; Hullett 118, Ridley s.n. Reservoir Woods, s.n. Oct.  
 1889 (Chan Chu Kang).

The flowers are pinkish yellow on opening, turning to  
 light reddish orange. It seems that there may be states  
 with persistently pink flowers.

*Form 6*

as Form 5 but petals .5–.7 cm. wide.

*Malayan Collections*

Penang; Curtis 2265 (see also Form 8).

*Form 7*

as Form 5 but corolla-limb 1.75–2.1 cm. wide, petals  
 subacute.

*Malayan Collections*

Perak; Henderson 10116.  
 Malacca; Goodenough 1692.

*Form 8*

as Form 5 but corolla-limb 2–2.5 cm. wide, petals .5–.65 cm.  
 wide, blunt to subacute.

*Malayan Collections*

Penang; Curtis 2265 (see also Form 6) (det. *I. fulgens* by  
 King).  
 Selangor; Hume 7577.

## Form 9

Ixora Singapore

Leaves as in *I. congesta* but rather narrow 4-28 × 5-9 cm., with 12-18 pairs of lateral veins.

Sepals rather blunt.

Corolla-tube 2.5-3.5 cm. long, the limb 2.3-2.8 cm. wide: petals .5-.6 cm. wide, ovate-lanceolate, acute, opening pinkish buff with only the base clear orange yellow, turning deep carmine-red or crimson.

## Malayan Collections

Singapore (cult. in Hort. Bot. Sing.); Corner 30794, 33699, Nur 22, s.n. 26.9.18, Ridley s.n. 1891.

It seems that this *Ixora* was received from Kew many years ago as *I. macrothyrsa*. But the plants in the Singapore Gardens have lost their labels and there is no certainty whence they came. Instead, the name *I. macrothyrsa* has for many years been given to the Common Red *Ixora* of our Gardens which I call *I. javanica* form 7.

Whether *I. congesta* form 9 is *I. macrothyrsa* I have no means of ascertaining. According to description (Bot. Mag. t. 6853) the flowers of *I. macrothyrsa* are persistently red, but the description is not sufficiently critical.

This form 9 has the leaf-shape and size of *I. javanica*, the pointed petals of some forms of *I. javanica* as well as of *I. Lobbiani*, but the numerous veins of *I. congesta*. Its systematic position is problematical yet demonstrative: because of the veins I classify it under *I. congesta*. It corresponds remarkably well with *I. fulgens* as that species must be interpreted from Rumphius' plate and description.

Unlike the common *I. javanica* form 7, this form 9 is strictly seasonal in flowering like the wild plants of *I. congesta*, *I. Lobbiani* and *I. javanica*.

## Form 10

Ixora Kemaman

Leaves with only 9-14 pairs of side-veins.

Corolla-tube 3.25-4 cm. long, the limb 2.5-3.8 cm. wide: petals .5-.65 cm. wide, oblong, blunt.

## Malayan Collections

Trengganu; Corner 30002 (Kemaman).

Pahang; Symington 28825 (Gunong Tapis), 28761 (Sungei Lembing).

This magnificent *Ixora* with large, brilliant flowers appears to be limited to the watersheds of the Kuantan and Kemaman rivers. It should be classified with *I. javanica multinervia* according to my criterion of the number of veins but the dark brown colour of the dried leaves and their coarse, conspicuous blackish venation is identical with that of *I. congesta* so that I am compelled to regard it as an aberrant form of this species. From the large flowered forms (7, 8) of *I. Lobbiani* it differs in the elliptic, simply pointed leaves (not lanceolate-obovate and acuminate) the fewer, coarser veins and the blunt petals.



*Form 11*

Corolla-tube 2.5–3.8 cm. long, limb 2.5–3 cm. wide, petals .6–.75 cm. wide, blunt to subacute, pale yellow turning light pinkish red.

*Malayan Collections*

Singapore; Corner s.n. 25.1.37 (Reservoir Jungle).

I have noticed in Singapore that plants of this form generally flower after those of other forms of *I. congesta* at each seasonal flowering.

*Sterile or Fruiting Specimens (not flowering)**Malayan Collections*

Trengganu; Moysey 33308.

Perak; Cantley s.n.

Pahang; For. Dept. 15139.

Malacca; Alwins s.n., Goodenough s.n. 1892 (Tebau).

Johore; Holtum 9221, Lake & Kelsall s.n. 20.10.92, (K.

Sembrong) Ridley 11164, s.n. 1900 (Minyak Buku).

Singapore; Cantley s.n., Burkill 709, 714 (det. *I. fulgens*), Hullett s.n. 1893 (Changi Road), Ridley 8410, s.n. 1889 (Selitar), s.n. 9.11.99 (Chua Chu Kang), s.n. 1901 (Yo Chu Kang).

*I. finlaysonian* DonSiamese White *Ixora*

Gen. Syst. 3, 1834, p. 572.

A shrub, commonly becoming a small tree 5–6 m. high with stout trunk as thick as a man's leg and massive old branches: glabrous except for the very sparsely puberulous branches of the cyme.

*Leaf-blade* 6–16 × 2–6.5 cm., rather small, lanceolate elliptic to lanceolate obovate or almost spathulate, varying blunt to simply acute, the base very gradually attenuate, rather leathery: *petiole* 4–8 mm. long, short: *stipular point* 1–2.5 mm. long, short.

*Corymb* 6–11 cm. wide, sessile or with a peduncle up to 1.5 cm. long, the branches articulate, pale green, dense, and sparsely puberulous, flowers white, scented: *bracts* 6–12 × 1.5–2.5 mm. linear-lanceolate, pale green: *bracteoles* 2–5 × .5–1 mm. linear: *sepals* 3–5 × 1.5–2 mm., oblong, pointed or rather blunt, glabrous, green-veined, longer than the ovary (1 mm. long): *corolla-tube* 2–3.5 cm. long, glabrous, the mouth also glabrous, pale greenish: *petals* 5–7 × 2.5–3.5 mm., at first acute, becoming blunt with recurved edges, white: ovary often pinkish.

Distribution—India, Indo-China, Siam.

Type:—Wallich Cat. 6166.

This species is easily recognised from its tree-like habit, its narrow, often blunt, leaves with rather few veins and short petiole (as in *I. javanica*), the white fragrant flowers, linear bracteoles and oblong green-veined sepals exceeding the ovary in length. It is frequently cultivated in India, Indo-China, Siam and Malaya, and its native country appears to be Siam.

Specimens from the plants cultivated in the Singapore Botanic Gardens were compared recently with the Wallichian type of *I. finlaysoniana* by Mr. M. R. Henderson who reported that they matched very well. The Malayan plants also agree with Pitard's description of the species except that Pitard describes the leaves as larger, with more pairs of lateral veins (10-12) and the corolla with short tube (19-21 mm. long) and smaller petals (4-5 × 2-2.5 mm.) (Fl. Gen. Indoch. 3, p. 312). But, as in other *Ixoras*, I find that the flowers vary considerably in size in different collections, the larger-flowered forms being always the more desirable for cultivation.

The species has been received from India for cultivation in Singapore as *I. stricta* var. *alba* which it cannot be because of the long sepals and bracts and the fragrant flowers. I think it has yet to be proved that there is really a white-flowered variety of any red-flowered *Ixora*.

### *I. fulgens* Roxb.

Hort. Beng. 1814, 10. (name and citation of *Flamma silvarum* of Rumph. Herb. Amb. 4, p. 105, t. 46).

Typus:—*Flamma silvarum* of Rumphius loc. cit.

#### *Interpretations*:—

Roxburgh, Fl. Ind. 1, 1820, p. 387.

Wallich, Cat. 6152.

Wight, lc. Pl. I, t. 151.

Miquel, Fl. Ind. Bat. 2, 1857, p. 264 (as *Pavetta fulgens*).

Hooker fil., F.B.I. 3, 1880, p. 146.

Koorders and Valeton, Bijdr. Booms. Java 8, 1902, p. 158.

King and Gamble, Mat. Fl. Mal. Pen. 4, 1904, p. 79.

Merrill, Interpr. Rumph. Herb. Amb. 1917, p. 487: Enum.

Phil. Pl. 3, p. 548.

Pitard, Fl. Gen. Indoch. 3, 1924, p. 325.

Craib, Fl. Siam. Enum. II, 1934, p. 157.

Bremekemp, Journ. Bot. 75, 1937, p. 111: Bull. Jard. Bot.

Buit. ser. 3, 14, 1937, p. 215.

From Roxburgh's description in the Flora Indica it is clear the binomial *I. fulgens* was made for a plant cultivated in the Royal Botanic Gardens at Calcutta, the plant having been introduced from the Moluccas. There is no specimen of Roxburgh's plant but a drawing of his which is that reproduced by Wight. There is also a collection of Wallich's 6152 which Wallich, who was Roxburgh's successor, identified with *I. fulgens*, and which was evidently seen and passed as such by Wight. Therefore, though Roxburgh's plant may have disappeared, it should be possible to determine what Roxburgh intended for *I. fulgens* from his drawing and from Wallich's specimens. Unfortunately, according to the Rules of Botanical Nomenclature, neither of these clues indicate what, taxonomically, must be intended by *I. fulgens*. The first publication of this binomial is in

Roxburgh's Hortus Bengalensis. This is accepted as a valid publication and, because a species can be validated merely by citation of a plate, Roxburgh's binomial *I. fulgens* which is without description is validated by reference to Rumphius' plate. Hence, taxonomically, the identity of *I. fulgens* hangs upon the identification of Rumphius' *Flamma silvarum*, about which no more is known than what Rumphius has written. Nevertheless, several interpretations have been made which I will now elaborate.

Roxburgh's own interpretation by his description and drawing, reproduced by Wight, is the first. It has been denied recently by Merrill and Bremekamp, after a century's acceptance, though I cannot discover that it has ever been amplified or critically examined in the light of modern systematics. Wallich's interpretation, by his collection 6152, has never been published, there being no description of his specimen: I imagine that his interpretation must coincide with Roxburgh's. Hooker's interpretation combines that of Roxburgh's and Wallich's (by quotation), with *I. Lobpii* by citation and by specimens (according to King and Gamble): it seems that the *Ixora* which botanists now call *I. Lobpii*, Hooker called *I. fulgens*. Koorders and Valetton follow Hooker and make *Pavetta salicifolia* Bl. into a variety of *I. fulgens* in their sense (= *I. Lobpii*). King and Gamble deny Hooker's interpretation and, distinguishing *I. Lobpii* from *I. fulgens*, refer to *I. fulgens* a narrow-leaved *Ixora* which appears to be my *I. javanica retinervia* (at least, according to the collections Wray 3024 and Scortechini, cited by King and Gamble, and according to their description). Merrill (1918) arrived at no decision concerning the identity of *I. fulgens*, though he named as such the Amboina collection, Robinson 169: there is no description of the collection so that Merrill's interpretation is hid, like Wallich's, until the specimens be examined and described. Later, 1923, Merrill identified, without advancing reason, *I. congesta* Roxb. with *I. fulgens* Roxb., thus refuting Roxburgh's own interpretation: (the acute petals shown in Rumphius' plate ill suit the blunt ones of *I. congesta* described by Roxburgh). Pitard's interpretation is a copy of that of King and Gamble ("teste the misquotation of Wight's plate). Craib also follows King and Gamble and identifies a Siamese collection with *I. fulgens*. Most recently Bremekamp has given the problem a wholly new turn by remarking that "Roxburgh described this species [*I. fulgens*] from a plant cultivated in the Botanic Gardens, Calcutta. It was supposed to have been introduced from the Moluccas, but this was obviously a mistake, probably due to a superficial resemblance to the plant described and figured by Rumphius under the name

*Flamma silvarum*". Further, Bremekamp adds for the distribution of *I. fulgens* "Known with certainty from Tenasserim only"; and he seems to doubt Craib's identification of the Siamese plant. As regards Bremekamp's first point, if it is true, then he has discovered some information hitherto unknown to botanists, even to Roxburgh himself, which will give a different value to Roxburgh's interpretation, yet one cannot except such a bare contradiction without proof. But from Bremekamp's second point, it is clear that he has misunderstood the taxonomic intricacy of the identity of *I. fulgens* which can be determined, if at all, only from the Amboina-flora. Moreover, like that of Merrill and Wallich, his interpretation of *I. fulgens* must remain a mystery to botanists who cannot examine the specimens cited, because there is no description. (Such interpretations seem to me valueless and of the same category as *nomina nuda*: the essence of systematic botany being to classify plants with sufficient accuracy that other botanists may recognise them from the *published descriptions*, hence *nomina nuda* are illegal, and so, too, should be *interpretationes nudi*: the mere citation of specimens or expression of opinion should be as insufficient to validate the interpretation).

It must be remarked, now, that from King and Gamble onwards there has passed unnoticed a discrepancy between the description of *I. fulgens* given by King and Gamble and the descriptions of Roxburgh and Rumphius. King and Gamble give the leaves of *I. fulgens* as  $3\frac{1}{2}$ - $5\frac{1}{2} \times 1\frac{1}{4}$ - $1\frac{1}{2}$ " : Rumphius gives  $8$ - $12 \times 2$ - $3\frac{1}{2}$ " , for *Flamma silvarum*: and Roxburgh gives  $6$ - $8 \times 1$ - $3$ ". I think that it is extremely improbable that *I. fulgens sensu* King and Gamble, with such small narrow leaves, should be identical with *Flamma silvarum* of Rumphius. Hence, it is evident that the interpretation of *I. fulgens* by King and Gamble and also those by Pitard, Craib and Bremekamp, who cite King and Gamble are doubtful. Bremekamp's interpretation is rendered yet more uncertain because he has not followed up the clue to Roxburgh's interpretation which the Wallichian specimens must afford.

*I. fulgens* Roxb. has therefore been interpreted as *I. Lobbii*, *I. congesta* and *I. javanica*, the three common species of Western Malaysia, from which I conclude that it is still an unknown species awaiting identification by a resident of Amboina. However, I may give my own interpretation which is that my *I. javanica* form 7 is the Rumphian plant, for the following reasons.

There is no record how this form 7 which is the Common Red *Ixora* of Malayan gardens, was introduced to



Malaya but it has evidently been in cultivation for very many years. It agrees so well with Roxburgh's description and drawing as well as with Rumphius' that I can find no discrepancy: it also has large leaves, 4-11 × 1 $\frac{3}{4}$ -4 $\frac{3}{4}$ " and, as Roxburgh remarks, it blossoms most part of the year. Wallich's collection 6152a came from Penang and/or Singapore; it agrees presumably with Roxburgh's drawing; it may even have been our Common Red *Ixora* because there is no other common big-leaved *Ixora* with red, pointed petals in Penang or Singapore. Now, if Roxburgh's plant of *I. fulgens* came from the Moluccas, is it not likely that this same species was brought by the early travellers to other countries and to what place more likely than Penang, especially on its way to India? Rumphius called his other red *Ixora*, *Flamma silvarum peregrina*, for the very reason that it had been widely dispersed and cultivated by travellers so early as the seventeenth century. If this be so, then we shall have the explanation of the origin of our common garden plant and it will be necessary to reduce *I. javanica* to *I. fulgens*.

*Some Collections determined as I. fulgens*

Merrill 1362 (Palawan) is *I. Lobbii* var. *stenophylla* form 10.

Moulton 78 (Borneo) is *I. Lobbii* form 8.

Ridley 8970 (Sumatra) is *I. Lobbii* form 5.

Wray 3024 (Perak) is *I. javanica* var. *retinervia*.

**I. grandifolia** Zoll. et Mor.

Pink River *Ixora*

Syst. Verz. 1846, p. 65 (= *Pavetta macrophylla* Bl.).

Synonyms:—

*Pavetta odorata* Bl., Bijdr. 1825, p. 952 (haud *I. odorata* Spreng., Syst. Veg. I. 1825, p. 407).

*Pavetta macrophylla* Bl., Bijdr., 1825, p. 953 (haud *I. macrophylla* DC. Prodr. 4, 1830, p. 487).

*Ixora Blumei* Zoll. et Mor., Syst. Verz. 1846, p. 65. (= *P. odorata* Bl.).

? *Pavetta Teysmanniana* Miqu., Fl. Ind. Bat. 2, 1857, p. 267 (fide Hooker fil., F.B.I. p. 143).

? *Pavetta macrocoma* Miqu., loc. cit. p. 274 (fide Hook. fil., loc. cit.).

? *Ixora arborescens* Hassk., Retzia I, 1858 p. (? 22) (fide Hook. fil., loc. cit., et Koorders et Valetton, Bijdr. Booms. 8, p. 150).

*Ixora macrosiphon* Kurz., Journ. Bot. I, 1875, p. 327 (fide Hook. fil., loc. cit.).

*Ixora rosella* Kurz., For. Fl. Burma II, 187, p. 23 (fide Hook. fil., loc. cit.).

*Ixora odorata* (Bl.) K. et V., Bijdr. Booms. Java, No. 8, 1902, p. 165.

*Ixora coriacea* Ridley, Journ. St. Br. R. As. Soc. 79, 1918, p. 83: Fl. Mal. Pen. II, 1923, p. 98 (= *I. elliptica* Ridley).

*Ixora crassifolia* Ridley, loc. cit. p. 83: Fl. Mal. Pen. II, p. 98. (haud *I. crassifolia* Merrill, 1910).

*Ixora fluminalis* Ridley, loc. cit. p. 84: Fl. Mal. Pen. II,

p. 97.

- Ixora gigantea* Ridley, loc. cit p. 84.  
*Ixora elliptica* Ridley, Fl. Mal. Pen. II, 1923, p. 98.  
*Ixora Ridleyi* Merrill, Gard. Bull. 8, 1935, p. 132.  
*Ixora lancifolia* Ridley, Journ. Bot. 72, 1934, p. 256.  
*Ixora Valetonii* Hochr., Candollea 5, 1934, p. 261.

### Varieties

- var. *coriacea* Hook. fil., F.B.I., III, 1880, p. 143.  
 var. *arborescens* Hook. fil., loc. cit.  
 var. *Kurzeana* Hook. fil., loc. cit.  
 var. *rosella* Hook. fil., loc. cit.  
 var. *gigantea* King and Gamble, Mat. Fl. Mal. Pen. 4, 1904, p. 156.  
 var. *acutifolia* Hochr., Candollea 5, 1934, p. 257.  
 var. *lancifolia* var. nov.

A shrub or tree up to 20 m. high, often flowering as a spindly bush 1½–5 m. high: twigs pale, greyish white or silvery buff: glabrous except the puberulous panicle and often puberulous style.

Leaf-blade 10–32 × 4–18 cm., rather large to very large, elliptic, often inclined to ovate, the apex blunt or acute, the base cuneate, rounded or even cordate, more or less coriaceous; primary lateral veins 6–16 pairs, directed obliquely forward, inarching near the edge, with coarse faint reticulations, the venation generally visible on both sides of the dried leaf: petiole .6–3.5 cm. long, stout: stipules 5–12 mm. long, broadly triangular with a minute point, generally more or less sheathing.

Corymb 12–23 cm. wide, erect, sessile, with 3 main, long-stalked branches from the base, the peduncles of the branches generally 5–9 cm. long, the branchlets not articulate, green flushed reddish, the corymb falling entire: flowers crowded, some sessile, others shortly stalked, fragrant or not: sepals shorter than the ovary, blunt to subacute: corolla-tube .6–3 cm. long, pink or reddish: petals 4–5.5 mm. long, 1.5–2.5 mm. wide, oblong, blunt or subacute, reflexed along the tube, not spreading, white, often tipped pink: anthers yellow: style projecting 3–5 mm. glabrous or the part in the corolla-tube more or less hairy, white.

Berries 10–12 mm. wide, subglobose, distinctly longitudinally sulcate when dried, green turning red then black.

Distribution:—Burma, Indo-China, Andaman and Nicobar Islands, Malaya, Sumatra, Java, Borneo, Philippines, ? Celebes.

### ✓ var. *lancifolia* var. nov.

Marsh *Ixora*

Frutex vel arbor minor, vix ramosus, usque 5 m. altus.

Lamina 20–36 × 3.5–12 cm., lanceolata, linearis (30 × 3.5 cm.) vel lanceolato-obovata, obtusa vel subacuta, utrinque gradatim attenuata praecipue basim versus, carnosio-subcoriacea, subtus sicco minute papilloso—rugulosa, nervis reticulatis haud distinctis, costis lateralibus utrinsecus 10–14.

Corymbus 8–16 cm. latus, semper minor, ramis 3 brevioribus pedunculo 1.5–5 cm. praeditis: corollae tuba 12–16 mm. vel 17–20 mm. longa.

Distribution:—Malaya, Sumatra.

Typus:—Ridley 2213 (Tahan River, Pahang).

That *I. grandifolia* is a variable species can be judged from the list of synonyms, as well as from the number of forms which I have distinguished. As it grows in Malaya, the species could be split into six or seven according to the inadequacy of the herbarium material, for one sheet typical of each form might be considered a species. However, from the numerous collections in the Singapore Herbarium and from the numerous plants which I have studied in the forest, I have discovered that these forms are by no means clearly defined and that with our present knowledge the subdivision of *I. grandiflora* is impossible. Indeed, in the wide sense, it is easily and conveniently recognised as a common species of swampy forest in Western Malaysia. In this sense, the species was understood by Hooker, King and Gamble; and so too by Koorders and Valetton, except for their separation of *I. odorata* (Bl.). Recently, for reasons which appear to me wholly inadequate as well as conflicting, Ridley has divided the species into six. As in the red-flowered *Ixoras*, the variability of *I. grandifolia* is not yet appreciated.

For the legitimate name of the species in this wide sense I have adopted *I. grandifolia*. The alternative, simultaneous name *I. Blumei* I have made the synonym because it is not well-known while the first is. Both these names of Zollinger and Moritz were proposed for Blume's two species without any reason being given, though evidently because Blume's specific names would make later homonyms in the genus *Ixora*—a point overlooked by Koorders and Valetton in their *I. odorata* (Bl.). For the interpretation of the species of Blume, Miquel, Hasskarl and Kurz, I have followed Hooker, Koorders, Valetton, King and Gamble, having no access to the types. Ridley's species I have been able to examine personally in Singapore.

As regards *I. grandifolia*, in the wide sense, the variability of the leaves in shape and venation has not been properly explained and it seems that the variability in the length of the corolla-tube, in the fragrance of the flowers and in the hairiness of the style is not realised at all: there is confusion also about the colour of the flower. That some trees have pointed and others blunt leaves I am certain from the numerous trees of my form 3 which I have studied in the East of Johore, but some collections are intermediate. The number of veins is also a fairly constant distinction but also imperfect through the occurrence of specimens with 9–12 pairs of lateral veins: unfortunately, because of the large size of the inflorescence, herbarium-specimens generally have only one or two pairs of leaves on the twig below the panicle and these uppermost leaves of the twigs

are commonly reduced. As for the leaf-base it varies greatly: even on the same plant, I have seen leaves with gradually tapered, cuneate, rounded and cordate bases, so that one unacquainted with the living trees might well make four species from separate leaves of the same plant. Concerning the texture of the leaf, I think there is great variability which cannot be used satisfactorily in defining varieties because of the numerous intergrades, with the one exception of var. *lancifolia* in which the texture is accompanied by other peculiarities. That the length of the corolla-tube is no sign of specificity is obvious from the fact that there are specimens differing only in this one character. And, likewise, regarding the hairiness of the style which I find to be as often rather sparsely puberulous as glabrous: (this point cannot be determined without pulling the style from the flower because it is the part of the style in the corolla-tube which is hairy). The colour of the flower may be described generally as white or pink, according as the corolla is open or not. When the flowers of a corymb are not yet open they look pink because the reddish pink corolla-tubes are conspicuous: but when the flowers open, the white petals are reflexed, concealing the corolla-tubes almost completely. Thus, I believe, have arisen the 'conflicting' statements of the flowers as white or pink, just as with *I. pendula*. The flowers are generally very fragrant but I have seen several trees in Johore (my form 3, as 32277) which had scentless flowers. I think this as important a varietal character as any other in the species, though it is one that will not commend itself so long as we are limited to dried specimens.

As regards *I. odorata* (Bl.) K. et V., the authors of the combination say that from *I. grandifolia* it is "toto coelo diversa (N.B. fructus valde diversi)". Nevertheless I am unable to follow them. The fruit of *I. grandifolia* they describe as 6-12 mm. wide and distinctly divided in 2 lobes, or didymous: that of *I. odorata* they describe as only 6-7 mm. wide and long, globose and never didymous, although in their plate (Baumart. v. Java, fig. 554) a slightly didymous fruit is shown. I find that the normal 2-seeded ripe fruits of *I. grandifolia* are 10-12 mm. wide and, when dried, are distinctly didymous as is general in *Ixora*, but that immature fruits 4-8 mm. wide, even when dried, do not show a longitudinal sulcation between the two seeds. Hence I conclude that Koorders and Valetton drew their opinion from immature fruits. But these authors also distinguish *I. odorata* by its short corolla-tube and hairy style. But as I have said, these characters vary much in different collections of *I. grandifolia* which in other respects are



identical. It seems a little fastidious, moreover, to distinguish two species of tree solely on the hairiness of the filiform style. *I. odorata* (Bl.) K. et V. is my *I. grandifolia* form 1: and *I. grandifolia* sensu K. et V. consists of my form 5 and my form 2 (as shown by the figure, Baumart. v. Java. fig. 545, in which the leaves are drawn with few lateral veins).

Hooker's varieties, as amplified by King for the Malayan flora, I interpret in this way. The var. *gigantea* is based on the size, shape and texture of the leaf and so it covers my form 2 (Ridley 4120), form 3 (Curtis 3384), form 4 (Wray 2973, 3971) and form 5 (King's coll. 5609, 10294, Wray 3678). The var. *coriacea*, based on the more or less lanceolate, very coriaceous leaf, covers my form 5 (Curtis 2486, Wray 2140) and, perhaps, var. *lancifolia* (Ridley 2213, which King doubtfully referred to var. *coriacea*). The var. *arborescens* covers my form 1 (Derry 310) and form 2 (Derry 571, King's Coll. 4686, Ridley 4165). The var. *rosella* may be my form 3, on account of its pointed leaves, but Kurz describes the corolla-tube "about an inch long", though Hooker gives  $\frac{1}{2}$  -  $\frac{2}{3}$ ". It seems to me that the varieties *gigantea*, *coriacea* and *arborescens* are unsatisfactory because from their definitions so many variable features have been omitted though it may be possible to define accurately var. *arborescens* and var. *coriacea* from the single, and therefore the type, specimens cited for each by Hooker.

As regards *I. macrosiphon* Kurz (= *I. grandifolia* var. *Kurzeana* Hook. fil), it differs from *I. grandifolia* only in the longer corolla-tube (2.5-3 cm. long) and my form 6 connects the two, having the tube 1.7-2 cm. long. The three collections of *I. macrosiphon* in the Singapore Herbarium leave no doubt that it is conspecific. These collections, which are cited by King and Gamble as var. *Kurzeana* are:—King's Collector 277, s.n. 3.3.94, Prain's Collector s.n. 1899 (all from the Andamans). The variety has not been found in Malaya, though it probably occurs.

Ridley's species are hard to understand through the different treatment which he has given them in his Flora and his previous paper. Thus *I. coriacea* of his paper (1918), based on Wallich 6151 which is the type of *I. grandifolia* var. *coriacea* Hook., is assigned to both *I. crassifolia* and *I. elliptica* in his Flora, while *I. gigantea* of his paper (starting in the middle of line 8 from the top of p. 84) which is there said not to be true *I. grandifolia* of Zollinger, is omitted from the Flora, though under *I. grandifolia* of the Flora it is remarked that var. *gigantea* King and Gamble "is a typical form" of the species.

*I. coriacea* Ridley, based on Wallich 6151, is evidently my form 5, according to Ridley's description, and this agrees with King's interpretation of var. *coriacea* Hook. (also based on Wallich 6151). In his paper, Ridley doubtfully refers Wallich 6153 to *I. coriacea*, but in his Flora he refers both Wallichian collections to *I. elliptica*. As the specific names "coriacea" and "elliptica" are manuscript names of R. Brown taken up by Ridley, it follows that *I. elliptica* ex Ridley is an exact synonym of *I. coriacea* ex Ridley. I may add that both Hooker and King regarded Wallich 6153 as typical *I. grandifolia*.

*I. crassifolia* is based firstly, in the paper (1918), on a specimen of Griffith's from Ayer Panas in Malacca and to it, in the Flora, Ridley assigns many other specimens as well as var. *coriacea* Hook. It is possible that this collection of Griffith's should be taken as the basis of var. *arborescens* Hook., but Griffith's specimens are not available in Malaya. In any case, Griffith's specimen is the type of *I. crassifolia* and, from Ridley's original description, I find it hard to distinguish from *I. coriacea*: it is said to have a blade  $8-9 \times 3-3\frac{1}{2}$ " with a blunt base. *I. crassifolia* of Ridley's Flora is said to have a blade  $13 \times 3$ ", lanceolate and narrowed to both ends, as my var. *lancifolia*, and the cited collections, which I can check for certain in Singapore, namely G. Janeng (Kelsall), Tahan River and Pekan, are my var. *lancifolia* to which Griffith's specimen from Ayer Panas cannot belong if Ridley has correctly described it. Hence, I have no hesitation in making the new variety *lancifolia*, for it is not covered by the original definition of any of Ridley's species or of Hooker's and King's varieties.

*I. Ridleyi* Merrill was proposed for *I. crassifolia* Ridley, which is a later homonym of *I. crassifolia* Merrill. Merrill merely cited Ridley's references so that he threw but another cloud over the problem.

*I. fluminalis*, as originally described, covers my form 1 (Derry, s. Rumbai), form 2 (Ridley 4165; Kunstler, Goping) and form 5 (Haniff 4049). It represents the common forms of *I. grandifolia* with leathery blunt leaves. A distinction of seeming importance between *I. fluminalis* and *I. grandifolia* which must occur to the reader studying Ridley's description is that *I. grandifolia* is said to have white flowers and *I. fluminalis* yellow. The corollas of both, however, have the white limb and pink tube typical of *I. grandifolia*. The reason for ascribing yellow flowers to *I. fluminalis* seems to have been the field-note of Kunstler's collection 4686, the "yellow flowers" of which refer, however, to the tiny calyces from which the corollas have

dropped. The distinction in flower-colour, of white or pink, given by Ridley for his species depends on whether the flowers of the specimen were open in which case they would have looked white, the reflexed limb concealing the corolla-tube, or not open, the pink tube then being more striking. It seems, in any case, that *I. fluminalis* must be discarded. Ridley based his species on "*I. grandifolia* var. *arborescens* King not *I. arborescens* Hassk." By this, Ridley meant var. *arborescens* Hook. fil in the definition of which Hasskarl's *I. arborescens* was directly cited. In other words, taxonomically, *I. fluminalis* Ridley is *I. grandifolia* var. *arborescens* Hook. fil. which is *I. arborescens* Hassk. with Hasskarl's plant as the type of each.

A specimen of Haviland's collection 2157, which is the type of *I. lancifolia* Ridley, in the Singapore Herbarium shows this species to be identical with the small-flowered, few-veined *I. Blumei* which is my *I. grandifolia* form 1.

*I. timoriensis* is very close to *I. grandifolia* but it differs in the laxer inflorescence with fewer flowers, all of which are distinctly pedicellate, and in the hairy corolla-mouth. I should be inclined to consider it as a variety, in which case it would be the legitimate name for the species.

#### KEY TO THE FORMS AND VARIETY OF *I. GRANDIFOLIA*

Leaves lanceolate, very gradually tapered to the base, the reticulations invisible in the dried leaf, and the undersurface finely wrinkled .. ..	var. <i>lancifolia</i>
Leaves more or less elliptic: reticulations visible: undersurface even	
Leaves with 6-10 pairs of side-veins: blade up to 9 cm. wide	
Corolla-tube .6-.9 cm. long .. ..	Form 1
Corolla-tube 1-1.2 cm. long .. ..	
Leaf-blade blunt .. ..	Form 2
Leaf-blade acute .. ..	Form 3
Leaves with 10-16 pairs of side-veins: blade 7-18 cm. wide	
Corolla-tube .7-1.0 cm. long .. ..	Form 4
Corolla-tube 1-1.2 cm. long .. ..	Form 5
Corolla-tube 1.7-2.0 cm. long .. ..	Form 6
Corolla-tube 2.5-3 cm. long .. ..	(var. <i>Kurzeana</i> )

#### Form 1

Leaves with 6-10 pairs of lateral veins, acute, subacute or blunt, 3.5-9 cm wide.

Corolla-tube short 6-9 mm. long.

#### Malaya

Pahang; Cons. For. 3603.

Negri Sembilan; Alvins s.n. (S. Ujong).

Malacca; Alvins 2254, 2332, Derry 310 (det. *I. grandifolia* var. *arborescens* by King).

#### Bornean Collections

Carr 26520, For. Dept. B.N.B. 4721, Wood 2033.

Haviland 1673 (det. *I. fluminalis*), Omar 395 (det. *I. fluminalis*).

Haviland 2157 (det. *I. lancifolia*).

*Javan Collections*

v. Steenis 2415 (det. *I. odorata* and *I. Blumei*).

Two forms might be made of this one, as in Forms 2 and 3, according as the leaves are blunt or acute. But my object is merely to explain the variety.

*Form 2*

Exactly as *Form 3* but the leaves blunt.

*Malayan Collections*

Perak; King's Collector 4686 (det. *I. grandifolia* var. *arborescens* by King).

Pahang; For. Dept. 15659, Burn Murdoch 200 (no flowers: det. *I. concinna*).

Malacca; Derry 571.

Johore; Corner 25892, 28628, s.n. 3.4.34 (S. Kambau pr. S. Sedili), Ridley 4165 (det. *I. grandifolia* var. *arborescens* by King), 13490, 15387.

Singapore; Ridley 4120 (det. *I. grandifolia* var. *gigantea* by King).

*Sumatra Collections*

Boden-Kloss 14567 (Siberut: det. *I. coriacea*).

*Javan Collections*

Koorders 34368, Teysmann 18651 (det. *I. macrophyloides* and *I. fluminalis*).

(Koorders et Valetton, Baumart. v. Java fig. 545).

*Form 3*

Leaves 3.5-9 cm. wide, the apex acute and generally acuminate with a tip 6-12 mm. long: lateral veins 6-10 pairs, the reticulations often very faint.

Corolla-tube 1-1.2 cm. long, the petals 3-4.5 × 1.5-2 mm. blunt.

*Malayan Collections*

Kedah; For. Dept. 17890.

Penang; Curtis 3384 (det. as *I. grandifolia* var. *gigantea* by King).

Malacca; Alvins 797.

Johore; Corner 32052, 32277, 32498, s.n. 11.4.36 (S. Kayu, pr. S. Sedili).

*Sumatran Collections*

Boden-Kloss 14669 (Sipora II.), Krukoff 4088, 4207, 4328.

*Bornean Collections*

J. & M. S. Clemens 26255, 31294.

*Form 4*

As *Form 5* but the corolla-tube 7-10 mm. long.

*Malayan Collections*

Perak; Wray 2973, 3971 (both det. *I. grandifolia* var. *gigantea* by King).

*Sumatran Collections*

Bartlett 2887.

*Javan Collections*

s.n. cult. Hort. Bog. XIII (det. *I. odorata*).

*Form 5*

Leaf-blade 7-18 cm. wide, blunt, with 10-16 pairs of side-veins: petiole 1.5-3.5 cm. long.

Corolla-tube 1-1.2 cm. long.



*Siamese Collections*

Haniff and Nur 4049 (det. *I. fluminalis* Ridley by Craib).

*Malayan Collections*

Kedah; Haniff 15480 (det. *I. fluminalis* Ridley by Craib), 21020.  
 Penang; Curtis 2486 (det. *I. grandifolia* var. *coriacea* by King).  
 Perak; King's Collector 5609, 10294 (both det. *I. grandifolia*  
 var. *gigantea* by King), Wray 2140 (det. *I. grandifolia*  
 var. *coriacea*), 3678 (det. *I. grandifolia* var. *gigantea* by  
 King).

Pahang; For. Dept. 17133.

Negri Sembilan; Alvins 1177.

Johore; Corner 28578, s.n. 11.10.36 (S. Kayu, pr. S. Sedili),  
 Henderson 28419, Kiah s.n. 6.10.36 (S. Kayu, pr. S. Sedili),  
 Lake and Kelsall s.n. 22.10.92 (G. Janing).

*Sumatran Collections*

Krukoff 4397.

*Bornean Collections*

For. Dept. B.N.B. 4302 (Brunei), Wood 2121.

*Form 6*

As form 5 but the corymb smaller and denser, 10–13 cm.  
 wide, with the peduncles of the main branches 2.5–4 cm. long:  
*corolla tube longer*, 1.7–2 cm., the petals .5 cm. long, blunt to  
 subacute.

*Malayan Collections*

Johore; Kiah s.n. 6.10.36 (S. Kayu, pr. S. Sedili).

The length of the corolla-tube in this form bridges the  
 gap between *I. grandifolia* and var. *Kurzeana* (= *I.*  
*macrosiphon* Kurz) in which it is 2.5–3 cm. long.

var. *lancifolia* Corner*Malayan Collections*

Kelantan; Nur and Foxworthy 11953.

Trengganu; (Kemaman), Corner 30719, s.n. 13.11.35 (2 sheets).

Pahang; Burkill s.n. June 1915 (Pulau Tioman), Ridley 2213,  
 (det. *I. grandifolia* var. *coriacea* by King), s.n. 1891  
 (Pengkalan Kasai), s.n. 1893 (Taka Tahan).

Negri Sembilan; Burkill 4478.

Malacca; Alvins s.n. (5 sheets), 2081, 2153, 2224, Derry 67.

Johore; Corner s.n. 9.3.36, s.n. 10.4.36 (Ulu Segun, Gunong  
 Panti), Holttum 9282, Kiah s.n. 12.10.36, s.n. 6.3.37, Lake  
 and Kelsall s.n. 21.10.92 (G. Janing), Nur 19988, Ridley  
 s.n. Jan. 1910 (Panti River, Kota Tinggi).

*Sumatran Collections*

Bartlett 7479 (pr. Loemban River, Asahan).

Forbes 1986 (det. *I. grandifolia* var. *coriacea* by King).

COLLECTIONS INTERMEDIATE BETWEEN *I. GRANDIFOLIA*  
AND VAR. *LANCIFOLIA*

Kelantan; Haniff and Nur 10090.

Perak; Derry s.n. 1899 (Maxwell Hill, det. *Tarenna grandifolia*),  
 King's Collector 5935 (det. *I. grandifolia* var.  
*coriacea* by King).

Pahang; Henderson 22416 (det. *I. crassifolia*), For. Dept.  
 41042.

Selangor; For. Dept. 16904 (det. *I. crassifolia*).

**I. javanica** (Bl.) DCJavanese *Ixora*emend. Koorders et Valetton, *Bijdr. Booms. Java* 8, 1902, p. 160.Basinym:—*Pavetta javanica* Bl., *Bijdr.* 1826 p. 949.

Synonyms:—

*Ixora stricta* auctt. non. Roxb.*I. fulgens* auctt. non. Roxb.*I. amoena* Don, *Gen. Syst.* 3, 1834, p. 571.*I. stricta* var. *amoena* Ridley, *Fl. Mal. Pen.* 2, 1923, p. 94.*I. aureora* Ridley, *Journ. Bot.* 72, 1934, p. 251.

Icones:—

Bot. Mag. t. 4586.

Baumart. Java 4, t. 553.

An evergreen shrub or small tree to 8 m. high, the trunk 1-8 cm. thick, with smooth brown bark: glabrous.

*Leaf-blade* 5-25.5 × .8-11.5 cm., *elliptic*, varying narrowly elliptic to lanceolate in riverside forms, *simply acute* or at most subacuminate, *the base varying from gradually tapered and narrowly cuneate to rather suddenly rounded*, widest about the middle, the proximal half often wider than the distal, membranous to subcoriaceous or distinctly coriaceous in some cultivated forms, *rather dull green*, often light or yellowish green: *lateral veins* 6-14 pairs, generally 6-10 or 9-13, inclined obliquely forward and without distinct marginal loops or in var. *retinervia* distinctly inarching: *petiole* .25-1.5 cm. long: *stipular point* .1-.75 cm. long, longest in the narrow-leaved riverside forms.*Corymbs* 3.5-20 cm. wide, with peduncles 0-9 cm. long, *the branches articulate and coral-red*: sepals blunt to subacute, variable in the same flower: *corolla-tube* 2-5 cm. long, the limb 1-3.8 cm. wide, the petals varying blunt to acute.

Berries 1.2-2 cm. wide, depressed globose, ripening red then black, 1-2 seeded.

Distribution:—India, China, Siam, Malay Archipelago.

✓ var. **multinervia** var. nov.

costis lateralibus utrinsecus 9-14, marginem versus non arcuato-connexis: lamina usque 25.5 × 11.5 cm., non vel vix acuminata.

Typus:—Corner 33438 (Kota Bahru, Kelantan, 22.4.37).

✓ var. **paucinervia** var. nov.

costis lateralibus utrinsecus 6-9 (-10), marginem versus non arcuato-connexis: lamina usque 15.5 × 7.8 cm., non acuminata.

Typus:—Burkill and Haniff 17342 (Telok Sisek, Pahang, 4.12.24).

✓ var. **retinervia** var. nov.*Ixora* Lotong

costis lateralibus utrinsecus 7-12, marginem versus conspicue arcuato-connexis, costa media angulo lato excurrentibus: lamina 6-15.5 × 1.7-5.8 cm., elliptica vel oblongo-elliptica, plus minus acuminata.

Typus:—Corner 29020 (E. Johore, 9.2.35).

## KEY TO THE VARIETIES

*Lateral veins* of leaf making a wide angle with the midrib, *conspicuously inarching with wide loops near the margin*: leaf-blade generally more or less acuminate, up to 15 × 5.5 cm. . .var. *retinervia*

Lateral veins of leaf inclined obliquely forward,  
not distinctly inarching: leaf-blade not acumi-  
nate

Lateral veins 6-9 (-10) pairs; blade up to 15 × 5.5 cm. . . . .	var. <i>paucinervia</i>
Lateral veins 9-14 pairs: blade up to 25 × 11 cm. . . . .	var. <i>multinervia</i>

There is much confusion over the nomenclature of the Malayan plants which I refer to *I. javanica*. They have been called *I. stricta* Roxb. until recently when Ridley has made them a new species, *I. aurorea*, and Burkill has referred them to *I. chinensis* Lam. (Dict. Econ. Prod. Mal. Pen. 1935). But, as I have explained under *I. chinensis*, *I. stricta* Roxb. is to be interpreted as a synonym of *I. chinensis*, which differs from the Malay specimens in its very short petiole and very blunt petals so that, provided this distinction is held, the Malayan specimens are not *I. chinensis*. I find that they agree exactly in all essentials with *I. javanica* as interpreted by Koorders and Valetton for the Javanese flora. Craib identified them with *I. amoena* but, as I have shown under that species, I can find no difference between it and *I. javanica*. Ridley's latest interpretation I consider no solution because it deals with very few specimens and, while resting on such extremely variable features as the size of leaf, stipule, corymb and corolla and the shape of sepals and size of corolla-tube, it ignores differences in the venation, the shape and size of the petals, and the colour of the flowers, and omits the common Red *Ixora* of Malayan gardens and villages.

*I. javanica* is the commonest and most variable *Ixora* in Malaya. I have distinguished 3 varieties and 30 forms so that the variation may be perceived. The one which I have found to be most constant is var. *retinervia*, which has not been recognised previously, yet there are intermediates between them all. Until the species has been studied genetically, I do not see how it can be dissected profitably in the herbarium.

*I. pseudojavanica* Bremekamp, *I. ovalifolia* Bremekamp and *I. lacuum* Bremekamp (Journ. Bot. 75, 1937, pp. 170-171) are to me only forms of *I. javanica*. Such "splitting" is quite impracticable.

var. *retinervia* var. nov.

*Ixora* Lotong

The Malayan specimens are remarkably constant in having rather small, subacuminate glossy leaves, drying dark-brown, fuscous or even black, inarching veins often making almost a right angle with the midrib, small corymbs 4-9 cm. wide and small corollas (tube 3-4 cm. long; limb 1-1.6 cm. wide; petals 2.5-3 cm. wide, oblong or subelliptic, more or less acute, light orange-yellow turning scarlet or

deep red.). One might, therefore, regard the variety as a species but there are several collections intermediate with var. *paucinervia* and as these lack the full characteristics of var. *retinervia* I have classed them with var. *paucinervia*. The variety *retinervia* also resembles *I. Lobbiai* var. *stenophylla* in the Herbarium: the distinctions are given under *I. Lobbiai*. Compare also *I. concinna*.

It appears that there are forms of this variety in Borneo which have not only larger flowers but leaves which dry pale. The systematic position of these Bornean specimens, which I have listed below, is problematical because they resemble also *I. Robinsonii*. Many more collections will be needed to establish their status from their variability.

*Malayan Collections*

- Penang; Curtiss 1112 (det. *I. stricta* by King), s.n. B. Laksmamana March 1890, (det. *I. stricta* var. *amoena* by King): For. Guard. 1112.  
 Perak; Wray 3024 (det. *I. fulgens* by King).  
 Pahang; Burkill 15704, 17229; Henderson 22009; Ridley 2226, 2227, 16243 (det. *I. concinna*); Strugnell 23453.  
 Trengganu; Moysey 33643.  
 Selangor; Burkill 6842.  
 Negri Sembilan; Holttum 9609; Kloss s.n. B. Tangga 1910; Nur 11669; Ridley s.n. G. Angsi, Feb. 1900.  
 Malacca; Alvins 62, 567, s.n. 29.1.86; Derry 257; Goodenough 1753, 1826.  
 Johore; Best 7717; Corner 29020, 29939; Goodenough s.n. 1893; Ridley 10940 (? 16940), s.n. 1892, s.n. 1898, s.n. 1906 (? 1908).  
 Singapore; J.S.G. 3999, 5004; Ridley s.n. 1904.

*Bornean Collections*

- ? Winter 2154 (S.E. Borneo, 1908), det. *I. amoena*: (the inarching of the veins not always distinct): (det. *I. Winkleri* Brem. Bull. J. Bot. Buit., XIV, 1937, p. 266).  
 ? Kloss 19136, For. Dept. B.N.B. 4256, 4276 (all det. *I. stenophylla*): corolla-tube 3-3.8 cm. long, limb 2.5-3 cm. wide, petals .6-.75 cm. wide.  
 ? For. Dept. B.N.B. 4037: corolla-tube 3.7-4.3 cm. long, limb 2.5-3.3 cm. wide, petals .5-.6 cm. wide.

KEY TO THE FORMS OF *I. JAVANICA* VAR. *MULTINERVIA*

- Corolla-tube 2-3 cm. long  
 Limb 1-1.5 cm. wide  
 Petals .5 cm. wide, blunt, yellow then pinkish orange Form 1  
 Petals .3 cm. wide, pointed, rich yellow then intense brick-red .. .. . Form 2  
 Corolla-tube 3-3.8 cm. long  
 Limb 2.5-3.8 cm. wide .. .. . *I. congesta*  
 Form 10  
 Limb 2.3-2.5 cm. wide .. .. . Form 4  
 Limb 2-2.3 cm. wide: petals acute .. .. . Form 9  
 Limb 1.5-2 cm. wide  
 Petals blunt,  
 Petals .5-6 cm. wide .. .. . Form 5  
 Petals .3-5 cm. wide .. .. . Form 6



Petals acute, .5 cm. wide			
Petals turning deep brick-red	..	..	Form 7
Petals pale orange buff then pale red	..	..	Form 8
Limb 1-1.5 cm. wide: petals subacute			
Petals .3-.4 cm. wide	..	..	Form 10
Petals .2 cm. wide, narrowly oblong	..	..	Form 11
Corolla-tube 3.8-4.3 cm. long			
Limb 1.2-1.5 cm. wide			
Petals .3 cm. wide, salmon pink	..	..	Form 12
Limb 1.7-2.3 cm. wide			
Petals .5-.6 cm. wide, acute: (leaves narrow, 2.5-6.5 cm. wide)	..	..	Form 13
Petals .3-.4 cm. wide, blunt			
Petals yellow then brick-red	..	..	Form 14
Petals pale reddish pink (leaves 2.5-3.8 cm. wide)	..	..	Form 15
Limb 2.3-2.5 cm. wide			
Petals .6-.7 cm. wide, acute, pale yellow then salmon pink	..	..	Form 16

KEY TO THE FORMS OF *I. JAVANICA* VAR. *PAUCINERVIA*

Flowers yellow, not reddening: "Yellow Javanica"

Corolla-limb 1.5-1.9 cm. wide	..	..	Form 17
Corolla-limb 2-2.5 cm. wide	..	..	Form 18

Flowers yellow turning red or pink

Flower pale yellow turning pale clear pink: "Pink Javanica"	..	..	Form 19
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Flower turning orange red to brick-red; "Red Javanica"

Corolla-tube 2-2.8 cm. long

Limb 1-1.5 cm. wide

Petals blunt: leaves thin .. .. Form 20

Petals subacute: leaves coriaceous .. .. Form 21

Limb 1.8-2.3 cm. wide: petals blunt .. .. Form 22

Corolla-tube 2.5-3.8 cm. long

Limb 1-1.3 cm. wide: petals .2 cm. wide, subacute .. .. Form 23

Limb 1.3-1.8 cm. wide

Petals .3-.5 cm. wide, blunt or subacute .. .. Form 24

Limb 1.8-2.2 cm. wide

Petals pointed

Petals .3-.5 cm. wide, elliptic .. .. Form 25

Petals .2-.3 cm. wide, oblong .. .. Form 26

Petals blunt, .4-.6 cm. wide .. .. Form 27

Limb 2-2.5 cm. wide: petals .4-.6 cm. wide, acute .. .. Form 28

Corolla-tube 3.8-5 cm. long: petals .3-.5 cm. wide, acute

Limb 1.7-2 cm. wide .. .. Form 29

Limb 2-2.5 cm. wide .. .. Form 30

Form 1

Corolla-tube 2-3 cm. long, the limb 1-1.5 cm. wide: petals .5 cm. wide, blunt, yellow then pinkish orange.

*Malayan Collections*

Kelantan; Corner 33443.

Penang; Ridley s.n. 1900 (P. Tikus).

Trengganu; Rostado s.n. Feb. 1904.

Singapore; (cult. in Hort. Bot.) Corner 30795 (det. *I. congesta*), Nur s.n. 14.6.29 (det. *I. congesta*).

## Siam

Keith 129 (det. *I. amoena* by Craib).

The two Singapore collections have coarsely veined leaves like *I. congesta* but only 10-13 pairs of side-veins like *I. javanica*. They might be classed with either species.

## Form 2

As Form 1 but the petals narrower, .35 cm. wide, pointed and turning deep red.

## Malayan Collections

Perlis; Henderson 22950.

Penang; Curtis s.n. (cult. Bot. Gdns.).

Kelantan; Corner 33434.

(? Selangor; For. Dept. 17493).

## Siam

Kiah 24360 (det. *I. amoena* by Craib).

## Java

Hallier 142.

## Form 4

Corolla-tube 3-3.8 cm. long, the limb 2.2-2.5 cm. wide: petals .6 cm. wide, acute or subacute.

## Malayan Collections

Singapore; (cult. in Hort. Bot.) Corner.

## Form 5

Corolla-tube 3-3.8 cm. long, limb 1.5-2 cm. wide: petals .5-.6 cm. wide, turning reddish pink.

## Malayan Collections

Kelantan; Corner 33437.

## Form 6

As Form 5 but the petals narrower, .3-5 cm. wide.

## Malayan Collections

Kedah; Ridley 8354.

(? Singapore, Ridley s.n. 9.11.1892, Kranji).

## Form 7

Corolla-tube 3-3.8 cm. wide, limb 1.5-2 cm. wide: petals .5 cm. wide, pointed, turning intensely brick-red.

Leaves rather large, the blade 8-28 × 5-12.5 cm.

## Malayan Collections

Kedah; Ridley s.n. June 1893.

Kelantan; Corner 33436, s.n. 21.4.37 (Kota Bahru), s.n. 22.4.37 (Kota Bahru).

Perak; Ridley 9710, Seimund s.n. 6.12.25 (P. Lalang), s.n. 8.3.26 (P. Rumbia) s.n. 23.3.26 (P. Rumbia).

Pahang; Burkill s.n. June 1915 (P. Tioman).

Malacca; Seimund s.n. 8.4.21 (P. Jarak).

Singapore; (cult. in Hort. Bot.) Cantley s.n., Nur s.n. 15.8.18, 14.6.29. Corner.

## Anamba Islands

Henderson 20225.

This is the commonest garden *Ixora* in Malaya, yet one that offers the greatest difficulty in classification. It has generally larger leaves with more numerous veins than *I. javanica*, besides pointed petals, and it flowers continuously all the year, whereas the wild forms of *I. javanica* like those

of *I. congesta* and *I. Lobbii* are seasonal. In the Singapore Botanic Gardens it has for many years been called *I. macrothyrsa* but it does not answer in any detail with the description of that species in Bot. Mag. t. 6853. It seems that dried specimens have never come into the hands of systematists working on the flora of Malaya or of neighbouring countries, unless as Wallich 6152 as I have suggested under *I. fulgens*. It corresponds so remarkably well with Roxburgh's interpretations of *I. fulgens* that it seems to be the species which he intended though whether it is the true *I. fulgens*, taxonomically, has still to be discovered.

It is known, colloquially, as the Common Red *Ixora* or the Giant *Ixora*. The only other garden-variety with which it may be mistaken is *I. congesta* form 9, which differs in its larger, redder flowers that develop seasonally, its much less bushy habit and its more numerous side-veins in the leaf.

*Form 8*

As Form 7, but the petals pale orange-buff turning pale red.

*Malayan Collections*

Kelantan; Corner 33435.

Trengganu; Holtum s.n. 10.5.25 (K. Trengganu).  
Singapore; (cult. in Hort. Bot.).

*Form 9*

As Form 7 but the corolla-limb 2-2.3 cm. wide.

*Siam*

Haniff & Nur 3910 (det. *I. amoena* by Craib).

*Malaya*

Pahang; Corner 29910.

*Form 10*

As Form 7 but the corolla-limb 1-1.5 cm. wide.

*Malayan Collections*

Kedah; Curtis 2607, Ridley 8354: (both det. *I. amoena* by Craib).

Penang; Ridley 7092.

Perak; Kunstler 2247.

*Form 11*

As Form 10, but the petals only .2 cm. wide, narrowly oblong.

*Malayan Collections*

Province Wellesley; Ridley 10776.

*Form 12*

Corolla-tube 3.8-4.3 cm. long, limb 1.2-1.5 cm. wide; petals .3 cm. wide, subacute, salmon-pink, never red.

*Malayan Collections*

Kelantan; Corner s.n. 22.4.37 (Kota Bahru).

*Form 13*

Corolla-tube 3.8-4.3 cm. long, limb 1.7-2.3 cm. wide; petals .5-6 cm. wide, pointed.

*Malayan Collections*

Trengganu; Moysey 33891.

*Form 14*

As Form 13 but the petals narrower, .3-4 cm. wide, blunt, turning deep brick red.

*Malayan Collections*

Kelantan; Corner s.n. April 1937 (2 collections).

*Form 15*

As Form 14 but the flowers pale reddish pink.

*Malayan Collections*

Kelantan; Corner s.n. 22.4.37 (Kota Bahru).

*Form 16*

Corolla-tube 3.8-4.3 cm. long, limb 2.3-2.5 cm. wide: petals .6-7 cm. wide, pointed, pale yellow then salmon pink.

*Malayan Collections*

Kelantan; Corner 33438, Nur &amp; Foxworthy 12255.

*Form 17*

Corolla-tube 2.5-3 cm. long, limb 1.5-1.9 cm. wide: petals blunt, persistently light orange buff or apricot-buff never reddening.

*Malayan Collections*

Singapore; (cultivated) Corner 34513, Hort. Bot. Sing. s.n. 10.8.21.

This and the following form are cultivated in Malayan gardens as a "Yellow *Ixora*" but they may be more accurately known as the "Yellow *Javanica*", to distinguish them from the "Yellow *Coccinea*". The colour is not a true yellow but a pale dull orange slightly pink.

*Form 18*

As Form 17 but the corolla-limb wider, 2-2.5 cm. wide.

*Malayan Collections*

Singapore; (cult.).

*Form 19*

Corolla-tube 3.2-3.8 cm. long, limb 2-2.6 cm. wide: petals .4-6 cm. wide, pointed, elliptic, pale yellow buff turning wholly pale rose pink, never red.

*Malayan Collections*

Negri Sembilan; Corner 31502.

This collection is from a rather narrow-leaved shrub, 10 ft. high, growing in thickets by a sluggish, forest stream beside the main road from Tampin to Gemas. Plants with rather broader leaves are also cultivated in Malayan gardens as a "Pink *Ixora*": they may be known more accurately as the "Pink *Javanica*".

*Form 20*

Corolla-tube 2-2.8 cm. long, limb 1-1.5 cm. wide: petals .3-4 cm. wide, blunt. Leaves thin.

*Malayan Collections*

Trengganu; Rostado s.n. Feb. 1904 (K. Kemaman).

*Form 21*

As Form 20 but with subacute petals and very coriaceous leaves.



*Malayan Collections*

Singapore; (cult. in Hort. Bot.) Nur s.n. 22.6.29.

*Form 22*

As Form 20 but the corolla-limb wider, 1.8-2.3 cm.

*Sumatra*

Ridley 8979 (Penasa) (det. *I. Lobbii* ex. enum. Herb. Kew).

*Form 23*

Corolla-tube 2.7-3.3 cm. long, limb 1-1.3 cm. wide: petals .2 cm. wide, subacute.

*Malayan Collections*

Perlis; Ridley 14997.

Penang; (cult. in Hort. Bot.) Curtis s.n. 29.11.02.

*Siam*

Setul; Ridley 14998 (det. *I. amoena* by Craib).

*Form 24*

Corolla-tube 2.8-3.5 cm. long, limb 1.3-1.8 cm. wide: petals .3-.5 cm. wide, blunt to subacute.

*Malayan Collections*

Kelantan; Henderson 19572, 22595 (both det. *I. stenophylla*).

Trengganu; Corner 25924 (det. *I. stenophylla*).

Penang; (cult. in Hort. Bot.) Curtis s.n. Aug. 1900.

Perak; Corner s.n. 29.7.36 (Pangkor), Ridley 7187, 10276.

Pahang; Burkill and Haniff 17342, 17602, Burn Murdoch 158, 319, Cons. For. 4767, Evans 13231 (det. *I. concinna* ex enum. Herb. Kew), Henderson s.n. 19.8.29 (Kuantan), Ridley s.n. 19.8.89 (Pekan), s.n. 1891, s.n. 25.8.91 (Pasir Mandi, det. *I. concinna*), 1085 (det. *I. concinna*), Seimund 962, Walker 23326.

Selangor; Hume 7107, Ridley s.n. 1.1.21 (Klang Gates), 13408.

Malacca; Burkill 1327, Derry 84, Seimund 1139.

Johore; Corner 25960, 25961, Henderson 18218.

Singapore; (cult. in Hort. Bot.) s.n. 31.10.21, Nur s.n. 12.6.24, s.n. 9.9.24.

*Anamba and Natuna Islands*

Henderson 20450, v. Steenis 966.

*Java*

v. Steenis 5416.

*Sumatra*

v. Steenis 3847.

This is one of the common wild forms of *I. javanica* in Malaya. It is abundant by the sea-shore and, as a narrow-leaved bush of the flood-zone, by riversides.

*Form 25*

Corolla-tube 2.8-3.8 cm. long, limb 1.8-2 cm. wide: petals .3-.5 cm. wide, elliptic, pointed.

*Malayan Collections*

Trengganu; Rostado 11971, s.n. 1904 (Bundi).

Pahang; Ridley 1075.

Singapore; (cult. in Hort. Bot.) Burkill s.n. 23.10.17, Corner s.n. 26.10.37.

*Form 26*

As Form 25 but the petals narrower and oblong, .2-3 cm. wide: corolla-tube 2.5-3 cm. long.

*Malayan Collections*

Singapore; (cult.) Corner s.n. 26.10.37.

*Form 27*Corolla-tube 3.2-3.8 cm. long, limb 1.7-2 cm. wide: petals .4-.6 cm. wide, *blunt*.*Malayan Collections*

Kedah; Ridley 15890 (Pulau Rawei).

Johore; Holttum 24958 (Pulau Pelandok).

*Form 28*Corolla-tube 3-3.8 cm. long, limb 2-2.5 cm. wide: petals .4-.5 cm. wide, *acute*.*Malayan Collections*Pahang; Ridley 2114 (det. *I. concinna*).

Johore; Ridley 15403 (rather narrow-leafed, riverside shrub).

*Form 29*Corolla-tube 3.8-5 cm. long, limb 1.7-2 cm. wide: petals .3-.5 cm. wide, *acute*.*Malayan Collections*

Kelantan; Nur and Foxworthy 12087.

Pahang; Burkill and Haniff 16107, Cons. For. 5176.

*Java*

Koorders 39079.

*Sumatra*Robinson and Kloss s.n. 19.3.14 (Korinchi Exped.: det. *I. amoena*).

All these collections are from riverside shrubs with small, narrow leaves, up to 12 × 2.5 cm.

*Form 30*

As Form 29 but the corolla-limb wider, 2-2.5 cm.

*Malayan Collections*

Perak; Ridley 14312.

Pahang; Kiah and Strugnell 23981 (det. *I. stenophylla*).

Both collections are from narrow-leafed, riverside shrubs (blade 6-20 × 1.5-3 cm.).

*Without open Flowers*

Kedah; Dolman 21705.

Perak; Burkill 12435, Wray 3448.

Pahang; Burkill and Haniff 16936 (riverside bush with lanceolate leaves: det. *I. stenophylla*).COLLECTIONS INTERMEDIATE BETWEEN *I. JAVANICA*  
AND *I. LOBBII**Borneo*

Elmer 20678, 21049, Wood 2262.

These three collections have been distributed as *I. Lobbii* but their leaves, which are narrowly oblong-elliptic (10-25 × 3.5-8.5 cm.), are simply pointed or subacute (not acuminate) and have only 10-16 pairs of side-veins. Therefore they are not *I. Lobbii*. I think they are extreme forms of *I. javanica* but the *Ixoras* of Borneo are too little known to be rightly understood.

COLLECTIONS INTERMEDIATE BETWEEN *I. CONGESTA*  
AND *I. JAVANICA*

- Perak; Murton 43 (det. *I. congesta*: but more like *I. javanica* form 7 with leathery leaves).  
 Selangor; Hume 8433 (det. *I. congesta*: but more like *I. javanica* form 7 with leathery leaves and remarkably strong veins; "flowers pink" on the field note does not apply to *I. congesta*).  
 Malacca; Alvins 781 (det. *I. congesta*: but with 11-17 pairs of side-veins; exactly between *I. javanica multinervia* and *I. congesta*).  
 Singapore; Baker s.n. 17.7.17 (Gardens Jungle), Goodenough 5.2.89 (Selitar), Ridley 5067, 5674, s.n. 1892 (Chan Chu Kang), s.n. 1892 (Changi): (all these collections, having 10-16 pairs of side-veins, seem exactly between *I. congesta* and *I. javanica*).

**I. Kingstonii** Hook. fil.

Fl. Br. Ind. III, 1880, p. 140.

A shrub or small tree up to 9 m. high, glabrous except for the puberulous branches of the inflorescence, or even wholly glabrous.

*Leaf-blade* 15-30 × 5-9 cm., rather narrowly oblong elliptic or narrowly obovate, more or less acuminate, the base cuneate, thinly coriaceous; *side-veins* 13-24 pairs, not distinctly inarching; *petiole* 6-1.5 cm. long.

*Corymb* 5-12 cm. wide, *dense*, sessile or with a peduncle up to 3 cm. long, the branches articulate, 2-3 mm. wide, *rather short*, finely and often sparsely puberulous, or even glabrous: *bracts*, at the base of the main branches, 6-12 × 4-7 mm., broadly lanceolate, subacute, *rather leafy*: *bracteoles* 3-6 × 2.5-3.5 mm., oblong, acute or subacute like the sepals: *flowers yellow-red*, ? inodorous: *sepals* 2.5-5 × 1.5-2.5 mm., *longer than the ovary*, glabrous, *oblong, blunt or subacute, unequal in length in the same flower*: *corolla-tube* 3-3.5 cm. long, glabrous, the petals 6-7 × 3.5-5 mm. elliptic, blunt or subacute.

Distribution:—Malaya.

Type:—Griffith 2996 (Malacca).

Collections:—Perak; King's Collector 5972, Burn Murdoch 202, Wray 726, s.n. 1889 (Changkat Serdang).

Selangor; Curtis 2346, Ridley 5674, 7300, 8536, s.n. Aug. 1904 (Sempang Mines): For. Dept. 122, 4941, 8274, 24253.

Malacca; Goodenough 1271, Hervey s.n. 20.9.90, Ridley s.n. 1890 (S. Baru).

Johore; Curtis s.n. April 1901 (Muar).

Very little is known of this species which has seldom been collected within the last thirty years. I interpret the species from the specimens identified by King in the Singapore Herbarium. According to King, and to the field-note on Burn Murdoch's collection, the flowers are yellowish red, perhaps yellow turning red and this character distinguishes it radically from the similar species *I. multibracteata*, *I. merguensis* etc. with which it may easily be mistaken in the herbarium. It is most like *I. umbellata* but differs in the narrower, more coriaceous leaves, the broader bracts, stouter branches of the corymb as well as in the colour of the flower.

I. *Lobbii* King et Gamble

Glossy Ixora

Mat. Fl. Mal. Pen. 4, 1904, p. 152.

Synonyms:—

*I. Lobbii* var. *angustifolia* K. & G., loc. cit. p. 153 *pro parte*.*I. fulgens* Roxb. sensu Hook. fil., F.B.I. 3, p. 146 *pro parte* (fide King and Gamble).*I. aurea* var. *major* Ridley, Journ. Bot. 72, 1934, p. 252.An evergreen shrub or treelet, 1–10 m. high like *I. javanica*.

Leaf-blade 10–28 × 4–8.5 cm., lanceolate-elliptic to lanceolate-obovate, more or less suddenly acuminate, widest at or above the middle, the base gradually tapered, dark glossy green, with 12–26 pairs of lateral veins inclined forward and distinctly inarching near the margin.

Sepals subacute to acute.

Petals yellow or pinkish yellow turning red, generally acute.

Distribution:—Lower Siam, Malaya, Borneo, Sumatra, Anamba and Natuna Islands.

✓ var. *stenophylla* var. nov.

Red River Ixora

Synonyms:—

*I. stenophylla* (Korth.) Kuntze sensu Ridley, Trans. Linn. Soc. 3, 1894, p. 311, Fl. Mal. Pen. 2, 1923, p. 94.*I. salicina* Ridley, Journ. Bot. 72, 1934, p. 253.

Lamina lanceolata, .7–2.3 cm. lata, utrinque attenuata, apice longe acuminate, costis lateralibus utrinsecus 8–15; frutex riparius.

A riverside shrub .5–3 m. high.

Leaf-blade 3.5–15 × .7–2.3 cm., lanceolate, gradually tapered to the long acuminate apex and to the base, broadest at the middle, with 8–15 pairs of lateral veins distinctly inarching at the margin and making a wide angle with the midrib; petiole .2–1.3 cm. long; stipular point up to .9 cm. long.

Distribution:—Malaya, Borneo, Palawan (?).

Type:—Ridley 2215 (Tahan River, Pahang).

This species has hitherto been attributed to Loudon for authorship. On turning to Loudon's reference, (Encycl. Suppl. II, p. 1543) it will be seen, however, that there is no description. Loudon based his name on *Pavetta Lobbii* Teysm. et Binn., which is also a *nomen nudum* as well as a *nomen invalidum* from its manner of publication. Hence the authorship must be attributed to King and Gamble who first described it. These authors give a reference to "Pavetta Lobbii Teysm. et Binn. in Miq. Ann. Mus. Lugd. Bat. IV, 194", but I cannot find the name on this page, nor in the whole volume, nor in any other work of Miquel's. Misgivings arise, therefore, whether the name *I. Lobbii* has not been antedated because the species is one of the commonest in western Malaysia. This is, unfortunately, impossible to decide from the earlier descriptions of red Ixoras and so one must wait until herbaria have been ransacked for the types of the old species. Surely it did not escape Miquel.



The narrowly obovate, acuminate, many-veined, dark glossy green leaves and the acute petals will generally distinguish *I. Lobbiai*. But there are narrow-leaved collections of *I. congesta* which seem to pass into *I. Lobbiai* and likewise many-veined collections of *I. javanica*, particularly of *I. javanica retinervia* which has the acuminate blade, pointed petals, and inarching veins of *I. Lobbiai*.

My basis for the identification of the Malayan material with *I. Lobbiai* is the specimens so named by King in the Singapore Herbarium. King doubtless saw the specimen of Teysmann and Binnendijk in the Kew Herbarium. It seems that the species is not recognised outside Malaya, though Bremekamp reports it from the neighbouring islands of the Rhio Archipelago.

The variety *angustifolia* King and Gamble, as pointed out by Ridley, is a mixture of a narrow, lanceolate-leaved state of *I. Lobbiai* and a small lanceolate-leaved riverside shrub. Of the collections cited by King and Gamble there belong to the first state Wray 519, Scortechini 1893 and King's collector 2718, and to the second only Ridley 2215. Therefore Ridley referred the first state to var. *angustifolia*, defined it anew and made Wray 519 as the lectotype: the second state he referred to the Bornean *Pavetta stenophylla* Korth. as *I. stenophylla* Ridley which name he changed subsequently to *I. salicina* as he considered the Bornean plant to be different. As regards var. *angustifolia* sensu Ridley, I am unable to distinguish it because there is every gradation to the typical, slightly broader-leaved state of *I. Lobbiai*, and the variety has no particular habitat or distribution, specimens from all parts of Malaya being referable to it. Hence I merge this variety with *I. Lobbiai*. On the other hand, *I. stenophylla* sensu Ridley (= *I. salicina*) is a well-marked riverside shrub with narrow, shorter leaves and fewer veins than typical *I. Lobbiai* and in Malaya, it appears to be limited to the rocky streams that are the tributaries of the rivers flowing into the China Sea: in which relation, may be, it occurs also in Sarawak and probably, Palawan. Nevertheless, I am unable to follow Ridley in maintaining his *I. stenophylla* (*I. salicina*) as a species. The low shrubs by the banks of swift flowing rivers that are prone to frequent and sudden flooding, like the Tahan and its tributaries, have small narrow leaves very different at first glance from those of *I. Lobbiai* in the quiet, deep shade of the forest, but the smaller and more precipitous the river the less are its riparian growths subject to flooding and the larger are the leaves and the bushes so that it is not easy to decide whether they should be classed as "stenophylla" or "Lobbiai", e.g. the Johore

collection of var. *stenophylla* (shrubs 2-4 m. high). I prefer, therefore, to reduce *I. stenophylla* sensu Ridley as a variety of *I. Lobbia* without any decision about its identity with *Pavetta stenophylla* Korth. The narrow-leaved, riparian form of *Melastoma malabathricum* affords a comparable case.

The variety *stenophylla* has been confused in Malaya with the narrow leafed riparian states of *I. javanica* but these differ in having fewer lateral veins, which do not inarch distinctly but are directed obliquely forward, and, generally, in having less acuminate leaves and smaller flowers with blunt or subacute petals. The type of *I. aurea* var. *major* Ridley, namely Nur 20007, is a riverside-form intermediate between *I. Lobbia* and var. *stenophylla*, perhaps a riverside-form of my form 7.

*I. salicifolia* (Bl.) (= *I. fulgens* Roxb. var. *salicifolia* K. & V.) differs from *I. Lobbia* var. *stenophylla* in having much longer, linear-oblong leaf-blades (12-38 × 1.2-2.5 cm.) with many more pairs of lateral veins (15-30 prs.). Nothing approaching *I. salicifolia* has been found in Malaya: and *I. Lobbia* seems not to occur in Java.

*I. javanica* var. *retinervia* may well be mistaken for *I. Lobbia* var. *stenophylla* in the herbarium. The var. *retinervia* is a small tree, or shrub, of lowland forest, not a riverside bush: its leaves are broader than those of var. *stenophylla*, have on the whole fewer lateral veins and are oblong elliptic to elliptic. It seems, moreover, that the Malayan specimens of var. *retinervia* are always distinguishable by their smaller flowers. Nevertheless, I feel there is some close relation between the two.

#### KEY TO THE FORMS OF *I. LOBBIA*

Corolla-tube 2-2.7 cm. long			
Limb 1-1.3 cm. wide: petals .25 cm. wide, acute	..		Form 1
Corolla-tube 2.5-3.8 cm. long			
Limb 1.2-1.8 cm. wide: petals .2-4 cm. wide			
Petals acute	..	..	Form 2
Petals blunt	..	..	Form 3
Limb 2-2.5 cm. wide: petals .4-6 cm. wide, acute	..		Form 4
Limb 2.7-3.3 cm. wide: petals .5-8 cm. wide, acute	..		Form 5
Corolla-tube 3.8-5 cm. long			
Petals .4-5 cm. wide, acute			
Limb 1.2-1.7 cm. wide: tube 3.7-5 cm. long	..		Form 9
Limb 1.8-2.3 cm. wide: tube 3.7-4.3 cm. long	..		Form 6
Petals .5-8 cm. wide: tube 3.7-5 cm. long			
Limb 1.8-2.5 cm. wide: petals .5-6 cm. wide	..		Form 7
Limb 2.5-3.3 cm. wide: petals .7-8 cm. wide	..		Form 8

#### KEY TO THE FORMS OF *I. LOBBIA* VAR. *STENOPHYLLA*

Corolla-tube 3-3.7 cm. long: petals .4-6 cm. wide			
Limb 1.7-2 cm. wide	..	..	Form 10
Limb 2.2-3 cm. wide	..	..	Form 11

Corolla-tube 3.7-5 cm. long

Limb 2-2.8 cm. wide: petals .4-.6 cm. wide .. Form 12

Limb 2.8-3.5 cm. wide: petals .5-.7 cm. wide .. Form 13

*Form 1*

Corolla-tube 2-2.7 cm. long, limb 1-1.3 cm. wide; petals .25 cm. wide, acute.

*Form 2*

Corolla-tube 3.2-3.8 cm. long, limb 1.25-1.8 cm. wide: petals .25-.4 cm. wide, oblong, acute.

*Malayan Collections*

Kedah; Henderson 21264.

Penang; Burkill 813, 2599, Curtis s.n. March 1892 (Govt. Hill), s.n. April 1884, 479.

Province Wellesley; Ridley 6991.

Perak; Cantley s.n., Curtis 3338, Fox 158, For. Dept. 11567, Ridley s.n. 1892 (K. Kangsar), s.n. 1892 (Maxwell's Hill), Scortechini s.n.

Pahang; Henderson 10695, Kiah 23901.

Selangor; Burkill 7580, Cons. For. 2278, Hume 9254, Pestana 28430.

Malacca; Alwins s.n., Alwins 60, Burkill 462, 1321, Corner s.n. 23.2.36, Derry 10, Hullett s.n. April 1888 (Mt. Ophir).

Singapore; Cantley s.n., Corner s.n. 1.4.37, Nur s.n. 23.2.29, Ridley 5673.

*Anamba Islands*

Henderson 20124.

This is the commonest form of *I. Lobbiai*, but whether it is taxonomically the typical state I do not know.

*Form 3*

as Form 2 but the petals blunt to subacute.

*Siam*

Curtis 3258 (Kasoom).

*Borneo*

Moulton 6703/15 (Upper Baram, Sarawak: det. *I. cf. amoena*).

*Form 4*

Corolla-tube 3-3.8 cm. long, the limb 2-2.5 cm. wide: petals .4-.6 cm. wide, lanceolate, acute.

*Malayan Collections*

Pahang; Henderson 21655 (Pulau Tioman).

*Anamba Islands*

Henderson 20185 (det. *I. javanica*).

*Form 5*

Corolla-tube 3-3.8 cm. long, the limb 2.7-3.3 cm. wide: petals .5-.8 cm. wide, acute.

*Sumatra*

Ridley 8970 (Batang Mandan, det. *I. fulgens*).

Except for its short corolla-tube, this form agrees with Form 8. Ridley's collection has, however, much smaller leaves than is general in the collections of Form 8.

*Form 6*

Corolla-tube 3.8-4.3 cm. long, the limb 1.8-2.3 cm. wide; petals .4-.5 cm. wide, elliptic, acute.

*Malayan Collections*

Pahang; Burkill and Holtum 8607, Henderson 10584, Nur 11179.

## Sumatra

Posthumus 724 (Djambi; det. *I. javanica*).

## Form 7

Ixora Sedili

Corolla-tube 3.8-5 cm. long, limb 1.8-2.5 cm. wide; petals .5-6 cm. wide, elliptic, acute: (corymb branches pale green in 32293).

## Malayan Collections

Johore; Corner 28166, 30787, 30962, 32293, 32495, Fielding s.n. Oct. 1892 (Pulau Tinggi).

This fine *Ixora* is known only from the watershed of the Sedili River in the East of Johore and from the island, P. Tinggi, off the East Coast of Johore. One may expect it therefore in Borneo, where its nearest ally, Form 8, occurs. It commonly develops into a spindly tree, 15-25 ft. high, with chocolate brown, cracked bark; the leaves have rather large, thinly leathery, dark glossy green blades which in shape and venation are inclined to resemble those of *I. congesta*, though they are always acuminate and generally more or less obovate and narrower. The more numerous veins and pointed petals distinguish it from *I. congesta* Form 10: it seems also to have a different distribution but our knowledge of the flora on the East side of Malaya is yet very meagre.

## Form 8

Giant Glossy *Ixora*

As Form 7 but the corolla-limb 2.5-3.3 cm. wide, the petals .65-8 cm. wide: (corymb branches pale green in 32292).

## Malaya

Johore; Corner 32292.

## Borneo

Allen 629 (Payao R., B.N.B., det. *I. congesta*).

Moulton 78 (Baram R., Sarawak, det. *I. fulgens*).

This is the finest red-flowered *Ixora* that I have seen. The big shining flowers contrast splendidly with the dark glossy leaves.

## Form 9

Corolla-tube 3.5-5 cm. long, limb 1.2-1.7 cm. wide, petals .4-5 cm. wide.

## Malayan Collections

Perak; Anderson 152, Burkill and Haniff 12713, Haniff 21043, Ridley 152, Wray s.n. 1889 (Taiping).

This variety from the Perak Hills has lanceolate leaves 12-24 × 2-5 cm. It much resembles var. *stenophylla* but the longer leaf-blade and a habit that is not riparian distinguish it.

## STERILE, FRUITING OR NOT FLOWERING COLLECTIONS

## Malaya

Penang; Curtis s.n.

Province Wellesley; Burkill 6538, Ridley s.n. Dec. 1895.

Perak; Haniff 10555, Ridley s.n. March 1896 (Gunong Tung-gul), Wray 519, 952, 2891, 3449.

Pahang; Burkill & Haniff 17003, For. Dept. 28273, Machado 11569.



Selangor; Ridley s.n. June 1889 (K. Lumpur).  
 Negri Sembilan; Nur 797.  
 Malacca; Alwins s.n., Burkill 6419, Derry 966.  
 Johore; Corner s.n. 11.3.37, Ridley 11324, s.n. March 1908  
 (S. Tebrau), s.n. Aug. 1908 (Sedenah).  
 Singapore; Cantley 83, Hullett s.n. 1893 (Changi Road).

*Sumatra*

Bartlett and La Rue 29 (det. *I. salicifolia*).  
 Bunnemeyer 3204 (det. *I. salicifolia*).

*Anamba Islands*

v. Steenis 897 (det. *I. javanica*).

*Borneo*

For. Dept. B.N.B. 4705.

FORMS OF VAR. *STENOPHYLLA*

*Form 10*

Corolla-tube 3-3.7 cm. long, limb 1.7-2 cm. wide: petals  
 4-6 cm. wide.

*Malayan Collections*

Johore; Holttum 10870.

*Form 11*

As Form 9 but the corolla-tube 2.2-3 cm. wide.

*Malayan Collections*

Trengganu; Corner 25825, s.n. 24.6.32 (Kemaman).

*Borneo*

Ridley 12443 (Puak) (det. *I. stenophylla*).

*Philippine Islands*

Merrill 1362 (Palawan: det. *I. fulgens*).

*Form 12*

As Form 11 but corolla-tube 2-2.8 cm. wide, petals 4-6  
 cm. wide.

*Malayan Collections*

Kelantan; Haniff & Nur 10280.

Pahang; Burkill and Haniff 16562, Corner s.n. Sept. 1937  
 (S. Tahan) (2 collections), Haniff and Nur 8089, Ridley  
 2215, Seimund 496, 585, Strugnell 22463.

*Form 13*

As Form 11, but corolla-limb 2.8-3.5 cm. wide, petals  
 5-7 cm. wide.

*Malayan Collections*

Johore; Corner 32490.

Pahang; Corner s.n. 7.9.37 (S. Tahan).

STERILE, FRUITING OR WITHOUT FLOWERS

*Malayan Collections*

Perak; Ridley s.n. Sept. 1890 (Bujong Malacca).

Pahang; Seimund 586, Nur 18924 (det. *I. stricta*).

Johore; Ridley s.n. 1904 (Castlewood).

*Borneo*

Anderson 213 (Gunong Rumpit), Ridley 11743 (Bidi).

COLLECTIONS BETWEEN *I. LOBBII* AND  
VAR. *STENOPHYLLA*

Johore; Nur 20007 (type of *I. aurea* var. *major* Ridley):  
Corner 31434.

These collections may well be narrow leafed riverside plants of my form 7. Their leaves are not lanceolate enough for true var. *stenophylla*.

**I. micrantha** Ridley

Mountain Ixora

Journ. St. Br. R. As. Soc. 61, 1912, p. 21.

Synonym:—

*I. patens* Ridley Journ. St. Br. R. As. Soc. 79, 1918, p. 83.

A mountain shrub or small tree to 8 m. high: glabrous except for the puberulous branches of the corymb.

*Leaf-blade* 9–18 × 3–8 cm., *oblong elliptic* or slightly obovate, *more or less acuminate*, the base cuneate or rather abruptly rounded, scarcely coriaceous, with 9–16 pairs of side-veins directed obliquely forward and inarching near the edge: *petiole* 3–1.5 cm. long: *stipular point* 3–7 mm. long.

*Corymb* 6–20 cm. wide, 5–14 cm. high, *large, sessile or very shortly stalked*, the branches *articulate and puberulous*, the *flowers* densely crowded and more or less sessile, *very fragrant*: *sepals* as long as or shorter than the ovary, *subacute: corolla-tube* 3–9 mm. long, *pink or red, or yellow turning red; petals* 2.5–3 × 1.5 mm., *oblong, blunt or subacute, reflexed along the tube, yellow gradually turning red.*

*Berry* 1 cm. wide, subglobose, scarcely sulcate.

*Distribution*:—Malaya; apparently only in the mountains, 1000–1700 m.

*Typus*:—Ridley 15830, Sempang Mines, Selangor, April 1911.

## KEY TO THE FORMS

Corolla-tube 3–5 mm. long	..	..	Form 1
Corolla-tube 7–9 mm. long	..	..	Form 2

*Collections*

Form 1:—Haniff 2455 (Perak, G. Hijau), For. Dept. 27552 (Pahang), Anderson 31 *pro parte* (Perak, G. Hijau).

Form 2:—Anderson 31 *pro parte*, Burkill and Haniff 12629, Henderson 11819 (all three from G. Hijau, Perak), Wray 3934 (Perak, G. Bubu), Hose 78 (Selangor, Fraser's Hill), Ridley 15830 (Selangor), Robinson s.n. 19.1.93 (Selangor, G. Menkuang: *type* of *I. patens*).

Without full-grown flowers:—Ridley 9708 (Perak, G. Keledang), 13640 (Pahang, Telom Valley) For. Dept. 28117 (Pahang, S. Lemai), 23394 (Selangor, Fraser's Hill).

This species is closely allied with *I. concinna*, having the same small fragrant flower with yellow corolla turning red, and similar leaves, but it is easily distinguished by its much larger inflorescences with stouter, puberulous branches. Most of the Malayan specimens have been identified with *I. concinna*. Ridley remarked that the species was related to *I. grandifolia* but the bracteate, articulate ramuli of the corymb forbid such an alliance.

I can find no specific difference whatever between the types of *I. micrantha* and *I. patens*. Ridley's statement that *I. micrantha* has only 9 pairs of side-veins to the leaf is wrong: the type-specimen has as many as 13. The differences in size of leaf and corymb, given by Ridley, are trivial and such as occur in any plant.

The collection Wray 3934 is the basis of the record of *I. undulata* in Malaya, being determined as such by King and Ridley. Wray's fieldnote is "flower yellow, tube tinged pink, as the flower gets older it turns to red", but *I. undulata* has white flowers, and this is to me conclusive that Wray's plant is not *I. undulata*: indeed, Wray's plant is identical with the type of *I. micrantha*.

### *I. nigricans* W. et A.

White Needles

Prodr. Fl. Ind. I, 1834, p. 428.

Wight lc. Pl. t. 318.

Synonyms:—

*I. affinis* Don, Gen. Syst. 3, 1834, p. 571.

*I. erubescens* Don, loc. cit.

*I. arguta* King, Mat. Fl. Mal. Pen. 4, 1904, p. 148.

*I. plumea* Ridley, Journ. Str. Br. R. As. Soc. 59, 1911, p. 117.

*I. nigricans* var. *erubescens* Kurz, For. Fl. Burma 2, 1877, p. 24.

*I. nigricans* var. *arguta* Hook. f., F.B.I. 3, 1880, p. 149.

*I. affinis* var. *arguta* Craib, Fl. Siam. En. 2, 1934, p. 147.

*I. affinis* var. *plumea* Craib, loc. cit. p. 148.

*Pavetta acutiflora* Korth. Ned. Kruidk. 2. 1851, p. 262 (fide auctt.).

*Pavetta subulata* Teysm. and Binn. Ned. Kruidk. Arch. 3, 1855, p. 403 (fide auctt.).

A bush or treelet to 4 m. high, flowering at 1 m., glabrous except for the puberulous branches of the corymb.

Leaf-blade 8–20 × 2.5–8 cm., narrowly elliptic to elliptic obovate, acuminate, gradually tapered to the base, the upper leaves on flowering branches often shorter, broader, and ovate or even cordate, membranous, blackening in drying: side-veins 7–12 pairs, not or vaguely inarching: petiole .5–1.5 cm. long: stipule-point .3–.8 cm. long.

Corymb 5–15 cm. wide, rather lax, erect, sessile or with a peduncle up to 4 cm. long, the branches slender, articulate, more or less puberulous, often reddish: bracts 4–8 × .1 mm. linear-lanceolate: bracteoles like the sepals but slightly broader: flowers white, fragrant often only faintly: sepals .7–1.5 mm. long, linear-lanceolate, glabrous, as long as, longer than or shorter than the ovary (ca. 1 mm. long), green: corolla-tube .8–1.3 cm. long, glabrous, the mouth also glabrous, white: petals 4–6.5 × 1–1.5 mm. linear-oblong, acute or becoming blunt on expansion, recurved against the tube; style projecting 3–6 mm.: ovary green or purplish.

Distribution:—India, Indo-China, Siam, Malaya, Sumatra, Anamba and Natuna Islands, Java, Bali.

Type:—Wight 1335.

Collections:—

Siam; Haniff and Nur 3590, 3851, Keith 277, Ridley 15098. Perlis; Ridley 14995, 15097, Henderson 23007.

Kedah; Best 21213, Curtis 3206, Holttum 15083, Ridley 8299.  
 Kelantan; Corner s.n. 1.5.37 (Kota Bahru).  
 Trengganu; Corner s.n. 1.5.37 (S. Besut).  
 Penang; Curtis 986, For. Guard. s.n. Ayer Itam, s.n. Balek Pulau.  
 Province Wellesley; Ridley 7013.  
 Perak; Curtis 1303, Haniff 14184, Henderson 10074, 10295, King's Collector 870, 10901, Ridley 7188, 11905, s.n. 1891, s.n. 1898, Wray 2135.  
 Pahang; Burkill s.n. June 1915 (P. Tioman), Evans 13229, Henderson 10665, 21678, Nur 18552.  
 Selangor; Ridley 8240, s.n. 1897.  
 Negri Sembilan; Burkill 4962.  
 Malacca; Alvins 1034.  
 Johore; Fielding s.n. 1892 (P. Dayong), Henderson 18212.

var. *ovalis* Pitard

Fl. Gen. Indoch. 3, 1924, p. 322.

Synonyms:—

*I. lucida* Hook. f., F.B.I. 3, 1880, p. 148.

*I. lucida* var. *densipila* Craib, Fl. Siam Enum. 2, 1934, p. 161.

Leaf-blade 5–14 × 2–6 cm., broadly elliptic to ovate-elliptic, generally broadly rounded at the base, the apex distinctly acuminate, drying shiny, the side-veins arising at a wider angle from the midrib and distinctly inarching near the margin: petiole rather short, 2–7 mm. long.

Corolla-tube 2–3 cm. long, puberulous, the mouth glabrous or more or less bearded: petals 5–7 × 2 mm.: ovary and sepals puberulous.

Distribution:—Indo-China, Siam, Malaya (north).

Type:—Pierre's specimen from Tan-Huyen (prov. Bien-hoa).

Collections:—

Siam; Kerr 7108.

Penang; Curtis 2451, Nur 1478.

Kelantan; Henderson s.n. 22.10.28 (Gua Ninek), s.n. 15.7.35 (Gua Teja).

Perak; Henderson 23856, Ridley s.n. Aug. 1909 (K. Kenering).

King's reason for rejecting the name *I. nigricans* for the Malayan specimens in favour of *I. arguta* rested on a misunderstanding. King regarded the Wallichian collection 6154 as the type of *I. nigricans* and, having discovered that the number included a variety of plants, he rejected *I. nigricans* as a confused species. But the publication of *I. nigricans* dates from Wight and Arnott's Prodrum where, in the paragraph following the description, it was clearly stated that the description was based on the collection 1335 of Wight's with the remark that this collection was not included under the Wallichian aggregate 6154. Wight's illustration is taken from his own collection and it undoubtedly depicts the Malayan species. Wight and Arnott described the corolla-tube as three-quarters of an inch long but the illustration shows the corolla-tube 10–12



mm. long as in most Malayan specimens and as described by Koorders and Valetton, King and Pitard. Hence I have no doubt of the identify of our Malayan plants.

Don's species, *I. affinis* and *I. erubescens*, have generally been regarded as identical with *I. nigricans*. They were published in the same year without any indication of priority over *I. nigricans* and, as this name is the better known, Don's have been reduced to synonyms (Bremekamp, Journ. Bot. 75, 1935 p. 296). Craib considered that Don's species were different from *I. nigricans* but gave no reason.

*I. plumea* Ridley is identical with *I. nigricans*. Craib endeavoured to distinguish it as a variety of *I. affinis* on the character of the sepals being longer than the ovary. But I find that there is every gradation to states with the sepals as long as the ovary and those with the sepals shorter: and the differences are trivial, concerning a length of .5-75 mm. Craib also distinguished *I. arguta* King as a variety of *I. affinis* without saying how it differed. The distinction between *I. affinis* and *I. erubescens* lies in the more oblong leaf and shorter petiole of *I. erubescens* according to Craib but he does not give the length of the petiole in either or say from what part of the plant the leaf or the petiole is to be taken for comparison. I consider that none of these distinctions has even varietal value especially when the general variableness of the plants in the length of the corolla-tube and petals, the size of the leaf and corymb, and the colour of the ovary has been disregarded.

On the other hand, var. *ovalis* Pitard does seem worth varietal rank through the longer corolla-tube, the different venation and the rounded leaf-base. Its leaves, in fact, throughout the plant are like those just below the corymbs of typical *I. nigricans*. Nevertheless there are some collections intermediate between the two, and the variety has all the important specific characters of *I. nigricans* though Bremekamp excludes it. Craib's *I. lucida* var. *densipila* seems to be only an extreme form of var. *ovalis* with densely puberulous corolla-tube and heavily bearded corolla-mouth. The collection, Curtis 2451, has a rather thinly bearded corolla-mouth whereas all the other Malayan collections have a glabrous mouth.

Of the typical *I. nigricans* the flowering specimens in the Singapore Herbarium can be separated into two forms, those with the corolla-tube 8-9 mm. long and those with the tube 10-13 mm. long. However, the length of the petals does not always vary concurrently there being short-tubed collection with long petals (5.5-6.5 mm.) and long-tubed collections with short petals (4-5 mm. long) as well as *vice versa*.

**I. pendula** Jack

Pink Needles

Mal. Misc. 1, 1820, p. 11.

Synonyms:—

*I. opaca* Don, Gen. Syst. 3, 1834, p. 573.*I. montana* Ridley, Journ. Br. Roy. As. Soc. 79, 1918, p. 82.*I. candida* Ridley, Journ. F.M.S. Mus. 10, 1920, p. 141.*I. pendula* var. *opaca* Ridley, Fl. Mal. Pen. II, 1923, p. 96.*I. Parkinsoniana* Craib, Kew Bull. 1932, p. 428.

A shrub or small tree up to 8 m. high, glabrous except for the puberulous cyme-branches and corolla-tube, occasionally wholly glabrous or with the corolla-tube glabrous.

*Leaf-blade* 10–35 × 3–12.5 cm., elliptic, oblong-elliptic, lanceolate elliptic or more or less obovate, the apex subacute, acute or distinctly acuminate, the base gradually tapered or rather suddenly rounded, thinly leathery or distinctly so, dull dark green: *side-veins* 12–24 pairs, directed forward and distinctly inarching near the edge: *petiole* .6–1.8 cm. long, rather stout: stipular point .2–1 cm. long.

*Corymb* 3–23 cm. wide, *deflexed perpendicularly on a long peduncle*, 1–28 cm. long, *the peduncle and branches generally puberulous and more or less suffused purple, articulate*, the corymb terminal or from the twigs behind the leaves and generally with a pair of leaf-like, often sessile and cordate, bracts at the base; *the flowers not scented: sepals varying lanceolate, acute and as long as the ovary (1 mm. long) to bluntly triangular and shorter than the ovary, the ovary and sepals glabrous or more or less puberulous: corolla-tube 1.8–3.5 cm. long, deep rose-red, generally puberulous outside, but often glabrous or nearly so, the limb .9–1.6 cm. wide: petals 1.5–2.5 mm. wide, oblong, subacute, more or less reflexed along the tube, with reflexed edges, white, or tipped pink, or partly suffused pink.*

Distribution:—Siam, Malaya, Sumatra.

Type:—Non extant, the type-locality being Penang.

*Form 1*(= *I. diversifolia* Kurz sensu King and Ridley).

Corolla-tube 1–1.2 cm. long, the limb .8–.9 cm. wide.

Collections:—

Lower Siam; Haniff and Nur 2718, Kiah 24363.

Malaya; King's Collector 5737, Ridley s.n. July 1909 (Ulu Temango), Wray 3491.

I can distinguish only one species in Malaya which has deflexed, scentless inflorescences, deep pink corolla-tubes and white petals, and such must therefore be *I. pendula* Jack. It is nevertheless exceedingly variable in detail, especially in the leaf. The variable features are the leaf-size, shape, venation and texture, the size of the corymb and the length of the peduncle, the length of the corolla-tube and the hairiness of the cyme-branches and corolla-tube. If one attempted to distinguish varieties or forms reckoning with all these characters, the number would be impractical.

Some of the Penang specimens in the Singapore Herbarium have large, rather blunt, not acuminate, leaves with rather few veins (blade 18–35 × 6–12.5 cm., veins

12-16 pairs): these are Burkill 6898, Curtis 2240, Curtis s.n. July 1887, April 1890, February 1900. On the sheet of Curtis s.n. July 1887 King has written "exactly the same as the type Wallich Cat. 6127": this collection is not the type but may be regarded as the neotopotype. Other collections have linear leaves  $10-20 \times 2-4$  cm. There is, however, such diversity of the leaves in detail, with every intermediate condition, that I do not see how varieties can be maintained on such characters: I have noticed, too, that the leaves on the short flowering twigs are often smaller, more pointed and with rounded bases than those of the stout vegetative shoots.

The size of the inflorescence and the length of the peduncle vary extraordinarily. King distinguished *I. opaca* from *I. pendula* by its short peduncle, 1-5 cm. long, and its erect corymb. The first point indicates merely the lowest part of the range in size of the inflorescence and is connected by all intermediates with the largest. The second point is certainly an error by no means easy to detect from herbarium specimens: the collections Ridley 3071, King's Collector 4061 and 4118, identified by King as *I. opaca* have the typical deflexed inflorescences. Ridley's definition of *I. pendula* var. *opaca* is not applicable, and there is no evidence that it is a mountain form more than a lowland. Hence I reduce *I. opaca* to *I. pendula*, as being founded on an inadequate range of material. The type of *I. opaca* is Wallich 6141 from Penang.

As regards the size of the corolla some collections have the tube 2.2 cm. long with the limb 1.2 cm. wide, others have the tube 3.5 cm. long and the limb 1.6 cm. wide, but most collections have some intermediate size. A few collections have the tube only 1-1.2 cm. long and the limb 8-9 mm. wide and they have been identified with *I. diversifolia* Kurz by King and Ridley. Some of these have unusually large leaves (up to  $35 \times 18$  cm.) but I cannot see any specific difference between them and *I. pendula*, for they have the same characteristic inflorescence and flowers and they display the same diversity of leaf. Whether they are true *I. diversifolia* which comes from Burma and has 'white' flowers I do not know. Hence I am content to regard them as a form only, like the forms of other *Ixoras* variable in size of corolla.

Of *I. montana* Ridley, there is a part of the fragmentary type-collection (Haniff 16310) at Singapore, consisting of two twigs, an inflorescence and two leaf-bases. It is identical with *I. pendula* except for the rather shorter corolla-tube (1.8-2 cm. long) and thus it connects with my form 1. The inflorescence is on a short peduncle like that of *I. opaca* but it is a wide inflorescence typical of *I. pendula*.



Whether the inflorescence was decurved, or the twig bearing the inflorescence was decurved, is now impossible to discover but, as the specimen agrees in all other points with other mountain specimens of *I. pendula*, I have not the slightest hesitation in reducing it.

*I. candida* Ridley is merely a narrow-leaved form of *I. pendula* var. *opaca*; that is, of the state of *I. pendula* with a small, shortly pedunculate inflorescence. Specimens of both type-collections are at Singapore: (it seems that the number 6219, given by Ridley, for Robinson's collection at Dayang Bunting should be 6189 as numbered in the Singapore Herbarium). There are numerous intermediates connecting these lanceolate-leaved specimens (with blades only 6–12 × 1.5–3 cm.) to the typical *I. pendula*. Both type-collections show the deflexed inflorescence and both have a puberulous ovary as in Craib's *I. Parkinsoniana*. The reason for considering the flowers as white is the field-note "flowers white" to Robinson's unnumbered syntype from Telok Wau, Terutan: it is likely that the pink-corolla-tube was concealed by the expanded white petals and so escaped the notice of the collector.

*I. Parkinsoniana*, according to the collections named by Craib in the Singapore Herbarium, is merely a form of *I. pendula* with puberulous ovary and sepals, short-corolla-tube (1.5 cm. long) and rather small, though long-pedunculate, corymb. These collections show that the inflorescence was deflexed as in *I. pendula*. Craib does not explain how *I. Parkinsoniana* is to be distinguished from *I. pendula*. If *I. Parkinsoniana* can be split off on the evidence of a puberulous calyx and corolla-tube, what should one do with the other forms of *I. pendula* with puberulous corymb and corolla-tube, puberulous corymb and glabrous corolla-tube, glabrous corymb and puberulous corolla-tube, and those glabrous in all parts? Then add to these variations, all the varieties of leaf-size, texture and venation, of width of corymb and of length of peduncle. To separate such as "species" seems to me not only impracticable in the extreme but also inability to distinguish "the wood for the trees", losing thereby the major aspects of natural features. The specimens named *I. Parkinsoniana* by Craib in the Singapore Herbarium are:—Holttum 15126, Haniff and Nur 3557, Ridley s.n. Jan. 1897 (Langkawi), Haniff 15531 (all from the island of Lankawi).

### **I. pumila** Ridley

F.M.S. Mus. Journ. 10, 1920, p. 142.

A dwarf shrub, 30 cm. high, with finely villous stem, petioles and branches of the inflorescence, and thinly villous undersides to the leaves.



*Leaf-blade* 12-18 × 5-7½ cm., obovate elliptic, simply pointed, gradually attenuate to the base, thin: *side-veins* 10-14 pairs directed obliquely forward, not inarching, the tertiary veins rather close and transverse: *petiole* 3-8 mm. long: stipule lanceolate with a long point, 4-6 mm. long.

*Corymb* 5 cm. wide, on a peduncle 4 cm. long, the branches articulate, hairy, erect, *the corolla white*: bracts lanceolate, the lowest pair 10 × 15 mm., the bracteoles like the sepals: *sepals* 2-3 cm. long, lanceolate or linear-lanceolate, acute, hairy, longer than the ovary: *corolla-tube* 3 cm. long, glabrous: *the petals* 5 × 2 mm., oblong, subacute: corolla-mouth glabrous.

*Distribution*:—Malaya.

*Type*:—Evans 13226 (Gunong Senyum, Pahang, June 1917).

This species, known only from the type-collection, should be easily recognised from the hairy stems and undersides of the leaves, the hairy lanceolate sepals and glabrous white corolla as well as from its apparently dwarf habit.

Compare *I. clerodendron* with broad red sepals and *I. Brunonis* with differently shaped leaves, hairy corolla-tube, and longer sepals.

## I. *Robinsonii* Ridley

Tahan Ixora

*Journ. F.M.S. Mus.* VI, 1915, p. 154.

A shrub up to 2 m. tall: glabrous.

*Leaf-blade* 7.5-20.5 × 2-7.6 cm., rather narrowly elliptic to broadly lanceolate or lanceolate-obovate, the apex tapered, simply acute or acuminate, the base very gradually tapered into the petiole, leathery, the edge incurved: *lateral veins* 9-18 pairs, passing obliquely out at a wide angle from the midrib, inarching near the edge, the reticulations coarse: *petiole* 5-2 cm. long, rather flattened and woody, passing so gradually into the blade as to have its upper limit indiscernible: stipular point 1-5 mm. long.

*Corymb* 7.5-15 cm. wide, the peduncle 0-2.5 cm. long, the branches red: sepals acute or subacute: corolla-tube 3.8-5 cm. long, the limb 2.3-3.8 cm. wide, the 4 petals 5-9 cm. wide, elliptic, acute, deep salmon pink to scarlet.

*Distribution*:—Malaya (Gunong Tahan, G. Padang and ? neighbouring mountains, 600-1800 m.).

*Type*:—Robinson 5304 (Gunong Tahan, 1300 m. alt.).

### *Key to the Forms*

Corolla-tube 3.8-4.5 cm. long: limb 2.3-2.8 cm. wide: petals 5 cm. wide	.. .. .	Form 1
Corolla-tube 4.3-5 cm. long: limb 3-3.8 cm. wide: petals 6-9 cm. wide	.. .. .	Form 2

### *Collections*

#### *Form 1*

Pahang; Robinson & Wray 5304 *pro parte* (G. Tahan).

#### *Form 2*

Kelantan; Henderson 19736 (ca. 650 m. Gua Ninek).

Pahang; Robinson & Wray 5304 *pro parte* (G. Tahan),

Haniff & Nur 8115 (G. Tahan, ca. 1300 m.), Ridley 16244 (G. Tahan 1300 m.).

Trengganu; Moysey 33360 (G. Padang, ca. 1300 m.).

The leathery leaves with extremely attenuate base, stout petiole and coarse reticulation and the mountain habit distinguish this species, the range of which is curiously limited. I believe that one may say that it occurs only in the mid-mountain forest on the quartzite ridges of the Tahan-group of mountains from G. Padang on the Trengganu boundary westward to the Telom River. Nevertheless, there are some Bornean collections from sea-level—one, indeed, from the sea shore—which bear a strong resemblance to this species though I prefer to classify them with *I. javanica*, viz. Kloss 19136, For. Dept. B.N.B. 4037, 4256, 4276 (vide *I. javanica* var. *retinervia*).

On the type sheet of *I. Robinsonii* in the Singapore Herbarium there are two specimens, one each of the two form of flower-size. As Ridley described the corolla tube as 2" long, one should regard my 'Form 2' as the type. Ridley's statement that the corolla has 5 lobes is erroneous.

Our collection are yet too few to say if the species is as variable in size of flower as the other red *Ixoras*.

### I. *Scortechinii* King et Gamble

Dwarf Red *Ixora*

Mat. Fl. Mal. Pen. IV, 1904, p. 154.

Synonyms:—

*I. humilis* K. & G., loc. cit. non *I. humilis* O. Kze (1891).

*I. Kingiana* Craib, Fl. Siam. Enum. II, 1934, p. 159.

*I. humilis* var. *Scortechinii* Ridley, Fl. Mal. Pen. II, 1923, p. 95.

A dwarf, evergreen, little-branched or unbranched shrub up to ½ m. high, the stem sometimes decumbent with a few upright branches: leaves tufted at the top of the stem with the internodes more or less concealed by the overlapping leaf-bases.

Leaf-blade 13-36 × 5-18 cm., elliptic to obovate, simply pointed or subacute, generally rather blunt, narrowed to the widely or narrowly cordate, base, generally subsessile, broadest at or above the middle, dull green: lateral veins 11-21 pairs, passing obliquely forward and distinctly inarching near the margin: petiole 0-5 mm. long, generally concealed by the cordate leaf-base: stipular point 1-5 mm. long.

Corymb 4-9 cm. wide, terminal, subsessile, very dense, with red branches: sepals subacute: corolla-tube 2-4.5 cm. long: corolla-limb 1-2.75 cm. wide, the petals .5-85 cm. wide, broad, rounded, blunt, pinkish yellow or orange pink generally deepening to brick-red.

Distribution:—Malaya (Pahang, Perak, Trengganu, Kelantan, Penang, Province Wellesley).

Syntypes:—As given by King and Gamble.

### var. *caulescens* var. nov.

A typo differt caule evoluto, usque 2¼ m. alto, internodis distinctis, corymbis terminalibus vel lateralibus longe pedunculatis (pedunculis 4-10 cm. longis) haud congestis.

Distribution:—Malaya, Lower Siam, (Selangor to Patani).

Typus: Hume 7940 (Selangor, Semyih, 13.7.21).

King and Gamble distinguished two species on the basis of the number of primary lateral veins to the leaf, namely *I. humilis* (15–18 pairs) and *I. Scortechinii* (8–12 pairs). I find that some collections have 11–16 prs. of veins, and others have 14–21. I have also seen plants with 11–14 prs. of veins on small leaves and 16–21 pairs on large leaves. But in no case have I seen as few as 8. King and Gamble referred, moreover, Curtis 400 and Wray 4157 to both species. The distinction seems to me inconsistent and therefore I have reduced both species, following Ridley, but have been obliged to re-install the binomial *I. Scortechinii* as the earliest legitimate name. Accordingly, Craib's later binomial *I. Kingiana* becomes a synonym.

Craib has given Penang as the type-locality of *I. humilis* K. & G., but these authors indicated no type, having cited six collections which must be taken as syntypes. Likewise there is no holotype of *I. Scortechinii* but 5 syntypes. Of the syntypes of *I. humilis* K. & G. I remove one (Ridley 7422a) to my variety *caulescens*.

This variety *caulescens* is abundantly distinct both in the herbarium and the field. It has the habit of a slender plant of *I. congesta* but the cordate, subsessile leaves and broad blunt petals of *I. Scortechinii*. There can be no doubt that *I. Scortechinii* is closely related to *I. congesta*, perhaps even derived directly from it, and therefore var. *caulescens* appears to retain its ancestral habit while typical *I. Scortechinii* has declined into a dwarf. The distribution of *I. Scortechinii* is curiously limited to the northern half of Malaya and that of var. *caulescens* scarcely exceeds it.

*I. Scortechinii* inhabits the dense, lowland forest. It is in cultivation at Singapore, where it makes a good front to a shady path or rockery, but it will not tolerate the open. In the size of the flower, perhaps also in the colouring, it is as variable as the other red-flowered species *I. congesta*, *I. javanica* and *I. Lobbia*.

#### KEY TO THE VARIETIES AND FORMS OF *I. SCORTECHINII*

Stem up to ½ m. high, leaves crowded at the top:	
corymbs sessile .. .. .	<i>I. Scortechinii</i>
Corolla-tube 2–2.5 cm. long	
Limb 1–1.3 cm. wide: petals .5 cm. wide ..	Form 1
Corolla-tube 2–3.8 cm. long	
Tube 2–3 cm. long: limb 1.3–1.6 cm. wide:	
petals .5–.65 cm. wide .. .. .	Form 2
Tube 3–3.8 cm. long: limb 1.8–2 cm. wide:	
petals .6–.75 cm. wide .. .. .	Form 3
Corolla-tube 3.8–4.5 cm. long	
Limb 1.8–2 cm. wide: petals .5–.65 cm. wide	Form 4
Stem 1–2¼ m. high, with distinct internodes:	
corymbs with peduncles 4–10 cm. long ..	var. <i>caulescens</i>

Corolla-tube 3.2-3.8 cm. long	
Limb 1.5-1.8 cm. wide: petals .5-.6 cm. wide	Form 5
Limb 2-2.3 cm. wide: petals .6-.9 cm. wide	Form 6
Limb 2.3-2.8 cm. wide: petals .6-.9 cm. wide	Form 7
Corolla-tube 3.8-4.5 cm. wide	
Limb 2.3-2.8 cm. wide: petals .7-1 cm. wide	Form 8
Limb 1.8-2 cm. wide: petals .5-.65 cm. wide	Form 9

## Collections

*I. Scortechinii* (typical)

## Form 1

Penang; Curtis s.n.: Perak, Wray 4157 (syntype).

## Form 2

Penang; Curtis 400 (syntype): Province Wellesley, Burkill 6596.

## Form 3

Perak; Ridley 7186 (syntype): Pahang; Burn Murdoch 215 (21.6.13): Kemaman; Corner s.n. (cult. Hort. Bot. Sing.: flowers becoming pinkish orange, never red).

## Form 4

Trengganu; Corner 25836 (the flowers of this form appear to be persistently orange pink).

Specimens without flowers:—Province Wellesley; W. Fox's Collector s.n., Ridley 6992 (syntype): Pahang; Henderson 25081.

var. *caulescens*

## Form 5

Pahang; For. Dept. Mal. Pen. 20364: Selangor, Ridley 8234.

## Form 6

Selangor; Ridley 7422a (syntype of *I. humilis* K. & G.).

## Form 7

Selangor; Ridley 7422, Hume 7770A, 7940 (type).

## Form 8

Patani; Machado s.n. Sept. 1893.

## Form 9

Kelantan; Henderson 19518.

Specimens without flowers:—Kelantan; Haniff and Nur 10110, Henderson 29660: Perak; Corner s.n. 22.8.37.

**I. umbellata** Koorders et Valetou Malayan White Ixora

Bijdr. Booms. Java 8, 1902, p. 162.

Baumart. Java, IV, t. 550.

lc. Bog. II, t. 183.

Bot. Mag. t. 8577.

## Synonyms:—

? *Pavetta Korthalsiana* Miq., Ann. Mus. Lugd. Bat. 4, 1868-9, p. 197.

*I. Korthalsiana* (Miq.) Boerl., Hand. Fl. Ned. Ind. 2, 1891, p. 135.

non *I. Korthalsiana* Kurz, Journ. As. Soc. Bengal 46 (ii), 1877, p. 149. (= *Pavetta calycina* Korth. non *I. calycina* Thw.).

A shrub or treelet up to 6 m. high, glabrous except for the puberulous branches of the inflorescence, the hairy corolla-mouth and the puberulous corolla-tube: twigs pale.

Leaf-blade 13-33 × 5-13 cm., elliptic, acuminate or simply pointed, occasionally subacute, narrowed gradually to the base, drying light greenish: side-veins 12-20 pairs, not inarching or only vaguely with reticulations, the secondary veins coarsely



and conspicuously reticulate in the dried leaves: *petiole* 6–20 mm. long, rather stout: *stipular point* 1–4 mm. long.

Corymb 8–17 cm. wide, almost sessile or with a peduncle up to 4.5 cm. long, the branches articulate, puberulous and slender (1–2 mm. wide): *bracts* 3–7 × 1.5–2.5 mm., *linear lanceolate*, green, narrowly leafy with minutely ciliate edge: *bracteoles and sepals* 3–6 × 1.5–3 mm. long, oblong, obtuse or subacute, minutely ciliate on the edge, green, like tiny leaves, the sepals unequal: *flowers white, fragrant: corolla-tube* 2.5–4 cm. long, white, *puberulous externally, the mouth sparsely to thickly bearded with white hairs: petals* 6–10 × 3–5 mm., white, oblong-elliptic, obtuse: *anthers yellow: style green: bracts, bracteoles and, generally, the sepals caducous in the infructescence.*

Distribution:—Malaya, Borneo, Java, ?Sumatra.

Type:—Hallier 719 (Java).

Collections:—

Perlis; Henderson 23027 (det. *I. crassifolia*), Ridley 14999a (det. *I. multibracteata*).

Kelantan; Henderson 19615 (det. *I. Kingstonii*).

Perak; Wray 3953 (det. *I. multibracteata*).

Pahang; Burkill 996 (det. *I. multibracteata*), Corner s.n. 11.6.32 (Pulau Tioman), Henderson 21677 (det. *I. multibracteata*), Nur 18754 (det. *I. multibracteata*).

Selangor; Kloss s.n. Feb. 1912 (det. *I. Kingstonii*) Ridley 8570, s.n. July 1897 (Gua Batu).

Johore; Corner 28489 (det. *I. Kingstonii*), 30685, Henderson 18219 (det. *I. multibracteata*), Ridley 12199 (det. *I. Kingstonii*).

Singapore; Ridley 15463.

Borneo; Mondri 219 (Karimata Archip.) (det. *I. Korthalsiana* Val.), Hallier 381 (det. *I. Korthalsiana* Val. and *I. umbellata*).

In the Eastern half of Malaya, this species is rather common by streams in the lowland forest. I have found it abundant in the sandy coastal woods in the East of Johore. The Malayan specimens have been identified mostly with *I. multibracteata* which I consider a distinct variety with larger bracts and sepals. Though I have not seen the type of *I. umbellata*, the original description and the three illustrations leave no doubt of the identity of the Malayan specimens. The white fragrant flowers, the large green leafy sepals and bracts, and the many-veined rather large leaves together characterise the species. It has been generally supposed related to *I. congesta* but the resemblance is superficial and suggests how little the genus can be interpreted from the herbarium.

Concerning *P. Korthalsiana* I am uncertain because there is no figure or recent description of it, though both Bornean specimens which I have cited were identified with it by Valetou.

The corolla tube and petals are very variable in length in different collections, so that it is impossible to define the species narrowly on flower-size.

var. **multibracteata** var. nov. Lesser Malayan White Ixora

Synonym:—

↓ *I. multibracteata* King and Gamble, Mat. Fl. Mal. Pen. 4, 1904, p. 148.

Leaf-blade rather smaller and narrower (? always) 8–30 × 3–10 cm., narrowed gradually to each end, the apex not acuminate, often subcoriaceous, dark glossy green with wavy edge: *side-veins* 10–15 pairs, generally fewer, the reticulations often faint: *petiole* up to 1.5 cm. long.

Peduncle of corymb up to 2.5 cm. long: *bracts, bracteoles and sepals larger: bracts* 8–12 × 5–10 mm., *ovate*, shortly acuminate or acute: *bracteoles and sepals* 6–12 × 4–7 mm.: *corolla-tube* 2.5–3.5 cm. long, *glabrous or sparsely puberulous outside, the mouth glabrous or hairy.*

Distribution:—L. Siam, North Malaya.

Syntypes:—As enumerated by King and Gamble.

Collections:—

Siam; Curtis 2954 (syntype).

Kedah; Curtis 3408 (syntype), Ridley 5540 (syntype), 15887.

Perlis; Henderson 23049, Ridley 14999.

Perak; Corner 31640, Wray 3317 (syntype).

The larger bracts and sepals distinguish this variety from typical *I. umbellata*. The difference is at first so striking that no doubt it led King and Gamble to overlook the resemblance of their species to Valetton's. Nevertheless the difference is barely double the linear dimensions of the parts, and little more than one finds in the variation of the size of the corolla, or of the sepals, in other species such as *I. concinna* and *I. Lobpii*, though in these, the sepals being much smaller, the variation is almost microscopic. Moreover fruiting specimens, from which the bracts and sepals have been shed, can be distinguished from those of typical *I. umbellata* only by a close comparison of the venation which reveals slight differences between the two which cannot be rendered in words: and, even so, I doubt if anyone could infallibly distinguish such.

Whether this variety is wide-spread in Malaya has still to be discovered. I have seen it only in villages where it is rather frequent from Ipoh northwards. Mr. J. N. Milsum informs me, however, that it occurs wild in the forest on the road to Grik.

### ***I. undulata* Roxb.**

Fl. Ind. I, 1820, p. 395.

This species is recorded as occurring in Malaya both by King and Ridley. The record is based on the collection, Wray 3934, which is *I. micrantha*, as I have shown under that species. There is no evidence that *I. undulata* is wild in Malaya.

*Ixora Sunkist* nom. hort. nov.

A dwarf bush up to 1 m. high, glabrous, flowering throughout the year.

*Leaf-blade* 1.7-8 × .7-2.5 cm., *small, sessile*, lanceolate elliptic to lanceolate obovate, acute or subacute, the base gradually or rather suddenly narrowed, subcoriaceous, rather dull and yellowish green; side-veins 6-13 pairs, directed obliquely forward and distinctly inarching near the edge: *petiole* .1-3 cm. long: *stipule-point* .1-3 cm. long.

*Corymb* 5-10 cm. wide, as in *I. chinensis*, the branches red: *sepals* as in *I. chinensis*, blunt to subacute: *corolla-tube* 2.2-3.3 cm. long, the limb 1.3-2.5 cm. wide, the *petals* .2-3 cm. wide, lanceolate acute or subacute, pinkish apricot-yellow turning brick red.

This description is based on specimens cultivated in Malaya, probably introduced from southern China, but their origin is unrecorded. They do not match any description I have seen. Pending a decision on their botanical status, I give to them the fancy garden name Sunkist. They grow best in the full sun and the round inflorescences are not unlike oranges in shape and colour. I find that there are two forms:—

1. leaves with 6-9 pairs of side-veins: corolla-tube 2.2-2.5 cm. long, the limb 1.3-1.6 cm. wide.
2. leaves with 8-13 pairs of side-veins: corolla-tube 3-3.3 cm. long, the limb 2-2.5 cm. wide.

As I have remarked under *I. chinensis*, this *Ixora* is what one imagines a hybrid of *I. chinensis* and *I. javanica* or *I. Lobbii* would be like. It has the foliage of *I. chinensis* and pointed petals of *I. coccinea*.

#### SUMMARY

The following new varieties of *Ixora* are described:—

*I. coccinea* var. *decolorans*, var. *aureo-rosea*, and var. *rosea*.

*I. grandifolia* var. *lancifolia*.

*I. javanica* var. *multinervia*, var. *paucinervia*, and var. *retinervia*.

*I. Lobbii* var. *stenophylla*.

*I. Scortechinii* var. *caulescens*.

*I. umbellata* var. *multibracteata*.

"*Ixora Sunkist*" (a horticultural name).



## PALMAE MALESICAE

IX.—TWO NEW CORYPHACEOUS GENERA  
IN MALAYA

By C. X. FURTADO,  
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## 1. General Remarks

While arranging, in the Singapore Herbarium, the specimens of the Malayan palms having fan-shaped leaves, I detected many anomalous characters in the specimens referred to *Livistona rupicola* Ridl. The petiole is not prolonged as a thick rachis into the lamina but ends in numerous, almost equal, primary ribs or costae of the lamina. Further the spadices or flowers are usually unisexual, the segments of the perianth are imbricate, and the three carpels of the ovary are free almost to the base and are provided with free styles.

These characters are sufficient to remove the specimens from the section to which the genera *Licuala* and *Livistona* belong and place them in a different section together with *Trachycarpus* and *Chamaerops*. The genus *Trachycarpus* is not recorded from any tropical regions, it being confined to sub-temperate regions from N. W. Himalaya to Tibet, Assam, Burma, Indo-China, China and Japan. It is closely allied to *Chamaerops*, which is confined entirely to the Mediterranean countries as far as Persia, and with which *Trachycarpus* is sometimes united. However BECCARI (Ann. Roy. Bot. Gard. Calc., XIII, 1933, pp. 7, 253 & 272) has shown that *Chamaerops* has ruminant seeds, and *Trachycarpus* non-ruminant ones grooved on the raphal side with a more or less deep intrusion of the integument. The Singapore specimens referred to *L. rupicola* have no mature fruits, but the seeds of the very young fruits present seem to agree with the description of the fruits of *Trachycarpus*. However the flowers exhibit details on which the specimens can be arranged into two definite groups, neither of which belong to *Trachycarpus* or *Chamaerops*.

The specimens in the first group are all from the limestone hills in the Langkawi Islands and have their stamens united into a conspicuous epigynous cup as in *Licuala*, whereas in *Chamaerops* the stamens are united into a small hypogynous cup and in *Trachycarpus* they are entirely free. These Langkawi specimens are made here the basis of a new genus *Liberbaileya* named in honour of the American palm specialist Prof. L. H. BAILEY. Its type species has been named here as *L. lankawiensis* Furtado to show the exact area where it is native. The imbricate perianth and the staminal cup would make the genus a close ally of the American palm genus *Acanthorhiza*.



The specimens of the second group are from the limestone hills in Selangor and are referred here to a new genus *Maxburretia*, named in honour of the European palm specialist Prof. M. BURRET. These specimens are generically distinguished from *Liberbaileya* by their stamens being epipetalous; and were it not for their free styles and imbricate perianth, *Maxburretia* would have been a close ally of *Livistona* and *Rhapis*. The type species of this new genus is *M. rupicola* (Ridl.) Furtado (*Livistona rupicola* Ridl. *emend.* Furtado). The generic description is derived not from the lectotype of *M. rupicola*, but from its apotype, NUR 34370.

*Liberbaileya lankawiensis* is a caespitose palm producing, under favourable conditions, a stem 10 ft. high. Its leaf-blade is small, about 1-1½ ft. in diameter and bears, as in some varieties of *Chamaerops humilis*, small punctiform brown marks all over in the lower surface. The flowers are arranged in groups of 3-5 on a simple spadix which bears two or three spathes in the peduncular parts and many, scattered, simple or divided flower-bearing branchlets at the apex. On the other hand, *Maxburretia rupicola* is apparently a stemless or scarcely caulescent, solitary palm; it produces larger leaves with no brown marks in their lower surface, compound spadices with 4-6 partial inflorescences, and one separate spathe at each internode, and usually solitary flowers (rarely in groups).

Both these species have unarmed petioles, thus differing from both *Chamaerops* and *Trachycarpus* and resembling the American genera *Trithrinax* and *Acanthorhiza*. The spadices in both these new genera appear to be dioecious, though traces of polygamous spadices have also been observed.

Since both these genera are confined only to the limestone hills in the Peninsula and have no allies in its immediate neighbourhood, it is reasonable to suppose that they are vestiges of an ancient flora of the Peninsula; and since the nearest allies are in America, in the sub-temperate regions of Asia and in the Mediterranean countries, it seems reasonable also to suppose these two Malayan genera are immediate descendents of a stock that existed somewhere at the Cretaceous period and that gave rise also to *Chamaerops*, *Trachycarpus*, *Acanthorhiza*, etc.

The fact that in some cases open limestone vegetation produces conditions favourable for the growth of plants of colder or seasonal climates or of higher altitudes (cf. KRASAN in Engl., Bot. Jahrb. II, 1882, pp. 240 & 249-250; VAN STEENIS in Bull. Jard. Bot. Buitenz. XIII, 1935, p. 296) might account for the persistence of these two genera in the Peninsula only on the limestone hills. This hypothesis would also explain why HENDERSON (Journ. Roy. As. Soc. Malayan Br. XVII, 1939, pp. 13-87) found that almost all

the genera occurring in the peninsular limestones, if not common in the Peninsula, represented the southernmost extension of the range of the genera found in the north of the Peninsula as in Thailand, Burma and Indo-China. On the other hand, the absence of these two palm genera or their very close allies in the countries lying immediately to the north of the Peninsula might be more apparent than real, for botanically these regions are very imperfectly known, especially as regards the occurrence and the distribution of palms; further explorations may reveal in the area the existence of these two new genera or their close allies.

However, there are cases, though very rare, where genera or species occur in the Peninsula only on the limestone hills and in distant temperate and sub-temperate climates but not in other parts of the Peninsula or in countries lying in the immediate neighbourhood of the Peninsula. Thus the genus *Pistacia* (ANACARDIACEAE) which has a wide distribution from the mountains of Luzon and Formosa to China, westwards to Yunnan, Upper Burma, Himalayas, Afghanistan, the Mediterranean region, and the Canaries in the Old World and in Texas and Mexico in the New World, is represented by *Pistacia malayana* on the limestone hills of Selangor and Upper Perak in the Peninsula, though the genus has so far not been recorded either from Lower Burma, Thailand and Indo-China, or from the northern parts of the Peninsula.

## 2. Systematic Notes

### A. *Liberbaileya* Furtado gen. nov. (CORYPHOIDEAE)

*Palmae* nanae, dioecae vel polygamae, caespitosae vel solitariae. *Petioles* inermes, apice in costas aequicrassas vel fere in lamina producti. *Laminae* frondium flabelliformes. *Spadices* interfoliares, simplices (semper?); flores unisexuales vel hermaphroditi. *Tepala* imbricata; calyx brevior quam corolla. *Stamina* 6, in anulum conspicuum unita ut in LICUALA. *Carpella* 3, libera. *Fructus* erectus, semine aequabile (?).

#### 1. *Liberbaileya lankawiensis* Furtado sp. nov.

*Caulis* humilis, ad 3 m altus, caespitosus vel non, inferne annulatus superne infra coronam foliarum vaginibus fibrosis caulem amplectantibus, nigris, tectus. *Petiolus* inermis, metralis, semiteres, utrinsecus angulatus, apice ut rachis haud productus, sed in uno latere in ligulam parvam et in altero latere in costas aequicrassas vel fere terminatus. *Lamina* frondis 25–40 cm. longa,  $\frac{3}{4}$ -orbicularis basi cordata, subtus glaucescens fusco punctulata, junior  $\frac{4}{3}$ -orbicularis basi cuneata; segmentis 25–30, unicastulatis, apice cuneatis-simis, acutis, pungentibus vel breviter bifidis, basi ad 5–12 cm. connatis. *Spadix* gracilis, unisexualis vel polygamus,

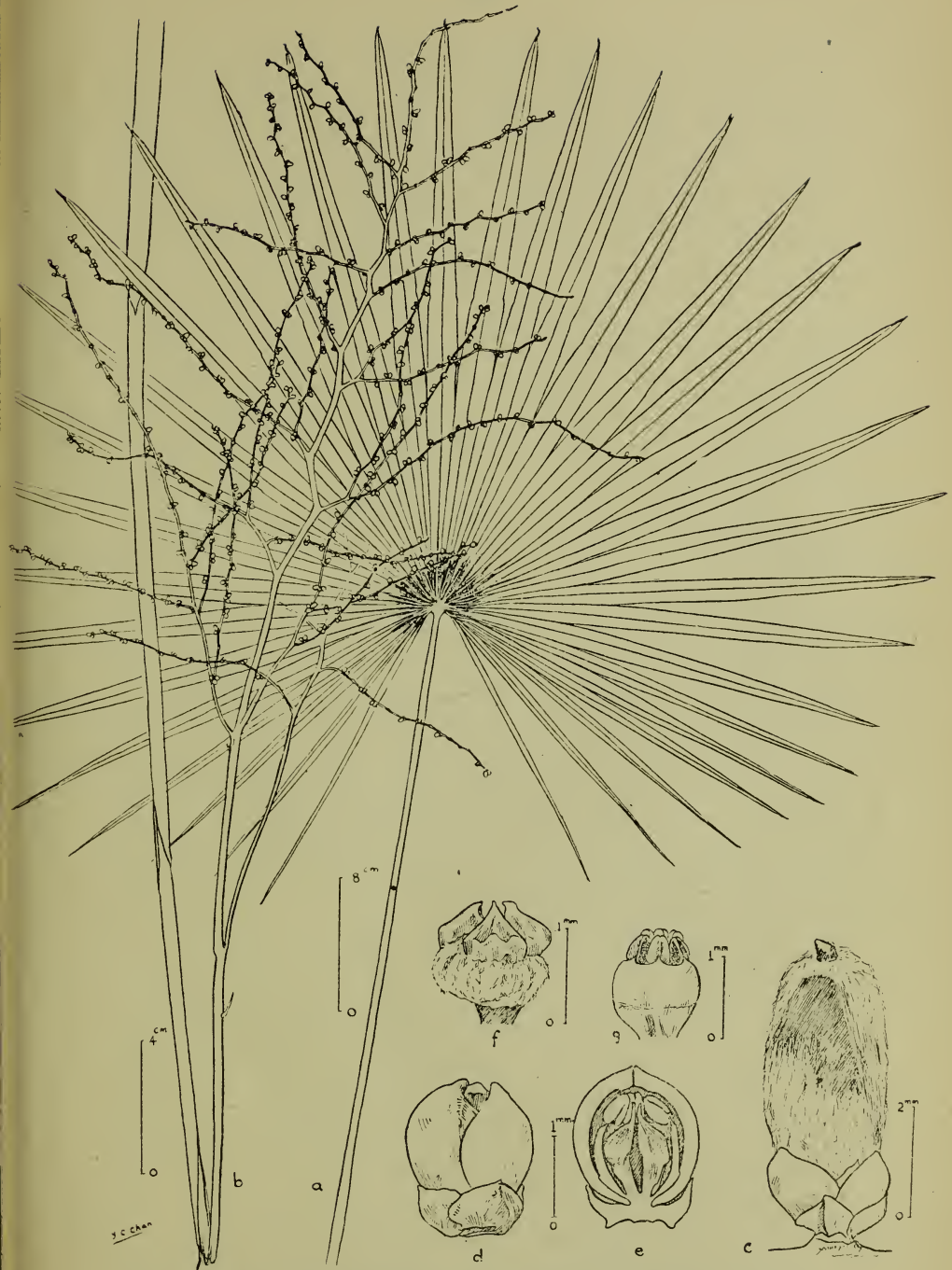


Fig. 1. *Liberbaileya lankawiensis* (Holotypus: HENDERSON 29134).  
 a. Folium cum parte petioli superiore. b. Spadix  
 integer. c. Fructus juvenilis. d. Alabastrum. e. Alabas-  
 trum verticaliter discissum. f. Carpella. g. Alabastrum,  
 tepala resecta ut aestivatio staminum appareat.



simplex, circa 80 cm. longus, inferne ad 50 cm. pedicelliformis, cum spathis 2-3 bicarinatis, tubulosis, gramineis, plus minusve striatis apice oblique truncatis, acutis vel bifidis involutus, et interdum infra partem ramosam 1-2 bracteolos liguliformes vel lineares ferens; superne in ramos remotos simplices vel ramulosos primo dense pubescentes tarde puberulos vel glabros, plerumque in axilla bracteoli orientes terminatus. *Flores* femineae, vel interdum hermaphroditi, oblongi, 2 mm. longi, 1.2 mm. crassi, in glomerulos distantes spiraliter dispositos 3-5 aggregati; flores masculi ignoti. *Calyx* circa 0.8 mm. longi, glaber, rugosus sepalis late ovato-reniformibus, imbricatis. *Corolla* calyce duplo vel triplo longior, glabra, striata, petalis oblongis, imbricatis. *Stamina* vel staminodia 6, in anulum membranaceum conspicue unita. *Carpella* 3, ventricosa, dense pubescentia, libera, in stigma glabrum abrupte terminata. *Fructus* juvenilis tantum visus, erectus, vestigio stylare apicale vel paulo excentrico; semen aequabile(?).

MALAY PENINSULA: *Langkawi*, Pulau Dayang Bunting in collina calcarea (Henderson, 29134, Holotypus; Curtis, 2661, vern. nom. Serdang Batu); loc. incert. (Fox in Dec. 1904).

Hermaphrodite flowers which are also seen in this species resemble the female flowers. The fruits are too young for an investigation into the nature of the albumen, the position of the embryo, etc.; in the shape and arrangement of the perianth and of the young developing ovaries this species appears to be like *Maxburretia rupicola*.

CURTIS mentions that the stems reach a height of 6-10 ft., and HENDERSON notes that they attain about 10 ft. amongst dry rocks, but that the plants are dwarfed when growing in cracks of the rocks near the sea. That the palm is caespitose has not been recorded by any of the collectors; but I have noticed this character in a plant growing in the Botanic Gardens, Singapore.

#### B. *Maxburretia* Furtado gen. nov. (CORYPHOIDEAE)

*Palmae* dioeciae, nanae vel acaulescentes. *Petioles* inermes, apice in costas aequicrassas in lamina producti. *Laminae* frondis flabelliformes. *Spadix* interfoliaris, unisexualis, in inflorescentias partiales divisus; flores solitarii vel glomerati. *Tepala* imbricata; calyx brevior quam corolla. *Stamina* 6, epipetala. *Carpella* 3, libera. *Fructus* erectus; semine erecto; albumine aequabile; intrusione integumentali brevi, ad latus raphale sito.

Specimen typicum NUR 34370.

#### 1. *Maxburretia rupicola* (Ridl.) Furtado comb. nov.

*Livistona rupicola* in Journ. Roy. Asiat. Soc. Straits Settl. XLI (1903) 41 et Mat. Fl. Malayan Pen., Monocot., II (1907) 16: *partim*; Becc. in Webbia V (1921) 16 et 20



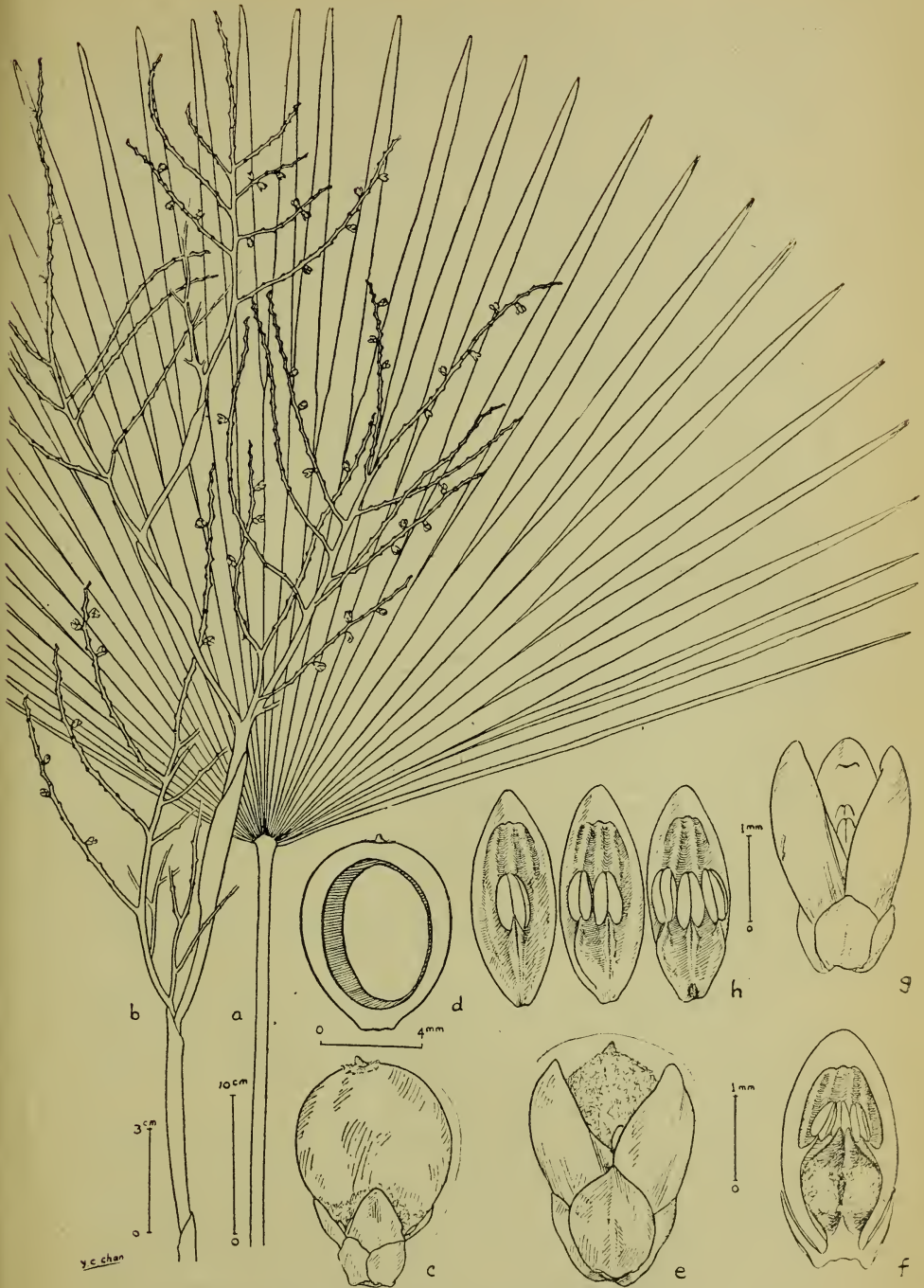


Fig. 2. *Maxburretia rupicola* (Apotyus: NUR 34370).

a. Folium cum parte petioli superiore. b. Pars spadicis feminei. c. Fructus juvenilis. d. Fructus verticaliter discissus ut albumen integumentumque appareant. e. Flos femineus post anthesin. f. Flos verticaliter discissus. g. Alabastrum. h. Petala cum staminibus.

(§ LIVISTONELLA); Ridl., Fl. Malay Pen. V (1925) 23 p.p.; Becc. in Calc. Annals XIII (1933) 105 t. 53 (§ LIVISTONELLA); Henderson in Journ. Roy. Asiat. Soc. Malayan Br. XVII (1939) 85 p.p. (ex altera parte = *Liberbaileya lankawiensis*).

*Planta* nana, vel acaulescens, solitaria (semper?), dioecia. *Petiolus* metralis, semiteres, inermis, postice convexo planus, untrinsecus angulatus, apice in costas fere aequicrassas in lamina percurrens, basi vagina fibrosa, brunneo-nigrescente, liguliforme, 10–20 cm. longa, caulem amplectante, in senectute in fibras persistentes soluta. *Lamina* frondis 50–60 cm. longa, flabelliformis,  $\frac{1}{3}$ -orbicularis, subtus albescens, basi cuneata, apice in laciniis acutas 12–18 cm. longas, aut 30–35 unicastulatas 2 cm. latas, apice bifidas, aut pauciores, latiores, 2–4 costulatas, apice totidas quot costulas. *Spadix* unisexualis, 45–60 cm. longus, masculus femineo longior, in 4–6 inflorescentias partiales, pubescentes, masculas femineis ramosiores, divisas. *Spathae* brunneae, glabrae, valde striatae, acutae, vel acuminatae, interdum bifidae. *Flores* solitarii, rarissime 2–3 glomerati, spiraliter dispositi; masculi circa 2.5 mm. longi, lineares vel obovato-oblongi, 0.8–1 mm. crassi; feminei ovato-oblongi paulo minores masculis. *Calyx* circa 0.8 mm. longus; sepala imbricata, ovata, acuta, rugosa. *Corolla* calyce triplo longior; petala striata, imbricata. *Stamina* 6, petalis paulo breviora, epipetala, filamentis subulatis, antheris cordatis. *Staminodia* petalis valde minora, 6. *Carpella* 3, valde ventricosa, fusiformia, dense sericea, 1–3 fertilia, singula in stylum conicum liberum glabrum subito contracta; stigmatate punctiforme. *Carpellodia* minuta, glabra. *Fructus* juvenilis tantum visus, glaber, erectus, obovato-oblongus; semine erecto; albumine aequabile; intrusione integumentali breve; embryone non viso; vestigio stylare apicale vel paulo excentrico.

MALAY PENINSULA: *Selangor* (Gua Batu, Ridley 8285, Lectotypus); Batu Takun prope Kanching (Nur, 34370, Apotypus).

RIDLEY notes that this produces a stem about 3 ft. high and 6 inches through; but NUR informs me that he found it always stemless and solitary. The situation of NUR's collection was steep, exposed limestone rocks where the vegetation usually makes a poor growth.

The basynym, *L. rupicola*, was based on two specimens, one collected at Gua Batu by RIDLEY and the other in the Langkawi Islands by CURTIS. As the two specimens represent two distinct species, and as the Gua Batu one appears to have been the principal basis of the description given by RIDLEY, I have typified the species on the last named specimen, making the other specimen the paratype of *Liberbaileya lankawiensis*.

The leaf in RIDLEY 8285 contains 2-4 costulate segments; and since this was unusual in the genus *Livistona* except in juvenile stages, BECCARI employed the character to create the section *LIVISTONELLA* under *Livistona*. But the many stages represented in NUR's collection lead me to conclude that the degree of leaf division in RIDLEY 8285 represents that of young plants.

There are no flowers in the lectotype preserved in Singapore, a reason why BECCARI failed to discover the erroneous generic identity made of the specimen by RIDLEY. However NUR 34370 has supplied the important diagnostic characters lacking in RIDLEY 8285, for which reason NUR's specimen has been called here the Apotype of the species (for the definitions of the nomenclature of types, see FURTADO in Gard. Bull. Straits Settl. IX, 1937, pp. 285-309).

## ALOCASIA MACRORRHIZA AND ITS VARIETIES

By C. X. FURTADO,

*Botanic Gardens, Singapore*

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## 1. Introduction

The binomial *Alocasia macrorrhiza* has been used in more than one sense. Some of the plants which have passed under this name are economically very important and found in cultivation or as escapes in the tropics of both hemispheres; others are of little economic value and not known in cultivation or as escapes except in their native country and perhaps in some botanic gardens. Further, many experiments and analyses have been made in order to test their value as food to men and animals, and the results have been sometimes conflicting. The existence of many varieties in some of the species called by this name is also a factor that has caused further ambiguity. The present paper is an attempt towards the clarification of this ambiguity.

It is my pleasant duty to record here my thanks to Dr. R. C. BAKHUIZEN VAN DEN BRINK, Agricultural Department, Buitenzorg, Dr. G. J. A. TERRA, Horticultural Division, Batavia, Dr. C. G. G. J. VAN STEENIS, Botanic Gardens and Herbarium, Buitenzorg, Dr. K. BISWAS, Royal Botanic Gardens, Calcutta, and Mr. E. F. ALLEN, Agricultural Department, Teluk Anson, Perak, for procuring for me planting material of the species and varieties connected with the nomenclatural problems of *Alocasia macrorrhiza* and its varieties; without this material it would have been impossible for me to clear many difficulties discussed in this paper.

## 2. The Authorship of the Name

The genus *Alocasia* was published first by NECKER. Elem. Bot. III (1791 p. 289), a work proposed for rejection by some botanists (see FURTADO, 1937, p. 252 footnote).



But whether by rejecting this we should also reject *A. macrorrhiza* (L) Sweet and *A. cucullata* (Lour.) Sweet I have not been able to investigate; both these names have been recorded with their respective basynyms in STEUDEL'S Nomenclator Botanicus ed. 2, vol. I (1840), though the authorities so far consulted by me attribute these combinations to SCHOTT (1854). No doubt in Index Kewensis these two combinations have been recorded as if they were published by SCHOTT et ENDLICHER in their Meletemata I (1832 p. 18); but this is an error, for there *Alocasia* was accepted only as a section of *Colocasia*. Since NECKER'S work is not yet rejected, I propose in this treatment to follow STEUDEL and cite the name as *Alocasia macrorrhiza* (L) Sweet.

### 3. The Typification of the Species

*Alocasia macrorrhiza* (L) Sweet is an isonym derived from *Arum macrorrhizon*, a binomial coined by LINNAEUS in Species Plantarum ed. 1 (1753, p. 965) for a species from Ceylon. The specific prologue<sup>1</sup> given by LINNAEUS runs as follows:—

“*Arum* acaule, foliis peltatis cordatis repandis: basi bipartitis: *Fl. Zeyl.* 327. *Roy. lugdb.* 7[?6].

*Arum* maximum macrorrhizon zeylanicum *Herm. par.* 73 1. 73. *Raj. Suppl.* 574.

Habitat in Zeylona, perennis.”

I have not been able to consult the last reference given by LINNAEUS. In the second reference the number “7” appears to be a misprint of “6”, but in neither of these references (6 or 7) are the leaves described as peltate. In the third reference (*Herm. Parad. Bat.* p. 73, t. 73), the species is described and depicted with sagittate leaves. In *Flora Zeylanica* (the first reference given by LINNAEUS), reference is made to ROYEN'S (the second reference) and HERMANN'S (the third reference) species, but the plant is described as peltate-leaved.

I have not been able to consult two more books cited under the species in *Flora Zeylanica*, and so I do not know whether these references refer to any peltate-leaved species. However, there is evidence to show that the Linnean phrase “foliis peltatis, basi bipartitis” refers to sagittate leaves in the modern sense. Thus the sixth *Arum* in *Hort. Cliff.* p. 435, which is said in *Flora Zeylanica* to have the same appearance as *Arum macrorrhizon*, is described as having “foliis peltatis, ovatis, basi bipartitis”, a description subsequently expanded to mean “modo latus foliis a petiolo

1. A PROLOGUE is the printed matter (description, etc.) accompanying the original publication of a name or epithet.—A. J. WILMOTT in *Journ. Bot* [London] LXXVII (1939) 206.

ad basin totum bipartitum" (RICHTER, 1840). LINNAEUS also described his *Arum peregrinum* in Hort. Cliff., p. 435, No. 7, as having leaves "folia peltata, cordata usque ad petiolum"; *Arum peregrinum* L. is an accepted synonym of *Alocasia macrorrhiza*.

The other alternative is to assume that LINNAEUS confused a species of *Colocasia* with *Alocasia macrorrhiza*, overlooking the warning given by HERMANN (1698, p. 74) in the following observation under his *Arum maximum macrorrhizon zeylanicum*, t. 73:

"Idem *Arum* videtur quod COMELINUS in *Catal. Horti. Med. Amstel.* nominat *Arum maximum Ceylanicum radice crassa longa rotunda geniculata Colocasiae folio. Welila Hort. Malab. part. 13* nondum editae. Ast appellatio isthaec non arridet, Nostri enim folia nihil cum *Colocasiis* habent commune, sed forma ad *Arum* accedunt, pediculumque cui incumbunt non in medio sed extremo foliorum insertum habent."

Welila or Weli-Ila in RHEEDE'S Hort. Malab. XI, t. 22, is a special variety of *Colocasia esculenta* which produces long, thick, edible subterranean suckers, and it is possible for persons not acquainted with the plants to apply the description of the runners of this variety of *Colocasia* to the thick, edible, sometimes inclined, rhizomes of *Arum macrorrhizon* (quoad HERMANN'S plate).

But there is not the slightest evidence to support this view. On the contrary there are abundant reasons to justify the typification of *Arum macrorrhizon* on HERMANN'S plate 73: (1) *Arum macrorrhizon* has always been interpreted as a species of *Alocasia* and not of *Colocasia* (both genera in the modern sense); (2) "foliis peltatis, basi bipartitis" in Linnean sense probably means sagittate leaves with a somewhat acute sinus at base: (3) *Flora Zeylanica*, which supplied the definitive phrase cited under *Arum macrorrhizon* L., was based mainly on HERMANN'S herbarium (TRIMEN, 1887; BOULGER, 1900; ARDAGH, 1931; OOSTROOM, 1937); (4) HERMANN'S plate and description indicating an *Alocasia* with sagittate leaves was cited both in *Flora Zeylanica* and again independently in the prologue of *Arum macrorrhizon*; (5) the specific epithet *macrorrhizon* adapted by LINNAEUS was derived from HERMANN'S specific phrase-name quoted in the prologue of *A. macrorrhizon*; (6) there are no specimens of the species either in the Linnean herbarium in London (JACKSON, 1912), or in HERMANN'S collection in Leiden (OOSTROOM, 1937), and the drawing which exists in HERMANN'S herbarium in the British Museum, London, represents the same species as HERMANN'S plate; (7) the species depicted by HERMANN is a common species in Ceylon, specially in the lowlands where HERMANN made the bulk of his Ceylon collection

(TRIMEN, 1887; BOULGER, 1900); (8) no species of *Alocasia* having large peltate leaves has been discovered in Ceylon (PETCH, 1919; ALSTON, 1931).

#### 4. Splitting the Species

The particulars given by HERMANN (1698) concerning the vernacular name and economic uses coupled with the description and the plate led some early botanists to interpret *Arum macrorrhizon* L. in the sense indicated by the present typification. Thus G. FORSTER (1786 & 1786 *bis*) identified as *Arum macrorrhizon*, the sagittate-leaved *Alocasia* cultivated in Ceylon, New Zealand and Polynesia for its edible stems and depicted by RUMPHIUS as *Arum indicum sativum*, Herb. Amb. V (p. 306, t. 106) (FORSTER gave an erroneous description of the flowers). ROBERT BROWN (1810, p. 192) also cited *Arum macrorrhizon* L., *A. maximum macrorrhizon zeylanicum* Herm. Parad. 73, t. 73, and *A. indicum sativum* Rumph. Amb. V (p. 308, t. 106) under his *Calladium ? macrorrhizon*, observing at the same time that both HERMANN'S plate and RUMPHIUS'S plate (without the spadix) were good representations of the plant in question.

LOUREIRO (1790), who was working in Cochin-China with a small library at his disposal, was probably not able to consult HERMANN'S *Paradisus*, or any other books which identified *A. macrorrhizon* with the large sagittate-leaved *Alocasia* furnishing edible stems. The Linnean statement that *A. macrorrhizon* was stemless had raised difficulties even to LINNAEUS, who suggested the possibility of *Arum indicum sativum* Rumph. being a different species, *Arum arborescens* (cf. STICKMANN, 1754). LOUREIRO was also misled by the phrase "foliis peltatis" used by LINNAEUS in the prologue of *Arum macrorrhizon*. Consequently LOUREIRO identified with the last a stemless species, having peltate leaves and [practically?] no appendix to the spadix (probably *Colocasia gigantea*), and named as *Arum indicum* the sagittate-leaved species depicted in the Rumphian plate 106 and cultivated also in Cochin-China for its edible stems.

The name *Arum indicum* of LOUREIRO was adopted by ROXBURGH (1832) for an edible *Alocasia* cultivated in Bengal. ROXBURGH found some difficulties in identifying *A. macrorrhizon* owing perhaps to the statement in the prologue that the species was stemless; he was thus inclined at first to identify *A. macrorrhizon* with *A. montanum* Roxb. (see ROXBURGH'S remarks under the latter op. cit., p. 497).

Since ROXBURGH had described *Arum indicum* in detail, giving its vernacular names and economic uses, and since ROXBURGH'S drawing of the plant was later published by



WIGHT (Ic. Pl. Ind. III, t. 794), the name *Arum indicum* and its isonym *Alocasia indica* became widely current in India for the plant cultivated in Bengal.

Since there were some discrepancies in the descriptions of *Arum indicum* Lour., *A. indicum* Lour. *sensu* Roxb. and *A. macrorrhizon* L., SCHOTT (1854) was inclined to consider these three descriptions as representing three distinct species. This view of SCHOTT was contested by KOCH (1854) who maintained that all these three represented but one single species. But SCHOTT's opinion, after his defence in pointing out the discrepancies (1855) and the revision of all the Aroids then known (1860), was followed by many botanists, notably ENGLER (1879) and later by ENGLER & KRAUSE (1920).

MIQUEL (1855) seemed to have agreed with KOCH in reducing *Arum indicum* Lour. *sensu* Roxb. to *Alocasia macrorrhiza*, but for some unaccountable reasons he also retained *Alocasia indica* with the synonym *Arum indicum* Lour. or Roxb. as the correct name for *Caladium giganteum* Bl.

PETCH (1919) pointed out that in Ceylon there is only one large-leaved species of *Alocasia* and that this should be called *A. macrorrhiza*, that specimens of this species from Ceylon were very rare in Europe, the only one he found being THUNBERG'S, and that the plants which pass in Ceylon as *A. indica* are cultivated species of *Xanthosoma*. ALSTON (1931) further pointed out that the only large-leaved *Alocasia* that occurs in Ceylon has sagittate leaves, that on geographical considerations the name *A. macrorrhiza* should be applied to this species, and that the real *A. indica* is probably a variety of *A. macrorrhiza*. ALSTON did not consider the problem either of the interpretation or of the typification of *A. macrorrhiza* on the original description of the species; nor did he consider whether *Arum odorum* Roxb. or *Caladium odorum* Roxb. *ex* Lindl. was a distinct species or not.

Perhaps influenced by the statements of ALSTON, MERRILL (1935), who had previously (1922) maintained *Alocasia indica* and *A. macrorrhiza* as specifically distinct, the former not occurring in the Philippines, considered *A. macrorrhiza*, *A. indica* and *Arum indicum* Lour., and *Arum indicum* Rumph. as representing the same species. He did not refer to the confusion of other species either with *A. indica* or with *A. macrorrhiza*.

##### 5. Confusion with *Alocasia odora*

There is an Aroid growing wild in Burma, Khasia, China, etc. which has peltate leaves and which was described as *Arum odorum* by ROXBURGH (1832) and figured by



WIGHT (Ic. Pl. Ind. III, t. 797), This species was named by KOCH (1854) as *Alocasia odora* and by SCHOTT (1854) as *A. commutata*. It does not occur in Ceylon, Malaya, Polynesia, etc. either in cultivation or wild.

But ten years before the posthumous publication of the binomial by ROXBURGH (1832), LINDLEY (Bot. Reg., 1822, t. 641) published under *Caladium odorum* a Latin version of ROXBURGH'S manuscript description of *Arum odorum* and a plate which in general aspects of the plant appears to correspond to *A. indicum* of ROXBURGH, though the inside of the spathe is depicted green. ENGLER (1879) and ENGLER & KRAUSE (1920) who keep *Arum macrorrhizon* L. and *A. odorum* Roxb. as two distinct species with *Alocasia macrorrhiza* and *A. odora* as the correct names, identified *Caladium odorum* Lindl. in Bot. Reg., t. 641, as *A. macrorrhiza* which normally produces a whitish or yellowish spathe-limb.

Since the drawing of the entire plant in LINDLEY'S plate was made from the living plant, whereas the details of the spathe, spadix, flowers, etc. were drawn from the specimens communicated to LINDLEY, it might seem legitimate to suspect that the different colours in these detail figures were given in order to make them conform not with the colours of the material (which might have faded) but with the colours indicated by ROXBURGH'S description quoted. However, this explanation does not receive any support from the plate published of apparently the same species, by HOOKER in Bot. Mag., (1842), t. 3935, under the name of *Colocasia odorata*; in this plate the colour of the spathe agrees with that given by LINDLEY in Bot. Reg., t. 641. However, if the determination by ENGLER (1879) is correct, and ENGLER had examined practically all the available Aroid material in the great botanical institutions in England, it is possible that the peculiar colour variation is a product of the stove environment in which the plants are grown in Europe. The two plates are so poor that it is difficult to decide whether the identification made by ENGLER (1879) is right or not. There is, however, ample evidence to show that the name *A. odorum* and its isonyms were used from LINDLEY (1822) onwards in more than one sense, perhaps for any large-leaved *Alocasia* grown in hot-houses of Europe (cf. the synonymy given by ENGLER (1879) and ENGLER and KRAUSE (1920) under *Alocasia indica*, *A. macrorrhiza* and *A. odora*).

This indifferent use of the name *Arum odorum* and of its isonyms, and the misleading use of the word "peltate" by LINNAEUS in describing his *Arum macrorrhizon* must have led THWAITES (1864), TRIMEN (1885 & 1898), HOOKER (1893), RIDLEY (1907 & 1925), KOORDERS (1911),

HAINES (1924) and FISCHER (1931) either to describe *Alocasia macrorrhiza* as having peltate leaves or at least to reduce *Arum odorum* or *Alocasia odora* as its synonym, or to do both, and then maintain *A. indica* as a distinct species. The synonymy given by ENGLER (1879) and ENGLER & KRAUSE (1920) in order to show the different uses of *Arum odorum* or its isonyms was probably not understood because these authors failed to note that, though *Caladium odorum* Lindl., Bot. Reg. (1822), t. 641, quoad descriptionem was *Arum odorum* Roxb., *C. odorum* Lindl., Bot. Reg. (1822), t. 641, quoad tabulam was, in their opinion, a different plant identical with *A. macrorrhiza*.

HAINES (1924), who noted the differences given by ENGLER & KRAUSE (1920) between *A. macrorrhiza* and *A. odora* and who had opportunities to study *A. odora*, could not understand the distinction given by ENGLER & KRAUSE, chiefly because he failed to recognize that *A. macrorrhiza* sensu lato included the plants he described as *A. indica*. Hence HAINES'S remarks that, if one were to follow ENGLER & KRAUSE (1920), *A. macrorrhiza* should be used for Ceylon plants and *A. odora* for the Indian ones. ALSTON (1931), who pointed out certain discrepancies in the colour of the spathes of Bot. Reg. t. 641, and in those of the Ceylon plant, noted that the Ceylon plants referred to *A. macrorrhiza* have sagittate leaves and on geographical grounds appeared to be correctly named.

## 6. Confusion with Colocasia & Xanthosoma Species

In some parts of India, where *Alocasia odora* and *A. macrorrhiza* occurred, it was not difficult to use *A. macrorrhiza* for *A. odora*, and *A. indica* for *A. macrorrhiza*. But in Ceylon (PETCH, 1919; ALSTON, 1931) and in Malaya, where no *Alocasia* with a large rhizome and large peltate leaves occurs, the use of the two binomials, *A. macrorrhiza* and *A. indica*, would have been extremely difficult, had it not been for the fact that cultivated species of *Xanthosoma* were, owing perhaps to their edible tubers and large leaves, mistaken for Asiatic plants. Thus THWAITES (1864), TRIMEN (1885, 1898), WILLIS (1911) & PARSONS (1926) recorded *A. indica* for Ceylon as if it were an exotic plant existing only in cultivation, and made no mention of any *Xanthosoma* species which have been long in cultivation there. According to PETCH (1919) the vernacular names cited under *A. indica* by TRIMEN and others also suggest the cultivated *Xanthosoma* species of Ceylon. BARRETT (1910) also mentions his receiving *Xanthosoma* material from Singapore, Buitenzorg, etc., as *Alocasia indica*, *Alocasia violacea*, *A. macrorrhiza* and *A. javanica*, or as

*Colocasia monorrhiza scriptum* and *Colocasia antiquorum niger*. And I have received Xanthosoma material from Calcutta as *Alocasia violacea* (a binomial usually reduced as a variety of *A. indica*).

Many factors must have contributed to allow this masquerade of Xanthosoma spp. as *A. indica* to pass undetected for so long. The basal sinus of the leaves of the edible Xanthosoma spp. cultivated in the East is wide, and since that of *A. macrorrhiza* is very narrow and was described in most books as peltate, it was easy to take the Xanthosoma species with a wide leaf sinus as fitting with the description given under *A. indica*. Besides *A. indica* is described as a large-leaved plant cultivated for its edible tubers or rhizomes, a description also applicable to the species of Xanthosoma. Further, owing to the large size of the leaves, herbarium specimens of these plants are usually very poor and are rarely made. Moreover the cultivated Xanthosoma species flower but rarely and without flowers it is not easy for systematists to identify the plants, the general tendency in such cases being to identify the plants on their vernacular names, economic uses, the country of origin, etc. (a procedure eminently suited for perpetuating the confusion if already made). In species of both these genera there are many forms, some with violet petioles. In fact BARRETT (1910) experienced such great difficulty in distinguishing, on sterile material, the species of Xanthosoma from those of *Alocasia* that he evolved a key based entirely on the openness of the leaf sinus, a key that, while enabling him to identify correctly the best kinds of Xanthosoma in cultivation, misled him to classify under *Alocasia* some inferior kinds of Xanthosoma.

Apparently the confusion existing in several botanical works coupled with the absence of a satisfactory key to enable one to distinguish generically between these plants on vegetative characters led OCHSE (1931) to record under *Colocasia esculenta* some information received by him concerning the uses and the vernacular names of the cultivated varieties of *Alocasia*, *Colocasia* and Xanthosoma, and also to suppress altogether any discussion on *Alocasia*, though *A. macrorrhiza* plays a very important role in the diet of the peoples of the Netherlands Indies, much more important than many other plants discussed in the book, e.g. *Schismatoglottis calyptrata*. MACMILLAN (1935) considered all edible species of *Alocasia* and Xanthosoma as if they were generically identical and depicted a species of Xanthosoma with "*Alocasia* (Xanthosoma) *indica* var." for its legend, though he was personally inclined to regard all these edible species of Xanthosoma and *Alocasia* as varieties of *Colocasia esculenta*.



Such a confusion, very common in books written before the beginning of the twentieth century, has now decreased considerably, apparently due mainly to the writings of BARRETT (1910) and of ENGLER and KRAUSE (1920), who worked on many specimens derived from cultivated material in Asia and America and who quoted in some cases vernacular names.

## 7. Varieties

Some of the varieties here described are so distinct that it may be better to separate them as species or subspecies; however I have retained the varieties, firstly to show their affinities, secondly to warn systematists and agriculturists against the confusion so often made over these names, and thirdly to conform with current procedure. In horticulture all these varieties usually pass as species.

The varieties described below may be divided into two large groups: (1) one having the spathe very much longer than the enclosed spadices: vars. *typica* and *nigra*; and (2) the other having the spathes nearly as long as, or slightly longer than, the spadices: vars. *variegata*, *marmorata* (?), and *rubra*. There is a tendency to restrict the binomial *A. indica* to the second group because it includes *Arum indicum* Lour. sensu Roxb. (1832), but *Arum indicum* Lour. itself appears to be the typical *Alocasia macrorrhiza*. If the second group were separated specifically from *A. macrorrhiza*, then the status of *Arum cordifolium* Bory (1804), *Arum punctatum* Desf. (1829), etc. will have to be investigated as they seem to have a better claim than *Alocasia indica*, if this is typified on ROXBURGH'S description.

1. *Alocasia macrorrhiza* (L.) Sweet in Steudel (1840)56; Schott (1854)409 and (1860)146; Engler (1879) 502; Engler et Krause (1920)84: cf. also Petch (1919), Alston (1931), Merrill (1935) and Furtado (1940).
  - A. indica* (Lour.) Schott (1854) 410: cf. also Koch (1854), Schott (1860), Engler (1879), Hooker f. (1893), Engler et Krause (1920) and Ridley (1925).
  - Arum indicum* Lour. (1790)537 and Roxb. (1832)498.
  - Arum macrorrhizon* L. (1753)965.
  - Colocasia indica* (Lour.) Kunth, Enumer. III (1841) 39; Hassk. in Hoen. et De Vriese, Tijdsch IX (1842) 160 p.p.; Engler (1879) 494 p.p.; Engler et Krause (1920)69 pro parte *typica* (ex altera parte = *Colocasia gigantea*).

The binomial *Alocasia macrorrhiza* must be typified on *Arum maximum macrorrhizon zeylanicum* Herm., Parad.



Bat. (1698) 73 t. 73 which represents the large green form common in Malaysia and Ceylon. The type was an edible race cultivated in Ceylon.

A faulty terminology employed by LINNAEUS in describing this species misled some botanists (*e.g.* HOOKER, 1893) to use the binomial to denote a mountainous or semi-tropical species from India whose correct name should be *Alocasia odora* (Roxb.) Koch. The latter has peltate leaves, whereas the leaves of the former are sagittate. In India the real *A. macrorrhiza* goes under the name of *A. indica* (Lour.) Schott, though there are evidences that some species of *Xanthosoma* are also included under that name.

In Ceylon and Malaya and other tropical countries where *A. odora* does not occur even as an escape and where *A. macrorrhiza* appears to be native, the name *A. macrorrhiza* is usually correctly employed, but almost all its published descriptions and the synonymies reveal the influence of HOOKER f. who was one of the first to use *A. macrorrhiza* as the correct name for *A. odora* (*cf.* also THWAITES, 1864, and HOOKER f. 1893); but the binomial *A. indica* has been generally used to name the edible species of *Xanthosoma* long introduced in these parts from America. Some races of the type form of *Alocasia macrorrhiza* furnish a very palatable rhizome, but others are too acrid to be fit for human consumption. I have not been able to detect any external differences in these races.

2. *Alocasia macrorrhiza* var. *variegata* (Schott) Furtado **comb. nov.**

✓ *A. indica* var. *variegata* (Koch et Bouché) Schott (1860) 145; Engler (1879) 502; Engler et Krause (1920) 88.

*A. macrorrhiza* var. *brisbanensis* Bailey, Queensl. Flora V (1902) 1697. **Syn. nov.**

*A. variegata* Koch et Bouché in Index Sem. Hort. Berol., 1851 app. p. 5.

I have not been able to consult the original description of this variety, and so I have followed the interpretation given to it by ENGLER (1879) and ENGLER and KRAUSE (1920) who had access to KOCH'S original description as well as to the living plants, or their progeny, and the type herbarium material studied by KOCH.

It is a smaller form than the type and includes the races described extensively by ROXBURGH (1832) under *Arum indicum* Lour. It is characterised by the presence of transverse brownish or purplish, irregular lines or marks on the petiole. I have seen only two races of this variety; in the one the markings are very conspicuous, and in the other they are faint. The former race appears to be the

typical form of this variety, while the latter is cultivated in Java and Bengal for its edible rhizomes, and also for its marble-sized tubers produced at the end of long root-like structures. ALSTON (1931) records the presence of this variety in Ceylon. Apparently both races furnish edible tubers.

3. *Alocasia macrorrhiza* var. *marmorata* Furtado var. nov.

*Planta minor quam forma typica. Petiolus viridis maculis albescens, irregularibus, paucis variegatus. Foliorum lamina maculis similibus, majoribus conspicuis praedita, interdum per unum latus totum albescens.*

This inedible variety is often cultivated in gardens as *Alocasia variegata* or *Alocasia indica* var. *variegata*, a name which, according to the descriptions given by ENGLER (1879) and by ENGLER and KRAUSE (1920), should be applied to the variety having transversely clouded petioles. The petioles in this variety have a few large, creamy spots and the leaf-lamina bears large similar markings; sometimes the entire half is cream.

The type specimen described here was taken from plants grown in the Singapore Botanic Gardens from tubers received from Calcutta Botanic Gardens.

4. *Alocasia macrorrhiza* var. *nigra* Furtado var. nov.

*A forma typica, cui in aspectu et dimensionibus similis, haec varietas differt petiolis et nervibus primariis in superficie laminae inferiore nigro-purpurascens.*

This form is large-leaved like the type form but has purple or violet colour in petioles and in the primary nerves in the lower surface of the leaves. In some measure it is easy to confuse this variety with *A. macrorrhiza* var. *rubra*, from which it is easily distinguished by the larger leaves, by the absence of purplish colour in the lower surface of the leaves (excepting nerves), by the upper leaf-surface being dark green (not dark olivaceous green), by the spathes being much longer than the spadices. The young leaves are usually green whereas in the var. *rubra* they are practically purplish in both surfaces.

The plant is quite common in Malaya and often passes as *A. indica* var. *metallica* and *A. indica* var. *violacea*. The stems attain a height of about 6 feet or more, but they are not edible even after a prolonged boiling.

5. *Alocasia macrorrhiza* var. *rubra* (Hassk.) Furtado comb. nov.

*A. indica* var. *metallica* Schott (1860)145 (the trinomial was not published by Schott, though the variety was indicated); Engler (1879)502; Engler et Krause (1920)88.

✓ *A. indica* var. *rubra* (Hassk.) Engler in Engler et Krause (1920) 88.

*Colocasia indica* var. *rubra* Hassk., Pl. Jav. Rar. (1848) 145.

*C. odorata* var. *rubra* Hassk., Cat. Bogor. II (1844) 55.

This very ornamental variety has much smaller leaves and spathes than *A. macrorrhiza* var. *nigra* with which it is often confused. The spathe in var. *rubra* is slightly longer than the spadix, and the purple colour is present in the lower surface of the leaves. Juvenile leaves are nearly purple in both surfaces, but the upper surface becomes dark olivaceous green having a very pleasant polish.

The plant is used medicinally by Javanese who also grow the plant around their houses as a protection against thieves and burglars; for the Javanese believe that this plant has the property of causing a cough in anyone who approaches the plant at night, and coughing would warn the inmates of the houses of the presence of any unwanted guests in the neighbourhood.

### 8. Varietates Dubiae vel Excludendae

1. *Alocasia indica* var. *diversifolia* Engl. in Engl. et Krause (1920) and its synonym *A. indica* var. *heterophylla* Engl. (1879) are synonyms of *A. Portei* (Shott) Engl. cf. Merrill (1922).

2. *Alocasia indica* var. *violacea* Engl. (Engler et Krause, 1920).

This was based on a specimen cultivated in the Royal Botanic Gardens, Calcutta. Tubers received from these Gardens under the name of *A. violacea* proved to be of a form of *Xanthosoma violaceum*. ENGLER based this variety apparently on sterile material and the description, which is applicable also to *X. violaceum*, is insufficient to determine its exact identity.

3. *Alocasia talihan* Elmer (1938).

The type of this species was cited by MERRILL (1922) under *A. macrorrhiza*. ELMER, finding it to be quite distinct from this species, described it as new, stating at the same time that it might not be an *Alocasia* at all. Since in the description of the spadix ELMER did not note a sterile appendix which he described in a true *Alocasia* species, *A. talihan* is, I suspect, a species of *Xanthosoma*. ELMER recorded that the species was cultivated for its edible tubers.

4. *Colocasia indica* var. *atroviridis* Hassk. (1844).

HASSKARL did not give any description of this variety but referred it to "Ari indici secunda species Rumph. amb. V. p. 308". The Rumphian description is too meagre for its certain identification; but the words "caules subtus fusci

sunt, at talibus lineis seu venis distincti, et maculati" suggest the form described here as *A. macrorrhiza* var. *variegata*.

5. *Colocasia indica* var. *pallida* Hassk. (1844).

HASSKARL referred this variety to "Ari indici tertia species Rumph. amb. V p. 308". It is difficult to identify this variety from the Rumphian description, though "caules albicantes, seu pallide virentes" suggest *Colocasia gigantea*.

6. *Colocasia odorata* var. *viridis* Hassk. (1844).

This was a varietal name proposed for the type form of what HASSKARL called *C. odorata*; but it is difficult to find how he really interpreted this species. *C. odorata* was formerly used indiscriminately to name any large species of *Alocasia* cultivated in the European hot-houses and the binomial was supposed to be an orthographic variant of *C. odora* Lindl. (1822).

### 9. Literature Consulted

1. ALSTON, A. G. H.—Fl. Ceyl. VI Suppl. (1931) 296-297.
2. ARDAGH, J.—Paul Hermann's Ceylon Herbarium & Icones—Journ. Bot. LXIX (1931) 137-138.
3. BARRETT, O. W.—Promising Root Crops for the South—U. S. Bureau Pl. Ind. Bull. 164 (1910).
4. BOULGER, G. S.—History of Ceylon Botany—Trimen, Fl. Ceyl. V App. IV (1900) 367.
5. BROWN, R.—Fl. Nov. Holl. (1810) 192.
6. ELMER, A. D. E.—Leafl. Philipp. Bot. X (1938) 3614.
7. ENGLER, A.—DC., Mon. Phan. II (1879) 490-510.
8. ENGLER, A. et K. KRAUSE—Engl., Pflanzenreich IV, 23E., Heft 71 (1920) 1-132.
9. FISCHER, C. E. C.—Fl. Pres. Madras IX (1931) 1581-1582.
10. FORSTER, G.—Fl. Insul. Austral. Prodr. (1786) 62.
11. FORSTER, G.—De Plant. Escul. (1786) 58-59.
12. FURTADO, C. X.—The Malayan Keladis and other Edible Aroids—M. A. H. A. Mag. X (1940) 11-17.
13. FURTADO, C. X.—A Commentary on the Laws of Botanical Nomenclature—Gard. Bull. Straits Settl. IX (1937) 223-284.
14. JACKSON, B. D.—Index to the Linnean Herbarium (1912).
15. HASSKARL, J. C.—Cat. Hort. Bogor. II (1844) 56-57.
16. HAINES, H. H.—Bot. Bihar and Orissa V (1924) 868-871.
17. HERMANN, P.—Parad. Bot. (1698) 73-75, t. 73.
18. HOOKER, J. D.—Fl. Brit. Ind. VI (1893) 523-528.
19. HOOKER, W. J.—*Colocasia odorata*—Bot. Mag. (1842) t. 3935.
20. KOCH, C.—Append. Gen. et Spec. quae Hort. Bot. Berol. 1894 —(cited by Schott and others).
21. KOORDERS, S. H.—Exkursionfl. Jav. I (1911) 261-262.
22. LINDLEY, J.—*Caladium odorum*—Bot. Reg. (1822), t. 641.
23. LINNAEUS, C.—Fl. Zeyl. (1747) 155.
24. LINNAEUS, C.—Hort. Cliff. (1737) 435 (cited by Richter).
25. LINNAEUS, C.—Spec. Plant ed. 1 (1753) 965.
26. LOUREIRO, J.—Flor. Cochinch. (1790) 535-536.
27. MACMILLAN, H. F.—Trop. Plant. and Gard. ed. 4 (1935) 288-289.
28. MERRILL, E. D.—Enum. Philipp. Pl. I (1922) 185.
29. MERRILL, E. D.—A Commentary on Loureiro's Flora Cochinchinensis—Trans. Amer. Philos. Soc. XXIV, Part II (1935) 97-98.



30. MIQUEL, F. A. G.—Fl. Ind. Bat. III (1856) 205.
31. NECKER, N. J. de—Elem. Bot. III (1791) 289.
32. OCHSE, J. J.—Veget. Dutch East Ind. (1931) 51–58.
33. OOSTSTROOM, S. J. VAN—Harmann's Collection of Ceylon plants in the Rijksherbarium—Blumea, Suppl. I (1937) 193–209.
34. PARSONS, T. H.—Alph. List Pl. Roy. Bot. Gard. Perad. Ceylon (1926) 9.
35. PETCH, T.—*Alocasia indica* Schott—Ann. Roy. Bot. Gard. Perad. VII (1919) 53–55.
36. RHEEDE TOT DRAAKSTEEN, H.—Hort. Ind. Malab. XI (1692) 43 t. 22.
37. RICHTER, H. E.—Cod. Bot. Linn. (1840).
38. RIDLEY, H. N.—Mal. Fl. Malayan Pen., Monocot III (1907) 18.
39. RIDLEY, H. N.—Fl. Malay Pen. V (1925) 99.
40. ROXBURGH, W.—Fl. Indica III (1832) 498–500.
41. ROYEN, A. VAN—Fl. Leyd. (1740) 7.
42. RUMPHIUS, G. E.—Herb. Amb. V (1750) 308–310.
43. SCHOTT, H. G.—Oester. Bot. Wachenbl. IV (1854) 409—(original not seen).
44. SCHOTT, H. G.—Araceen Betreffendes II (1855) 1–22.
45. SCHOTT, H. G.—Prodr. Syst. Aroid (1860) 140–157.
46. SCHOTT, H. G. & S. Endlicher—Meletem. I (1832) 18.—(original not seen).
47. STEUDEL, E. T.—Nomencl. Bot. ed. 2 (1840) 56.
48. STICKMANN, O.—Herb. Amb. (1754) 22.
49. THWAITES, G. H. K.—Enum. Pl. Zeyl. (1864) 336—(nomenclature chiefly by J. D. Hooker).
50. TRIMEN, H.—Syst. Cat. Flower. Pl. Ceyl. (1885) 98.
51. TRIMEN, H.—Hermann's Ceylon Herbarium and Linnaeus's Flora Zeylanica—Linn. Soc. Journ. Bot. Lond. XXIV (1887) 129–155.
52. TRIMEN, H.—Fl. Ceyl. IV (1898) 359–361.
53. WIGHT, R.—Ic. Pl. Ind. III (1844) tt. 794 & 797.
54. WILLIS, J. C.—Cat. Flow. Pl. Ceyl. (1911) 98 & 149.

THE TYPIFICATION OF *CALOPHYLLUM CALABA* L.

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In the prologue of *Calophyllum Calaba* L., Spec. Pl. ed. i (1753) 514 LINNAEUS gave a number of references which show that the species included at least three elements or syntypes: (1) a Ceylon element, (2) a Malabar element and (3) an American element. The American element was described and figured by PLUMIER under the Caribbean name *Calaba* (PLUM., Gen., 39 t. 18), and references to PLUMIER'S plant are found in pre-1753 works of LINNAEUS, namely in Fl. Zeyl. (1747) 90, no. 202, and in ROYEN, Fl. Leyd. Prodr. (1740) 476, both cited in the prologue of *C. Calaba* L. In addition a reference to PLUMIER'S *Calaba* was made by LINNAEUS in his Gen. Pl. ed. v (1754) 229 and ed. vi (1764) 266, works having an important bearing on the interpretation of the genera published in LINN., Sp. Pl. ed. i (1753) and ed. ii (1763) (Art. 20). The particulars given in the prologue concerning the habitat of the species includes also the West Indies, for the habitat is stated to be "in Indiis", a phrase frequently employed by LINNAEUS to indicate that a plant occurs in the East as well as in the West Indies.

In view of this inclusion of the American element in the prologue of *C. Calaba* and in view of the facts:—that LINNAEUS adopted the American vernacular name as the scientific epithet of the species; that the treatment given by LINNAEUS in Gen. Pl. eds. v & vi included the American element as a syntype of the genus *Calophyllum*; and that *C. Calaba* was the only species of the genus as published in 1753 to include an American element, it is not surprising that botanists in general should typify *C. Calaba* on the American syntype and make this species as the lectotype of the genus.

I have not been able to consult the treatment given to the different syntypes of the species by WILLDENOW, who in his Spec. Pl. (1800) 1160 suspected the Asiatic elements to be different from the American one, and who is reported to have later published *C. apetalum* Willd. (Mag. Ber. 1811, p. 79) for an Asiatic element of *C. Calaba*. In the absence of the original description of *C. apetalum*, it is impossible to decide which of the Asiatic elements from *C. Calaba* was included in *C. apetalum*; and the subsequent reports are somewhat contradictory. However it is quite certain that A. DE CANDOLLE (Prodr. I, 1824, pp. 562–563) reserved the binomial *C. Calaba* exclusively for the Caribbean element, and published *C. spurium* Chois. ex DC. to include *C. apetalum* Willd. and at least the Malabar element of *C. Calaba*.

Owing, however, to the contradictory typification of *C. apetalum* and *C. spurium*, some having typified them on the Malabar syntype and others on the Ceylon one, these two binomials have been generally disregarded and later ones are in use, namely, *C. decipiens* Wight (= *C. Wightianum* Wall.) for the Malabar element, and *C. Burmannii* Wight for the Ceylon element.

This exclusion of the Asiatic elements from *C. Calaba* was so generally adopted that, at the Cambridge Botanical Congress (1930), the British Botanists proposed that the genus *Calophyllum* L. (1753) should be typified on *C. Calaba* L. *quoad* the American element. According to a decision of the 1935 Botanical Congress, Amsterdam, this proposal should be followed unless there are grave reasons for adopting another type; and so far no serious reasons have been brought forward for disregarding the type proposed by the British Botanists.

It is true that there have been a few opponents to this general typification of *C. Calaba*. One of the first to select a lectotype of *C. Calaba* from the Asiatic elements was LAMARCK (Encycl. I, 1783, p. 553) who typified *C. Calaba* on the Malabar element quoted as Tsjerou-ponna, RHEEDE, Malab. 4, p. 81, t. 39, in the prologue of the species, interpreting at the same time *C. inophyllum* L. in a wide sense to include not only the Ceylon and the American elements of *C. Calaba*, but also a new one from Madagascar later named as *C. Tacamahaca* Willd. (1811). Had it not been for the fact that the genus *Calophyllum* has to be interpreted on *C. Calaba* L. *quoad* the American element (included also in LINN., Gen. Pl. eds. v & vi) on the recommendations by the 1930-1935 Botanical Congresses, a very strong case could have been made in favour of this Lamarckian typification of the species; for RHEEDE's plate of Tsjerou-ponna is quoted directly in the prologue of *C. Calaba* as well as in two out of the three additional references given in the prologue, while there is an indirect reference to this plate also in the third citation.

To my knowledge TRIMEN (Journ. Linn. Soc., Lond., XXIV, 1887, p. 143) was the first to assert that the Ceylon element alone should be considered in typifying *C. Calaba*. TRIMEN was then working on HERMANN's herbarium in the British Museum, London, and had typified, correctly as *C. Burmannii* Wight, HERMANN's specimen cited by LINNAEUS under *C. Calaba*; but, apparently not realising that other elements were also included in the prologue of *C. Calaba*, TRIMEN remarked as follows:—

"The name *C. Calaba* has been generally abandoned for this Eastern species to which it originally belongs, in consequence of JACQUIN having figured in 1763 (Hist. Select. Stirp. Amer. t. 165)



as LINNAEUS'S species the Martinique plant, to which PLUMIER first gave the generic name *Calaba*, taken from the Caribbee name. LINNAEUS (Sp. Plant. ed. ii, p. 732) accepted JACQUIN'S determination, and hence makes his own species to include both the E. and W.—Indian plants. The name should not be maintained for either."

This view of TRIMEN ignores the Malabar and the American elements from the prologue of *C. Calaba* L. (1753) and therefore cannot be accepted. Yet RENDLE and FAWCETT (Fl. Jamaica V, 1926, p. 200) supported TRIMEN'S views by creating the name *C. Jacquinii* for the American element of *C. Calaba* and by remarking as follows:—

"*C. Calaba* L. Sp. Pl. 514 (1753) is founded on a Ceylon plant (Fl. Zeyl. no. 202) named later *C. Burmannii* Wight (III. i, 128, 1838) a different species from the West Indian plant described by JACQUIN under the same name. In Sp. Pl. ed. ii, 732, LINNAEUS added the reference to JACQUIN."

The logical development to these erroneous assumptions of TRIMEN and of RENDLE and FAWCETT concerning the syntypes of *C. Calaba* L. (1753) culminated when ALSTON in his Suppl. to TRIMEN, Fl. Ceyl. (1931, p. 22) adopted *C. Calaba* L. as the correct name for the Ceylon plant with *C. Burmannii* Wight as its synonym. In this treatment of the Ceylon plant, ALSTON has been followed by VAN OOTSTROOM (Blumea, Suppl. I, 1937, p. 196), and by ABEYESANDERE and ROSAYRO (Descript. Check-List Ceyl. 1939, p. 34), despite the fact that this treatment, based as it is on erroneous assumptions, renders it impossible to typify *Calophyllum* L. (1753–1754) on the American element as recommended by the 1930 and the 1935 Botanical Congresses.

In view of the foregoing considerations I submit that *C. Calaba* L. should be accepted as the correct name for the American element named as *C. Jacquinii* by RENDLE and FAWCETT, and its use for any of the Asiatic elements should be rejected as illegal. The nomenclatural treatment proposed here is also in accordance with the procedure which, in my opinion, should be followed in order to secure stabilisation in the nomenclature of plants (FURTADO in Gard. Bull. Straits Settl. IX, 1937, pp. 244–249 and 296–299). Under more recent interpretations of the rule of *nomina ambigua* (Art. 62) it would be possible to demand the rejection of the binomial *C. Calaba* L. as an impriorable name on the grounds that its use in different senses has become a source of confusion; but such a demand has been argued by me to be contrary to the very fundamentals of the Nomenclatural Rules (FURTADO in Gard. Bull. Straits Settl. XI, 1939, pp. 7 and 28).





## PUBLICATIONS OF THE BOTANIC GARDENS, SINGAPORE

---

1. The Agricultural Bulletin of the Malay Peninsula [Old Series] nos. 1-9, 1891-1900 (out of print).
2. The Agricultural Bulletin of the Straits and F.M.S. [Second Series, monthly issues] Vols. 1-10, 1901-1911. Most numbers are available, price 50 cents each or \$5 per volume.
3. The Gardens Bulletin, Straits Settlements.
  - Vol. 1 nos. 1-5, January to May 1912 (as *Agricultural Bulletin of the Straits and F.M.S., Third Series*), nos. 6-12, December 1912-March 1917 (as *The Gardens Bulletin, S.S.*).
  - Vol. 2 nos. 1-12, July 1918-August 1921.
  - Vol. 3 nos. 1-12, August 1923-March 1925.
  - Vol. 4 nos. 1-12, June 1926-January 1929.
  - Vol. 5 nos. 1-12, August 1929-June 1932.
  - Vol. 6 nos. 1-15, (issued as parts 1-3) December 1929-October 1930.
  - Vol. 7 parts 1-3, September 1932-June 1934.
  - Vol. 8 parts 1-4, October 1934-October 1935.
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  - Vol. 10 parts 1 and 2, January, 1939-August, 1939.

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